Ecology and Ethics 1

Ricardo Rozzi · S.T.A. Pickett
Clare Palmer · Juan J. Armesto
J. Baird Callicott *Editors*

Linking Ecology and Ethics for a Changing World

Values, Philosophy, and Action

Springer

Ecology and Ethics

Volume 1

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Ecology and Ethics

This series is devoted to continuing research at the interfaces of ecology and ethics (embedded in the multiple fields of philosophy and ecology) to broaden our conceptual and practical frameworks in this transdisciplinary field. Confronted with global environmental change, the academic community still labors under a tradition of strong disciplinary dissociation that hinders the integration of ecological understanding and ethical values to comprehensively address the complexities of current socio-ecological problems. During the 1990s and 2000s, a transdisciplinary integration of ecology with social disciplines, especially economics, has been institutionalized via interdisciplinary societies, research programs, and mainstream journals. Work at this interface has produced novel techniques and protocols for assessing monetary values of biodiversity and ecosystem services, as illustrated by the Millennium Ecosystem Assessment. At the beginning of the 2010s, however, an equivalent integration between ecology and philosophy still remains elusive. This series undertakes the task to develop crucial theoretical and practical linkages between ecology and ethics through interdisciplinary, international, collaborative teamwork. It aims to establish a new forum and research platform to work on this vital, but until now insufficiently researched intersection between the descriptive and normative domains. The scope of this series is to facilitate the exploration of sustainable and just ways of co-inhabitation among diverse humans, and among humans and other-than-human co-inhabitants with whom we share our heterogeneous planet. It will address topics integrating the multiple fields of philosophy and ecology such as biocultural homogenization, Planetary or Earth Stewardship.

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Editors
Ricardo Rozzi
Department of Philosophy
and Religion Studies
University of North Texas
Denton, TX, USA

Institute of Ecology and Biodiversity
Universidad de Magallanes
Punta Arenas, Chile

Clare Palmer
Department of Philosophy
Texas A&M University
College Station, TX, USA

J. Baird Callicott
Department of Philosophy
and Religion Studies
University of North Texas
Denton, TX, USA

S.T.A. Pickett
Plant Ecology, Cary Institute
of Ecosystem Studies
Millbrook, NY, USA

Juan J. Armesto
Departamento de Ecología
Pontificia Universidad Católica de Chile
Institute of Ecology and Biodiversity
Santiago, Chile

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Foreword

Living on Earth, we need to figure out who we are, where we are, and what we ought to do. "The unexamined life is not worth living" (*Apology*, 38). The classic search has been to figure out what it means to be human. Socrates, however, was sometimes wrong. Socrates loved Athens. We live in towns; humans are "political animals" (Greek: *polis*, "town;" Aristotle, *Politics* 1. 2). Cultures shape our humanity. But Socrates avoided nature, thinking it profitless. "You see, I am fond of learning. Now the country places and trees won't teach me anything, and the people in the city do" (*Phaedrus*, 230d).

I have claimed to be wiser than Socrates. "Life in an unexamined world is not worthy living either." Humans, the only species capable of enjoying culture, are also the only species capable of enjoying the splendid panorama of life. In the pages that follow, my more inclusive conviction is endorsed, fortunately, by over 40 contributors sharing their accounts, of living well in place, combining nature and culture, residing on landscapes: "Rozzi's biocultural ethics." "The inclusive ecosystem recognizes humans as components" (Pickett). Nadkarni shows how "ecologists might bring the 'humanist' aspects of their work to provide more compelling arguments to connect humans with nature to help solve environmental problems." The reader can look forward to diverse spiraling around this common theme.

This requires examining as Meine says following Leopold, "these spheres—what we know from science, what we do in practice, what we value and believe through our philosophies, and how we govern ourselves." The conclusions of this array of scholars and activists agree with another of my claims, that abundant living requires a deep sense of place in three dimensions—the rural, urban, and wild. Otherwise we will be one-dimensional persons, under-privileged. Here is a strong sense of "inhabiting" landscapes, not just as citizens but as residents, not just supported by ecosystem services, but of dwelling in one's country, and co-dwelling with the larger community of life, even of spiritual ties to a landscape.

These spiritual (or religious, or deeper philosophical) dimensions are found here often—as with Chapin and his co-authors examining the Alaskan indigenous peoples, or Cafaro recalling Carson's reverence for life, or Sideris and her sensitivity to ecospirituality in classical traditions. Religious values appear again in Nadkarni's surveys of how urban people value nature. Mallory exposes the errors in the view "that nature is something out there, removed, displaced from the social and cultural dwelling places of people and the sites of human community … fundamentally irrelevant to human problems of inequality and injustice." We conserve our landscapes, and that includes "linking ecology and ethics for a transition to the sustainable city" (Pincetl).

People and their landscape "co-constitute" each other. In the sense that we humans are searching for our appropriate behavior on landscapes, as Hayward develops, "there is always, and inevitably, some 'anthropocentrism' at the heart of environmental ethics." We need living on a landscape with "environmental imagination," as Klaver sees it, even with urban Texans engaging surroundings more grey than green, "being in, or being with" hodgepodge slices of nature/culture. Pincetl envisions how Los Angeles could become much greener than it is, and at the same time more equitable in its opportunities for those who live there to experience nature—green, grey, or brown. This requires resisting the "homogenization" (the "McDonalization") of both culture and nature, and insisting on regional distinctiveness. We heed Rachel Carson's "warnings concerning the increased artificiality and simplification of the landscape" (recalled by Cafaro).

This two way people-nature interchange is a repeated focus here, about which there is both welcome and warning. "Biogeochemistry + anthrogeochemistry = novel world." Naeem knows that humans require their "ecosystem services," but, should this become simply an anthropocentric concern for human benefits in a future world, he is also apprehensive: "Is a planet servicing one species likely to function?"

We need, repeatedly, as Meine contends, "Leopold's special contribution as a defining moment in the discourse connecting conservation science, ethics, policy, and practice. That discourse continues, especially in emerging interdisciplinary fields, even as our critical environmental concerns make the need for integrated thinking ever more apparent and immediate." Leopold already saw in the last century what has become central on our agenda in the new millennium: We live, "I think, at what might be called the standard paradox of the twentieth century: our tools are better than we are, and grow better faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it."

Callicott, following Leopold, opens up his project of "world view remediation," concluding with some uncertainty: "Is there anything that can be characterized as an ecological worldview? And, if so, in what does it consist? Does ecology, that is, provide us with a conceptual framework that functions as a lens through which our sensory experience is classified and organized to form a coherent whole, an ecological worldview?"

Pickett recalls "the changes that ecological paradigms have undergone" and addresses some of the issues that bother Callicott: "the flux of nature: changing worldviews and inclusive concepts." Pickett replies: "What matters most, as embodied in the new paradigm, is the underlying resilience of ecological systems, the degree to which they can adjust to new opportunities or adapt to changing situations."

A feature that contributes to such resilience, according to Wu, is their hierarchical structure. “Hierarchy theory neither implies inflexibility nor a lack of diversity and creativity. On the contrary, an appropriate hierarchical, dynamic structure provides opportunities for diversity, flexibility, and creativity, as well as higher efficiency and stability that are difficult to obtain in non hierarchical complex systems.” Naeem shares this account of the biosphere as a “vision of Earth as a series of nested spheres.” Interestingly, such biosphere structure returns us somewhat toward the stability about which Pickett has his misgivings. But, on further thought, one can readily expect that a resilient biosphere, challenged over millennia, will have settled into some repeated stabilities—in some modular components and at some hierarchical levels (predators, prey, plants, animals, photosynthesis, trophic pyramids, DNA codings, seasonal patterns) within its ongoing dynamisms. “Hierarchic structures … provide the most viable form for any system of even moderate complexity” (Wu).

That resilience can regularly be found on the landscapes we inhabit, but it is equally needed by the human residents in search of “remediating” their world views. Thankfully, Callicott finds that some worldviews are superior to others, “a more tenable and a more viable worldview” and also more “aesthetically and spiritually satisfying as well” (as Lintott and Carlson concur). This more viable worldview is hopefully one that sees Earth as a planet with a biosphere because that is in fact what Earth is (Naeem). Life on Earth has been ongoing, dynamic, and resilient for over four billion years. We can claim such a view (in Callicott’s terms) as “‘knowledge’ because it is a highly confirmed, self consistent worldview that is also consistent with and comprehensive of all known relevant facts.”

A major trouble is humans with a sense of arrogant dominion (as Mallory realizes) as they estimate who they are and what they ought to do, inadequately appreciating that they are earthlings on Earth. Let’s hope that more knowledgeable humans are resilient in reforming their worldviews and behaviors accordingly and cherishing this biosphere in which we are incarnate. “A myth is that with enough knowledge and technology we can manage planet Earth… What might be managed is us: human desires, economies, politics, and communities” (Poole, following David Orr).

Any adequate environmental philosophy, as Palmer claims, has to include issues of environmental justice and justice between generations, as well as concerns whether “non-human animals, living organisms, ecosystems and species have some kind of moral status,” and there can be “deep fissures” between analysts. Hayward worries about “justice in the world today as those of a crowded planet where some people deprive others (as well as non humans) of access to sufficient ecological space.” “One of the greatest ethical problems is that humans, rather than being concerned too much about humanity, are generally not concerned enough about caring for other humans.” “In fact, we are now being forced to recognize that we inhabit a contained, dense biosphere that is being put under enormous strains and as we make increasing demands on its capacities, the space becomes increasingly crowded.” The nature/culture—is/ought challenge is figuring out “ecological space in a crowded biosphere” (Hayward). By Northcott’s account, “The inability of industrial civilisation to adapt to the climatological limits of the biosphere arises from the refusal of liberal economists and others to recognise that justice is contextual to the boundaried nature of political communities, and to the limits of the earth system.”

Power is another returning theme here, always closely related to justice and injustice. So Mallory undertakes how "the critique of unequal power relations, both intra human and that between humans and what ecophilosophers term 'the more than human world' can help scientists and policy makers to comprehensively address current environmental issues, such as global climate change, environmental racism, biodiversity loss, inegalitarian social arrangements, and recognition of ecosystem services in remote, rural, and urban areas." She is convinced that "ecological issues not only have particular cultural manifestations, but are raced and gendered as well—and that equity and sustainability go together."

Questions of values and their separation and integration in sciences, such as ecology, and in the humanities, such as ethics and policy have complex dimensions. Longino examines positivism, revising that worldview into her "critical contextual empiricism," and finds a "socially contextualized conception of knowledge and of scientific inquiry," which also has a "conformation of representation to object represented." "Both philosophers and scientists must admit the role values play in the sciences while preventing the empirical from being overrun by the normative and the ideological." The need to "recognize that advocacy and public engagement [are] a necessary path for ecology" was well seen in Rachel Carson, as Cafaro details here.

Taking Pickett and Callicott's concerns about whether and how the ecological sciences can feed into a worldview in a new direction, Eliot is encouraging: "Environmental ethics does not require objects more robust than those ecology already offers." The descriptions of ecological process and products are "sufficiently real in the right sort of way." That underscores the need for "ethics literacy in environmental education," advocated by Poole and her collaborators.

Hayward invites us to "an 'ecological' way of seeing the place of humans in the world, as they relate both to the rest of nature and to each other. This leads to a conceptualisation of 'ecological space' as what answers to the most fundamental needs of human beings, such as to be appropriately regarded as the object of a human right." "By attending to lessons of ecology, we can develop much more appropriate ethical thinking than we otherwise might—not only regarding our treatment of the natural environment, but also regarding some fundamental questions of justice, and on a global scale" (Hayward). That is carefully analyzed by Northcott looking at the multiple dimensions and effects of climate change. "Anthropogenic climate change however represents a new kind of exile, this time not from ancestral lands but from earth itself."

But there are limits to the kinds of value questions that ecology can answer. "Ecology can provide insight into how we might rescue a species from extinction if we decide to do so, how to preserve a forest patch if we remove its human occupants, or how to manage a forest patch if people remain, but the questions of ethics, morality and fairness are for society to answer" (Naeem). Larson carefully examines "metaphorical links between ecology, ethics, and society," the subtle "feedback" between nature and culture again, scientific metaphors in social context. "Metaphoric choices in ecology should be subject to ethical scrutiny" (analyzed also by Pickett). Keep a critical openness—as Bratton can do with her own Christian tradition and equally of the ecologists, of which she is one, and as Sideris can do pressing those who advocate “a mythopoeic rendering of scientific information as a robust and superior rival to religion” “recasting scientific information as a consecrated narrative and poetic vision.” All this brings us to big questions about this big outdoors we inhabit, the sky over our head and the ground under our feet, the community of life, the biosphere.

We have entered the first century in 45 million centuries of life on Earth in which one species can jeopardize the planet’s future with their “novel biosphere” (Naeem). The main concerns on the world agenda for the new millennium are: war and peace, escalating populations, escalating consumption, degrading environments. They are all inter-related. Ecology is about living at home (Greek: *oikos*, “house”). We don’t want to live a de-natured life. Humans neither can nor ought to de-nature their planet. Be a good citizen, and more. Be a resident on your landscape. Read on, think together with these deeply concerned environmentalists, and you will get put in your place. I guarantee it.

Colorado State University Holmes Rolston III
Fort Collins, CO, USA

Preface

Confronted with global environmental change, the academic community still labors under a tradition of strong disciplinary dissociation that hinders the integration of ecological understanding and ethical values to comprehensively address the complexities of current socio-ecological problems. The Rio+20 Earth Summit held in Brazil in 2012 showed that since the Rio 1992 Earth Summit the rate of environmental degradation had increased rather than decreased (Viola et al. 2012). To reorient this trend, it is essential to overcome the narrow economic and technical-scientific approach that dominates much of the discussion in academic research, education, and decision making.

The need to strengthen the linkage between understanding human values and ecological science has been pointed out by the Ecological Society of America (ESA) and a growing number of scientists for at least half a century. In the 1980s, ecologist and former ESA president, Frank Golley concluded that the ecosystem concept has provided a basis for "a dialogue about how humans value nature," and for "moving beyond strictly scientific questions to deeper questions of how humans should live with each other and the environment" (Golley 1993, p. 205). In the 1990s, another former ESA president, marine biologist Jane Lubchenco (1998) emphasized in a position paper for *Science* that many of the choices faced by society are ethical ones, for which ecological sciences provide essential understanding to inform responsible societal decisions. During the 1990s and 2000s, a transdisciplinary integration of ecology with social disciplines, especially economics, has been institutionalized via interdisciplinary societies, research programs, and mainstream journals. Work at this interface has produced novel techniques and protocols for assessing monetary values of biodiversity and ecosystem services, as illustrated by the Millennium Ecosystem Assessment (MA 2005). At the beginning of the 2010s, however, an equivalent integration between ecology and philosophy still remains elusive (Pickett et al. 2007; Rozzi et al. 2012). This book undertakes the task to develop crucial theoretical and practical linkages between ecology and ethics through interdisciplinary, international, collaborative teamwork among ecologists and philosophers. It aims to establish a new forum and research platform to work on this vital, but until now insufficiently researched intersection between the descriptive and normative domains. In particular, it seeks to go well beyond the predominance of economic thinking that has characterized environmental decision frameworks at the turn of the twenty-first century.

Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action resulted from the homonymous 14th Cary Conference, which brought together leading scholars and practitioners in ecology and environmental philosophy. We discussed core philosophical and ecological terminologies, methods, and questions, as well as practical frameworks to incorporate interdisciplinary integrations of ecology and ethics into sustainability policies, environmental decision making, and long-term socio-ecological programs such as the International Long-Term Ecological Research network or the UNESCO network of biosphere reserves. On the one hand, this Cary Conference is the result of a long-term theoretical endeavor to better understand the reciprocal links between ecological sciences and ethics, broadly understood as the ways we *perceive* the world and the ways we should *co-inhabit* the world (*sensu* Rozzi 1999). On the other hand, the conference and the preparation of this book are stimulated by the pressing need to address urgent practical questions on how to reorient some prevailing eco-social trajectories toward more sustainable paths; such reorientation of trajectories requires not only the natural and social sciences, but also ecologically informed ethics. To address these major theoretical and practical challenges, the present volume is organized in four interrelated parts; each one begins with a concise introduction that identifies concepts discussed in the chapters that are essential for cross-disciplinary understanding.

Part I. Integrating Philosophy and Ecology: Biocultural Interfaces

Over 2,000 years ago, ethics was established by Aristotle as an "exclusive club" in which only humans, and in fact only certain humans, had the privilege to participate. Until 20 years ago ecological sciences, especially in North America, remained focused on study sites located in wilderness areas, as remote from humans as possible. With the arrival of globalization, this divorce is no longer possible. Ricardo Rozzi proposes a biocultural ethics that dissolves the walls of the exclusive club of ethics. He invites philosophers to understand humans and other beings as co-inhabitants embedded at the interfaces of multiple biophysical, symbolic-linguistic, institutional, and socio-political levels of organization; and invites ecologists to explore interrelationships between research questions on ecosystems and biodiversity with questions on how to co-inhabit ecosystems and the planet. These questions are stated in different terms by the diverse contributors to this volume, but, foremost, this book is an invitation to explore and open new questions at the interfaces of ecology and philosophy. As Irene Klaver asserts in her chapter "Life is *vita* in Latin… An in-*vita*-tion leads to new connections, new situations, or a renewal of existing relations, which entail change and transformation. This affects how we understand things."

Peter Vitousek and Kamanamaikalani Beamer affirm that "all knowledge is embedded in values and practices, in the science of ecology as well as in any indigenous culture." They present an intercultural, interdisciplinary dialogue that transits toward the practices involved in the development of the Kamehameha Schools in Hawaii. Grounded in a Hawaiian integration of ecological knowledge, values, practices, and institutions, they ask: "How can [traditional] institutions and societies sustain themselves while in contact with the homogenizing power of the modern world? And, what can such institutions or societies bring to living more sustainably in the world, through their values, practices, and knowledge?" In local–global dialectics, stewardship and dialogic partnerships bring twenty-first century ecologists, philosophers, and other professionals to work together with traditional communities both in remote places and in metropolises. Historically, universities have conducted *outreach* programs that offer one or a set of potential problem-specific solutions, such as gardening or renewable energy. However, partnerships aim to also foster *inreach* from communities to the university, as emphasized by Stuart ("Terry") Chapin and his Alaskan collaborators. The local–global dialectic is not always idyllic, however.

Daniel Simberloff discusses the motives people have for antipathy towards introduced biological species, including ecological and economic negative impacts, aesthetics and at various times xenophobia. However, antipathy towards introduced species is frequently inspired not by their foreign origins *per se* but rather by the fact that their presence replaces local biodiversity, and also culture. Tensions between native and foreign biota and cultures are frequently tacit. For example, when, shortly after the arrival of the Spaniard conquerors, the Virgin of Guadalupe appeared to Juan Diego Cuauhtlatoatzin in Nahuatl territory, she offered him a *tilma* full of fresh roses, not of native flowers. As Susan Bratton describes, the Virgin of Guadalupe has a long-established role as protector of the humble and undefended, and today her image is found at roadside shrines, bus pennants, and school decoration where (non-native) roses are omnipresent. How to address the tensions between native floras and cosmopolitan ornamental species such as roses that comprise 66 % of the world flower market today? Irene Klaver suggests that philosophers can act as translators: "An environmental philosopher is an initiator, translating various concerns along multiple perspectives opens up new situations and affords us the freedom of ongoing new beginnings. It is crucial to an understanding of [and respect for] the various viewpoints, positions, places and experiences of others."

Part II. Ecological Worldviews: Aesthetics, Metaphors, and Conservation

Twenty years ago, in another book in the Cary Conference series, Mark McDonnell and Steward Pickett (1993) apologized to Sergio Leone and the genre of "Spaghetti Western" for describing the ecological influences of humans as divided between the "the good, the bad, and the subtle." McDonnell and Pickett there focused on human influences on the biophysical properties of ecosystems, and a major spectrum of *ecological novelties* that came with "the subtle." In this volume, J. Baird Callicott addresses a symbolic-linguistic level of reality, by focusing on the concept of worldview. With a post-Kantian epistemological freedom and a Leopoldian ecological wisdom, Callicott identifies: a "bad" worldview associated with an "Abrahamic" concept of the land, regarded as a commodity that belongs to humans; a "good" worldview associated with an ecological-evolutionary concept of the land, regarded as a community to which humans belong. The *philosophical novelties* come with his call for a worldview remediation. How to decide which are bad and good, wrong and right worldviews? In a post-Kantian world "to determine the *truth* of a worldview by comparing it… to some objective reality is epistemologically impossible. We have no unfiltered access to any such objective reality." To address this aporia, Callicott turns to the concept of the "tenability" of a worldview. To the traditional epistemological criteria of self-consistency and of consistency with the empirical evidence, he adds "to be more tenable and a more viable worldview than are its historical antecedents, I think that Leopold would also add a third criterion for the tenability of a worldview: it should be aesthetically and spiritually satisfying as well." The integration of aesthetic and spiritual dimensions of ecological worldviews is discussed in the chapters of Part II of this volume.

Aldo Leopold's highest moral maxim summarizes that "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." Sheila Lintott and Allen Carlson ask: "How does the word 'beauty' fit in this maxim?" To answer, they introduce a compelling cognitive approach to aesthetic appreciation, which enables them to explain why "beauty" is introduced into the Leopoldian maxim, and which are the ethical consequences of having this word introduced within this maxim. According to the cognitive approach, ecological understanding stimulates a broader aesthetic appreciation that goes beyond a mere *picturesque* stereotype of landscapes. Once aesthetic refined appreciation is achieved, it motivates the preservation of lands that have ecological aesthetic value. In a three-step movement, from (i) ecological understanding to (ii) aesthetic appreciation onto (iii) the preservation imperative, the traditional fact/value problem is avoided. When ecological facts are embedded within aesthetic appreciation, there is no direct movement from facts to values. The movement is wholly from aesthetic value, which is itself informed by ecological facts. Within a broader historical and cultural context, it is interesting to note that aesthetic has been indeed a major motivation for conservation in the United States (Hargrove 1989), and other regions such as Germany (Jax and Rozzi 2004). Moreover, the word "ecology" was coined by a German artist and scientist: Ernst Haeckel.

At a socio-political and institutional level, Aldo Leopold's endeavor is analyzed by Curt Meine, who emphasizes that "creative interdisciplinary thinkers in the history of both ecology and ethics have ventured beyond their disciplinary boundaries and into the zone where they overlap." Meine emphasizes how Leopold was vigorously committed to encourage his colleagues and students to be integral professionals, much more than mere trained technicians. With the guidance of a fluent historian, such as Meine, we appreciate how Leopold offers us an outstanding example of how to integrate conservation science, policy, philosophy, and practice. Rachel Carson's life offers a complementary perspective on the integration of theory and practice embedded in an ecological worldview; her science led her to an outstanding life of advocacy. After a 15-year career as a U.S. Fish and Wildlife Service biologist, she learned about the beauty of wild places and biodiversity, and the wounds caused by humans to habitats, their plants and animals. Phil Cafaro shows how Carson's life teaches us much about humility and courage, a courage that allowed her not to remain silent, and to denounce the "Silent Spring" that had been caused by the indiscriminate use of pesticides. Cafaro quotes a letter in which she wrote "if I kept silent, I could never again listen to a veery's song without overwhelming self-reproach." Lisa Sideris emphasizes in her chapter the significance of everyday experiences, such as listening to the songs of veeries. She concludes that encounters with the natural world are essential and that a variety of worldviews can orient these everyday experiences that nourish our reenchantment with nature and give us the courage to protect it. Brendon Larson, however, cautions that different worldviews and metaphors arise from and stimulate different social practices and values. He calls attention to the synergistic, multidirectional, feedbacks between metaphors and the ecological (and other sciences) and the social contexts in which these metaphors originate, enriching the understanding about the reciprocal links between ecological sciences and ethics, and about potential and actual pathways to enact worldview remediations.

Part III. Environmental Philosophy: Ethics, Epistemology, Justice

Fifteen years ago, as an epilogue to the Cary Conference book on the Ecological Basis of Conservation, Joel Cohen wrote "A Vision of the Future," which began proclaiming that:

> If conservationists, together, with demographers, economists, earth scientists, anthropologists and politicians, could put forward a positive and persuasive vision of the future, they could lead billions of nonscientists to look to conservationists as helpful allies in their search for better lives. They could also give direction and meaning to the daily research that occupies many scientists (Cohen 1997, p. 400).

In our own Cary Conference we addressed Cohen's recommendation. In order to work on this question, we began by extending the scope of the participants. First, we considered not only scientists but also philosophers, traditional ecology and religion studies scholars in the team of participants who are experienced in examining the concepts of "better lives." Second, we considered not only human beings but also other-than-human beings in the discussions about a "better life."

Part III of our volume begins with Clare Palmer's chapter that introduces some essential terminology from what she calls "Anglo-American" approaches to environmental ethics. This terminology is helpful in addressing core ethical questions such as: (i) *Where does value come from?* Subjectivists maintain that value are created by human beings; objectivists maintain that, in some sense, values exist in the world independently of our creating them. (ii) *What entities and attributes have value?* For some environmental ethicists, not only individual living beings have value, but also species and ecosystems; while we may also values qualities such as naturalness and diversity. While traditionally philosophers have privileged human rationality, ethicists have increasingly expanded the circle of those they consider to have some kind of moral relevance. A focus on sentience (roughly, the capacity to feel pain and pleasure) enables the inclusion of other vertebrates in the community of morally relevant beings. Some philosophers – biocentrists – argue that all living-beings have a welfare and are therefore morally relevant. Ecocentrists argue that inclusive entities such as ecosystems and species are morally relevant in themselves; thereby they do not only extend the moral community, but they also propose new "new objects of value" – a question explored further in Eliots's paper in this Part III.

Palmer further addresses the questions (iii) *Which ethical theories should orient human actions?* (iv) *Should people decide on a single governing value, principle or ethical theory?* Different forms of ethical monism and pluralism are discussed with regard to values, ethical theories, and methodological approaches, and applied to the context of policy and decision making. Palmer's overview equips the reader with an ethical vocabulary, and an introduction to central values and theories, as well as conflicts among the different positions. She does not advocate for a particular position, but leaves ecologists and other readers better equipped to address Joel Cohen's question about the concept of "better lives."

Consistent with a conceptual framework that interrelates the ways we understand the world guided by sciences, and the ways we should co-inhabit the world guided by ethics, Palmer's chapter is followed by a chapter on scientific epistemology. Helen Longino focuses on *positivism*. This focus is very relevant given the high influence that positivism has had and continues to have on scientists, ecologists included. Longino provides a concise but critical historical overview of positivism. She considers criticisms of *verificationism* flowing from the notions of *incommensurability*, *theory-ladenness of meaning*, and *underdetermination*. Addressing these criticisms, Longino has developed an interesting alternative: *critical contextual empiricism*. Longino distances herself from the original meaning of positivism, and arrives to (at least) three conclusions that are particularly relevant for a biocultural approach to ecology and philosophy: (i) "It is possible that multiple non-reconcilable accounts of the same set of phenomena be equally acceptable"; (ii) "Local epistemologies are evaluable with respect to the particular cognitive goals brought to bear on a phenomenon or set of phenomena"; and (iii) "knowledge in this framework must also be understood as partial and as dynamic. Partial because limited by the questions, and their associated assumptions and methodologies."

Part IV. Ecosystems: Science, Values, and Action

In the opening plenary lecture of the first Cary Conference in 1985, Gene Likens asked:

> Why is ecology so fractioned at the current time? Is this healthy or normal? … Should we get our act together to make some quantitative jump in understanding of ecosystems? … Our hope is that the Conference will be useful, not only in examining these questions, but in providing some insight about where ecology may go in the future and how it might make a quantum jump in terms of our understanding of ecosystems (Likens 1987, pp. 1–2).

Our answer to Likens' initial questions is that, today, the branches of ecology are much more intertwined. Each Cary Conference has made significant contributions in a series of quantum jumps in the development of the field. Our 14th Cary Conference made an ethical quantum jump: we move from questions about "understanding of ecosystems" to an integration of them into questions about how to "co-inhabit ecosystems."

To address these new transdisciplinary questions, ecology provides "theoretical lenses" or paradigms that orient the understanding of our place in ecosystems and the biosphere, as well as "practical lenses" or cross-disciplinary methodologies for integrating ecology and environmental philosophy into research, education, and ecosystem management practices, thereby broadening current theoretical and applied approaches to enhance regional and global sustainability. Part IV begins with two chapters by ecologists who have contributed to a shift in the twenty-first century ecological worldview: Steward Pickett provides an updated view of "the flux of nature" paradigm, and Jingle Wu offers an encompassing overview of hierarchy theory.

Two scientists present chapters that outline important frameworks that inform contemporary ecology, and hence are relevant to how the sciences might interact with the theory and practice of ethics. Steward Pickett notes the shift in paradigm from the classical worldview, based on *balance of nature* and its technical expressions. Important assumptions have been altered, by the new *flux of nature* paradigm. These acknowledge the openness of ecosystems to material fluxes, the regulatory role of external influences, the lack of a single stable end point to dynamics, and the role of disturbance and probabilistic dynamics, and finally the entanglement of humans with the biota and physical structures of ecosystems. In addition, the complexity of the science of ecology is illustrated by methodological paradigms that focus on individual entities as opposed to material and energetic fluxes, and which focus on instantaneous, contemporary dynamics as opposed to historical legacies in environment and adaptation. The science of ecology is making great strides in overcoming the fractured nature of its knowledge base and explanatory apparatus noted by Likens in the quote above (Pickett et al. 2007).

Further structuring ecological science is hierarchy theory, introduced by Jianguo Wu. Ecological systems are seen as self-organizing, nested hierarchical systems, in which scaling relationships and partial decoupling are important. These last two features suggest that the generalization that "everything is connected to everything else" is misleading in the realm of ecology, and hence its application. Complex, hierarchical systems are in fact highly modular, such that the successful ones can isolate the effects of disturbance and stress before they ramify unchecked across an entire system. Understanding system dynamics and characteristics emerges from focusing on a given level of organization, while understanding the slower moving dynamics from the level above as constraints, and the faster moving dynamics of the lower level as mechanisms. The principles laid out by Wu apply to all ecological systems, of whatever scale or specific methodological paradigms they fit, whether large or small, or whether they focus on entities versus aliquots, historical versus contemporary causation.

The chapter by Shahid Naeem further elaborates on a view based on nested hierarchical levels of organization, and points out that this view is inconsistent with current political, technological and economic governance. He highlights that in spite of the vast growth in scientific information, the prevailing Western scientific view of ourselves and life on Earth has not changed much since Ancient Greece. The overarching worldview of nested spheres remains essentially the same. The modern scientific view of life is that it exists within a slim sphere; the biosphere, which suffuses into the hydrosphere and atmosphere, is nestled between an underlying sphere of rock and magma and the vast expanse of the cosmos above. The notion of ecosystem services seems very narrow within this broader worldview. The ecosystem service construct is clearly important, but it is insufficient by itself to form the foundation for our environmental actions aimed at achieving environmental sustainability because it continues to promulgate the notion that nature is in the service of humanity. The worldview and the empirical evidence suggest that such an approach may be an impediment rather than a catalyst for achieving environmental sustainability. Naeem admonishes that the decoupling of economics and technology from the biosphere has increased exponentially, and if we do not reorient our socioeconomic trajectories toward coupled socio-ecological ones, then we will cross the sustainability thresholds of the functioning biosphere.

Based on her long-term ecological studies in Los Angeles, Stephanie Pincetl adds in her chapter another layer of difficulty to couple social and ecological spheres. For the last two decades, in the United States, public funds for cities have steadily declined, particularly for parks and recreation. She raises three questions that are relevant beyond the case of Los Angeles: "What to make of all these efforts in a time of budget shortages and rise of nonprofit philanthropy? How are the agendas set and carried out? What community participation is involved and whose vision is being advanced?" Pincetl presents emerging new urban ecosystem and greenspace public/private initiatives for greater urban sustainability led by public/nonprofit partnerships. However, these initiatives are characterized by opportunism, little accountability and consultation, and in low-income communities, they may create an additional burden of responsibility and labor for maintaining these new infrastructures. The type of governance and government organization is central, and public administration should ensure coverage of essential socio-ecological needs in urban ecosystems encompassing both rich and poor neighborhoods. For example, projects such as stormwater infiltration, whose relevance Irene Klaver analyzes from a phenomenological and community perspective in Part 1, would require indispensable public administration for long-term socio-ecological urban sustainability and justice.

Nalini Nadkarni offers an alternative to address some of the concerns expressed by Naeem and Pincetl. According to Nadkarni, "ecosystem ecology provides a powerful framework to understand and care for biota and the environment." The key is to enhance the capacity of ecologists to communicate and the valuation that academia and scientific societies give to initiatives to share ecological knowledge with people outside of academia, particularly with underserved audiences and those who have little exposure to science and nature. Nadkarni critically assesses the effectiveness of the way in which the "Second Criterion" or Broader Impacts Statement of the National Science Foundation (NSF) is being implemented by researchers and institutions. Most of the proposals submitted to NSF included just teaching and training mostly for small groups (<50 people) that are close to academia, and less than 10 % of the proposals considered assistance with under-represented groups. To overcome this narrowness, Nadkarni illustrates several case studies of interactions among scientists and diverse social groups that show ways of linking ecological and social values, and the relevance of direct exposure to nature. Interestingly, Nadkarni not only *reaches out* to diverse and numerous audiences, but she also *reaches in* to the epistemic community of ecologists, demonstrating the decisive impact that early experiences of exposure to nature had on their career paths. The chapter by Alexandria Poole and collaborators also highlights case studies that emphasize the relevance of direct encounters in nature. Complementarily she and her colleagues address two major barriers to integrate ecology and ethics in education, from elementary school to higher education. First, the *assumption of value free science*, although outdated is still prevailing. Second a two-century-long *culture war* prevents the teaching of ethics in the United States. Latin America has also suffered a severe reduction in ethics education since the 1960s (Rozzi 2012). Despite these barriers, as demonstrated by the previous chapters of this book, conceptual frameworks are available for an academic, interdisciplinary education of ecology and ethics both in school and higher education. As a good example of an axiological model that integrates ecology and ethics, Poole at al. refer to Holmes Rolston, III, one of the founders of the field of environmental ethics. Rolston (1985) identified a variety of environmental values in wilderness areas, and he identified the ecosystem as the fundamental one. According to Rolston, organism values, individual and social preferences, and market prices and economic values should be always subordinated to ecosystem values. Poole et al. highlight Rolston's axiology by affirming that:

> Inverting the value hierarchy—i.e., treating economic value as the primary value as we usually do—is as incorrect as planting a tree with its roots in the air.

The chapter and the book conclude with the presentation of six ongoing education programs that integrate ecology and philosophy. These ongoing programs take place in different regions of the Americas, from the United Sates to Mexico, Colombia, Venezuela, Guyana, along the Andean and Amazonian Ecuador, Peru, Bolivia, to Argentina, Chile and the southern end of the Americas in Cape Horn. These programs involve scientists, philosophers, and educators working in formal and non-formal education, developing conceptual basis and practical strategies for the integration of ecological and ethical concepts, theories, and values, into methodologies that involve inter-institutional and international collaborations.

Future Projections at the Interfaces of Ecology and Philosophy

This book builds on the valuable history of a series of Cary Conferences and ecosystem science books that progressively have included (i) humans as components of ecosystems, (ii) interdisciplinary approaches to investigate ecosocial questions, and (iii) the integration of theory and practice to achieve broader ecological understanding and decision making (Table I). Embedded in this trend, the 14th Cary Conference innovated by having been jointly organized by three different institutions that

Table I Series of Cary Conference books

Conference title	Year	Publisher	Editors
1 *Status and Trends in Ecosystem Science*	1985	IES	Likens et al. (1987)
2 *Long Term Studies in Ecology*	1987	Springer	Likens (1989)
3 *Comparative Analysis of Ecosystems*	1989	Springer	Cole et al. (1991)
4 *Humans as Components of Ecosystems*	1991	Springer	McDonnell and Pickett (1993)
5 *Linking Species and Ecosystems*	1993	Chapman & Hall	Jones and Lawton (1995)
6 *The Ecological Basis of Conservation: Heterogeneity, Ecosystems, and Biodiversity*	1995	Chapman & Hall	Pickett et al. (1997)
7 *Success, Limitations and Frontiers in Ecosystem Science*	1997	Springer	Pace and Groffman (1998)
8 *Understanding Urban Ecosystems: A New Frontier for Science and Education*	1999	Springer	Berkowitz et al. (2003)
9 *Understanding Ecosystems: The Role of Quantitative Models in Observation, Synthesis, and Prediction*	2001	Princeton University Press	Canham et al. (2003)
10 *Ecosystem Function in Heterogeneous Landscapes*	2003	Springer	Lovett et al. (2005)
11 *Disease Ecology: Effects of Disease on Ecosystems and of Ecosystems on Disease*	2005	Princeton University Press	Ostfeld et al. (2008)
12 *Resilience in Urban Ecology and Design: Linking Theory and Practice for Sustainable Cities*	2007	Springer	Pickett et al. (2013)
13 *Effective Communication of Science in Environmental Controversies*	2009	Frontiers in Ecology and the Environment (Special Issue)	Groffman et al. (2010)
14 *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action*	2011	Springer	Rozzi et al. (2014)

became independently interested in the interface of ecology and philosophy: the Cary Institute of Ecosystem Studies, New York, the Institute of Ecology and Biodiversity (IEB-Chile), and the University of North Texas (UNT). The Cary Institute provided the strength of a tradition of cutting-edge research on ecosystem science and coupled human-nature systems. IEB added for the first time in the history of the Cary Conferences an international partner, which represents a leading Latin American research center committed to develop long-term socio-ecological research in southwestern South America. The UNT Department of Philosophy and Religion Studies and its Center for Environmental Philosophy integrate epistemological, ethical, and environmental justice approaches to address socio-ecological challenges. In this way, the 14th Cary Conference builds on a strong partnership among these three institutions, which have different histories of long-term collaborations between ecologists and philosophers, as shown by previous international workshops, such as *Comparative Studies of South and North American Temperate Ecosystems* held in January 1991 (Pickett and Armesto 1991), *Integration of Ecology and Environmental Philosophy into Biocultural Conservation and Long-Term Socio-Ecological Research* held in March 2007 and June 2008 (Rozzi et al. 2008; Anderson et al. 2010), and *Latin- (inter-) American Conference on Environmental Philosophy* held in March 2013 (Massardo et al. 2012) with participation of ecologists and philosophers from the USA, Chile, Latin America and other regions. These workshops were aimed at building the theoretical and practical foundations for integrating ecological sciences and environmental ethics into long-term socio-ecological research programs, including the new Long-Term Socio-Ecological Research (LTSER-Chile) network in southwestern South America (Rozzi et al. 2012).

Through this Conference and book, this partnership aims to stimulate further growth of the field and to consolidate action plans for improved cross-disciplinary integration, generating innovative research questions and approaches, broader professional training, practice, and place-based projects. The results will be essayed in Long-Term Ecological Research (LTER) programs at national and international sites that span from urban to remote pristine ecosystems, the exploratory network of Urban Long-Term Ecological Research Areas (ULTRA), or in forest, range, and aquatic management programs, as well as UNESCO biosphere reserves that integrate the goals of improving human well-being and the preservation of biological and cultural diversity. As an example of setting in motion the interface of ethics and ecology at the southern end of the Americas (Rozzi et al. 2012), we are currently making progress in the following endeavors: (1) creating new field work methods that bring together ecologists and philosophers, thus fostering novel research questions and broader understanding of human-nature relationships; (2) developing a cross-disciplinary agenda of workshops and courses, based on a network of field stations associated with LTSER-Chile, which creates opportunities for training, academic discussion and collaboration among practitioners of ecology, philosophy, and other professions; (3) guiding field-based, co-tutored, graduate theses that integrate ecological and ethical concepts to address critical issues in the disciplines; (4) strengthening research on environmental ethics and ecology in a region of the world threatened by large-scale economic development projects (such as, salmon farming, hydropower) that are often in conflict with local community aspirations; (5) conducting transdisciplinary research programs with government agencies and local communities. Such activities are being supported through collaboration agreements among local universities (e.g., Universidad de Magallanes), national research Institutes (Institute of Ecology and Biodiversity, Chile), and international research programs based at academic institutions (Sub-Antarctic Biocultural Conservation Program, at the University of North Texas, USA). This model of interaction among disciplines, academic institutions, regional authorities and local communities can offer a valuable scenario for assessing methodological approaches essayed at the interface of ethics and ecology.

The fundamental importance of broadening socio-ecological research and better integrating human values in environmental decision making in this rapidly changing age compels us to continue the task addressed in this Cary Conference by organizing a series of activities on *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action* at the 100th anniversary of the Ecological Society of America that will take place in Baltimore in August 2015. Our present volume aims also to become the first of a new series of books on Ecology and Philosophy published by Springer. This series will be devoted to continuing research at the interfaces of ecology and ethics (embedded in the multiple fields of philosophy) to broaden our conceptual and practical frameworks in this transdisciplinary field. We hope that this will help to effectively guide society toward more sustainable and just ways of co-inhabitation among diverse humans, and among them and other-than-human co-inhabitants with whom we share our habitats in the heterogeneous regions of the planet.

Denton, TX, USA — Ricardo Rozzi
Millbrook, NY, USA — S.T.A. Pickett
College Station, TX, USA — Clare Palmer
Santiago, Chile — Juan J. Armesto
Denton, TX, USA — J. Baird Callicott

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Contents

Contributors

Juan J. Armesto Departamento de Ecología, Pontificia Universidad Católica de Chile, Institute of Ecology and Biodiversity, Santiago, Chile

Kamanamaikalani Beamer Hui ʻĀina Momona Program, Hawaiʻinuiākea School of Hawaiian Knowledge & Richardson School of Law, University of Hawaii-Manoa, Honolulu, HI, USA

Alan R. Berkowitz Cary Institute of Ecosystem Studies, Millbrook, NY, USA

Susan Power Bratton Department of Environmental Science, Baylor University, Waco, TX, USA

Todd J. Brinkman Scenarios Network for Alaska and Arctic Planning, University of Alaska Fairbanks, Fairbanks, AK, USA

Philip Cafaro Department of Philosophy, Colorado State University, Fort Collins, CO, USA

J. Baird Callicott Department of Philosophy, University of North Texas, Denton, TX, USA

Allen Carlson Department of Philosophy, University of Alberta, Calgary, AB, Canada

F. Stuart Chapin III Department of Biology and Wildlife, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, AK, USA

Patricia Cochran Alaska Native Science Commission, Anchorage, AK, USA

Tamara Contador Centro Universitario Puerto Williams, Universidad de Magallanes, Puerto Williams, Chile

Philip Day Department of Philosophy, University of North Texas, Denton, TX, USA

Christopher H. Eliot Hofstra University, Hempstead, NY, USA

Peter Feinsinger Wildlife Conservation Society, Bronx, NY, USA

Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ, USA

William Forbes Department of Social and Cultural Analysis, Stephen F. Austin State University, Nacogdoches, TX, USA

Lily R. Gadamus Kawerak, Inc., Nome, AK, USA

Eugene C. Hargrove Center for Environmental Philosophy, University of North Texas, Denton, TX, USA

Tim Hayward School of Social and Political Science, University of Edinburgh, Edinburgh, UK

Orville H. Huntington Tanana Chiefs Conference, Wildlife & Parks, Fairbanks, AK, USA

J. Tomás Ibarra Fauna Australis Wildlife Laboratory, Department of Ecosystems and the Environment, Pontificia Universidad Católica de Chile, Santiago, Chile

Department of Forest Sciences, University of British Columbia, Vancouver, BC, Canada

Irene J. Klaver Department of Philosophy and Religion Studies, University of North Texas, Denton, TX, USA

Corrine N. Knapp University of Alaska Fairbanks, Fairbanks, AK, USA

Brendon M.H. Larson Department of Environment and Resource Studies, University of Waterloo, Waterloo, ON, Canada

Sheila Lintott Department of Philosophy, Bucknell University, Lewisburg, PA, USA

Helen E. Longino Department of Philosophy, Stanford University, Stanford, CA, USA

Chaone Mallory Department of Philosophy, Villanova University, Villanova, PA, USA

Francisca Massardo Institute of Ecology and Biodiversity, Universidad de Magallanes, Punta Arenas, Chile

Curt Meine Center for Humans and Nature and Aldo Leopold Foundation, Baraboo, WI, USA

Kelli Moses Sub-Antarctic Biocultural Conservation Program, University of North Texas, Denton, TX, USA

Nalini M. Nadkarni Department of Biology, Center for Science and Math Education, University of Utah, Salt Lake City, UT, USA

Shahid Naeem Department of Ecology, Evolution, and Environmental Biology, Columbia University in the City of New York, New York, NY, USA

Michael S. Northcott School of Divinity, New College, University of Edinburgh, Edinburgh, UK

Jaime Ojeda Laboratorio de Macroalgas Subantárticas, Universidad de Magallanes, Punta Arenas, Chile

Clare Palmer Department of Philosophy, Texas A&M University, College Station, TX, USA

Steward T.A. Pickett Plant Ecology, Cary Institute of Ecosystem Studies, Millbrook, NY, USA

Stephanie Pincetl Institute of the Environment and Sustainability, University of California Los Angeles, Los Angeles, CA, USA

Alexandria K. Poole Center for Environmental Philosophy, University of North Texas, Denton, TX, USA

Ginger Potter US Environmental Protection Agency, Washington, DC, USA

Ricardo Rozzi Department of Philosophy and Religion Studies, University of North Texas, Denton, TX, USA

Institute of Ecology and Biodiversity, Universidad de Magallanes, Punta Arenas, Chile

Lisa H. Sideris Department of Religious Studies, Indiana University, Bloomington, IN, USA

Daniel Simberloff Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN, USA

Iralys Ventosa Rodríguez Wildlife Conservation Society, Bronx, NY, USA

Peter Vitousek Department of Biology, Stanford University, Stanford, CA, USA

Jianguo Wu School of Life Sciences, Arizona State University, Tempe, AZ, USA

Participants

Participant	Affiliation	E-mail
Allen, Timothy	University of Wisconsin	tfallen@wisc.edu
Anderson, Christopher	National University of Tierra del Fuego; Austral Center for Scientific Research (CADIC-CONICET), Ushuaia, Argentina	canderson@alumni.unc.edu
Balvanera, Patricia	Universidad Nacional Autonoma de Mexico, Mexico	pbalvanera@cieco.unam.mx
Barbosa, Olga	Universidad Austral de Chile/Institute of Ecology and Biodiversity, Chile	olgabarbosa@gmail.com
Brown, James	University of New Mexico	jhbrown@unm.edu
Cadenasso, Mary	University of California, Davis	mlcadenasso@ucdavis.edu
Celis, Juan Luis	Institute of Ecology and Biodiversity, Chile	jlcelis@gmail.com
Cook, Elizabeth	Arizona State University	elizabeth.m.cook@asu.edu
Cuddington, Kim	University of Waterloo, Canada	kcudding@gmail.com
Degeorges, Patrick	French Ministry of Ecology and Sustainable Development, France	patrickyellow@gmail.com
deLaplante, Kevin	Iowa State University	kdelapla@iastate.edu
Dow, Kirsten	University of South Carolina	kdow@sc.edu
Gaxiola, Aurora	Pontificia Universidad Catolica de Chile, Institute of Ecology and Biodiversity, Chile	aurora.gaxiola@cantab.net
Grim, John	Yale University	john.grim@yale.edu
Grove-Fanning, William	University of North Texas	williamgrovefanning@hotmail.com
Grun, Mauro	University of North Texas	mgrun@uol.com.br
Higgs, Eric	University of Victoria, Canada	ehiggs@uvic.ca
Hook, Jonathan	University of North Texas	Jonathan.Hook@unt.edu

(continued)

(continued)

Participant	Affiliation	E-mail
Jax, Kurt	Helmholtz-Centre for Environmental Research, Germany	kurt.jax@ufz.de
Keeling, Eric	Cary Institute of Ecosystem Studies	keelinge@caryinstitute.org
Kolasa, Jurek	McMaster University	kolasa@mcmaster.ca
Likens, Gene	Cary Institute of Ecosystem Studies	likensg@caryinstitute.org
Lockwood, Jeffrey	University of Wyoming	lockwood@uwyo.edu
Maass, Manuel	University of Mexico, Mexico	manuel.maass@gmail.com
Marquet, Pablo	Universidad Catolica de Chile & Institute of Ecology and Biodiversity, Chile	pmarquet10@mac.com
Mikkelson, Gregory	McGill University, Canada	gregory.mikkelson@mcgill.ca
Morse, Jennifer	Cary Institute of Ecosystem Studies	morsej@caryinstitute.org
Ogden, Laura	Florida International University	ogdenl@fiu.edu
Perez-Quintero, Ana-Elisa	University of Puerto Rico, Puerto Rico	p.anaelisa@gmail.com
Power, Mary	University of California, Berkeley	mepower@berkeley.edu
Ramos, Jorge	Arizona State University	jramos10@asu.edu
Reiners, William	University of Wyoming	reiners@uwyo.edu
Schlesinger, William	Cary Institute of Ecosystem Studies	schlesingerw@caryinstitute.org
Sewell, Kenneth	University of North Texas	kenneth.sewell@unt.edu
Strayer, David	Cary Institute of Ecosystem Studies	strayerd@caryinstitute.org
Taylor, Peter	University of Massachusetts, Boston	peter.taylor@umb.edu
Tjossem, Sarah	Columbia University	sft2101@columbia.edu
Tucker, Mary Evelyn	Yale University	maryevelyn.tucker@yale.edu
Vereen, Ethell	University of Georgia/ USDA-ARS	Ethell.Vereen@gmail.com
Weathers, Kathleen	Cary Institute of Ecosystem Studies	weathersk@caryinstitute.org

Part I
Integrating Philosophy and Ecology: Biocultural Interfaces

Chapter 1
Introduction to Integrating Philosophy and Ecology: Biocultural Interfaces

Ricardo Rozzi

Abstract Part I of the book is organized under the perspective of a *biocultural ethic* that interrelate the Habits and Habitats with the identities and well-being of the co-in-Habitants to assess and reorient the ecological and social consequences of globalization. The interrelationships among the "3 Hs" of the *biocultural ethic* proposed by Ricardo Rozzi involve biophysical, symbolic-linguistic, and institutional-socio-political-technological domains, and have foundations three families of worldviews: (i) pre-Socratic and other non-mainstream Western philosophies, (ii) Amerindian and other non-Western ecological worldviews, and (iii) contemporary ecological-evolutionary sciences. Peter Vitousek and Kamanamaikalani Beamer present an intercultural, interdisciplinary dialogue that transits toward the practices involved in the development of the Kamehameha Schools in Hawaii, addressing the problematic, but unavoidable interactions between local and global *habitats* and *habits* today. In local–global dialectics, stewardship and dialogic partnerships bring twenty-first century ecologists, philosophers, and other professionals to work together with traditional communities both in remote places and in metropolises. Stuart ("Terry") Chapin and his Alaskan collaborators combine traditional and scientific ecological knowledge to examine the close connections that Amerindian peoples habits have with their habitats. Daniel Simberloff shows, however, that today the local–global dialectic is problematic, and argues that introduced species and foreign cultures are not bad *per se* but rather by the fact that their presence replaces local biodiversity, and also culture. Susan Bratton describes tensions between native and foreign cultures and their interrelated changes in the habitats and habits in the context of environmental injustice. Irene Klaver proposes the concept of *situational agency* to interpret human habits and interactions with other human and more-than-human co-inhabitants in urban habitats.

R. Rozzi (✉)
Department of Philosophy and Religion Studies, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-0920, USA

Institute of Ecology and Biodiversity, Universidad de Magallanes, Punta Arenas, Chile
e-mail: rozzi@unt.edu

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Biocultural is a term that since the 1960s began to be gradually adopted by the fields of human evolution (Bowles 1966; Baker 1969), ecology (Bennet et al. 1975), anthropology of health (Moore et al. 1980), ecological restoration (Allen 1988; Janzen 1988), and ethnobiology (Maffi 2001, 2005). Ricardo Rozzi adopts the term biocultural to propose an ethics that considers –ontologically and axiologically– the interrelations between the *Habits* and the *Habitats* that shape the identities and well-being of the *co-in-Habitants*. The interrelationships among the "3 Hs" of *biocultural ethics* provides the lens under which Part I of the book is organized.

In the context of globalization processes of biotic homogenization (McKinney and Lockwood 1999; Simberloff and von Holle 1999) and of cultural homogenization have been described separately. However, positive feedbacks between both types of homogenization can lead to a process that Rozzi has called *biocultural homogenization*. Biocultural ethics investigates and evaluates the ecological and social consequences of biocultural homogenization. Complementarily, biocultural ethics investigates and evaluates the maintenance of regionally heterogeneous habitats and habits that lead to *biocultural conservation*. Rozzi points out that the term *biocultural* helps to also understand the inextricable links among three interrelated domains of human co-inhabitation: (i) the biophysical, (ii) the symbolic-linguistic, and (iii) the socio-political, institutional, technological. An understanding of these interrelationships –as well as between the habits and the habitats within communities of co-inhabitants– can be found not only in contemporary ecological and evolutionary sciences, but also in Amerindian ecological worldviews, and in Western worldviews that date back to the pre-Socratics.

Peter Vitousek and Kamana Beamer integrate scientific ecological knowledge with Hawaiian traditional ecological knowledge, and they start their chapter by referring to their *habitats* and *habits*: "Kamana is helping to restore and maintain a series of irrigated *kalo* (taro) fields …, while Peter is working to restore rainfed *uala* (sweet potato) fields." They also address the interrelationships among the biophysical, symbolic-linguistic and socio-political domains, asserting that "our perspectives are shaped by the systems we study … Epic chants and cosmogonic genealogies were used as sources of knowledge that linked Hawaiians to their islands in familial, metaphysical, and material forms." Beamer and Vitousek introduce themselves as co-inhabitants with their own identities: a native Hawaiian cultural practitioner, scholar, and educator, and an ecologist who has worked in both site-specific and global biogeochemistry for nearly four decades. The gesture of introducing themselves is very relevant for a biocultural approach to science because it makes explicit that researchers are subjects –i.e., autonomous, active, and creative beings–, as opposed to merely objective applicants of protocols and methods of science. Further, Vitousek and Beamer engage in subject-subject relationships with other members of Hawaiian society through a dialogic participatory manner that goes way beyond the narrow one-directionality of the prevailing notion of *outreach*: from science to society.

Terry Chapin, Patricia Cochran, Orville Huntington, Corrine Knapp, Todd Brinkman, and Lily Gadamus begin their chapter by referring to the close connections that Amerindian people have with the habitats. They combine traditional and scientific ecological knowledge to examine these connections through maps of the distribution of languages and the distribution of habitat types in Alaska (Fig. 4.1). They find a high degree of overlap, a result that resembles the overlap between linguistic and habitat-type maps described for southern South America in Chap. 2 (Fig. 2.4). The close biocultural connections are however disrupted if access to the ancestral habitats is impeded. It is critical to note that many of the processes disrupting the biocultural links between habitats and habits are taking place right now; they did not only occur in the past, as the term *post-colonial* might misleadingly suggest for our era. Chapin et al. document that "in 1971, the United States federal government settled the land claims of Alaska's Native people." As a consequence of this loss of access to their ancestral habitats, Native Alaskans had to give up management of natural resources on government land, including traditional hunting and gathering practices. From the perspective of biocultural ethics, this situation in Alaska shows how a loss of access to native habitats involves a loss of traditional habits, a transformation from nomadic habits to sedentary habits. Chapin and his collaborators explain how traditional habits have been replaced by "standardized tests in public schools, Alaska state laws and regulations that do not recognize the federally mandated rights of indigenous tribes, and the expectation that indigenous people will adopt and use Western institutions for self-governance and infrastructure perpetuate the pressures for assimilation." This conflict offers an example of the mechanisms of biocultural homogenization that involve a reinforcing feedback between the transformations of the habitats and the habits.

Conflictive interrelated changes in the habitats and habits are addressed by Susan Bratton in the context of environmental injustice. Referring to the work of feminist liberation theologian Ivonne Gebara, Bratton deplores the conditions of the lives of displaced communities in the outskirts of South American metropolises. She contends that "the poor receive the least benefit from greenhouse gas producing industries, and will be the first people harmed by the unintended ecological consequences." To improve their understanding of how to assess environmental change, Bratton invites religious ethicists to collaborate with ecologists. In turn, she invites ecologists to collaborate with religion scholars and practitioners to improve their communication capacities and their understanding about religious ecological narratives. In this way, she calls for "two-way conversation[s]" among members of the ecological sciences and religious communities. As shown in Part IV of this volume, such a collaborative dialogue has been undertaken by canopy ecologist Nalini Nadkarni.

Daniel Simberloff initiates his chapter by referring to the habitats that have been transformed by species introduced by humans. Even in the remote Patagonian pampas, in 1832 during his voyage on board H.M.S. Beagle Darwin, documented that the habitats were "dominated by massive stands of two plant species – the cardoon (*Cynara cardunculus*) from Europe and north Africa and the giant thistle of the pampas (*Silybum marianum*) from southern Europe and Asia." To analyze some of the causes and impacts that introduced species have on the habitats and the cultural habits, Simberloff integrates ecology and environmental philosophy. He uses Aldo Leopold's ecologically informed "land aesthetic" (*sensu* Callicott 1983), highlighting that the work of Leopold is inundated with biting references to the aesthetic disharmonies caused by introduced species. Leopold did not only criticized the aesthetic of the habitats transformed by introduced species, but he was most sarcastic about the bioculturally narrow habits of engineers, for whom the flora of roadsides is "merely weeds and brush; they ply it with grader and mower" (Leopold 1949, p. 268). Through this habit, engineers create processes of plant succession that rapidly transform "the prairie gardens" into "a refuge for quack grass." After the native garden is lost, Leopold criticizes how the highway department employs landscapers to plant exotic trees under a conventional, homogenous aesthetic design that is valued as "roadside beauty." Simberloff, Callicott, and Leopold together offer an integrated ecological-aesthetic prism to understand the interrelationships between habitats and habits and the consequences they have for the identities and the fate of the communities of co-inhabitants, humans included.

The debate on introduced biota is far from simple. Simberloff develops an interwoven analyses of the ecological, economic, and public health concerns, as well as aesthetic considerations of introduced species. He concludes by raising questions about problems associated with biocultural homogenization (*sensu* Rozzi et al. 2008), and with the moral considerability of introduced species. With an emphasis on everyday urban habits and human-made habitats, Irene Klaver contributes a novel prism to address some of these concerns. She affirms that "environmental philosophy considers practical as well as basic theoretical questions, varying from issues of rights and values, to ontological and epistemological investigations into the nature-culture relation, including questioning the dualism that is implied in this very phrasing of nature versus culture." Overcoming the dualism between active cultural subjects and passive natural objects is essential to overcome a sheer instrumental relation between humans and nature. Klaver builds on the pre-Socratic philosophy of Heraclitus and the twentieth century phenomenology of Merlau-Ponty to overcome this dualism.

Klaver proposes the concept of *situational agency* to interpret human habits and interactions with other human and more-than-human beings as the result of a variety of experiential vectors: "intentionality arises in the very interaction of inward and outward forces, neither merely in me (voluntarism), nor completely outside me (determinism), but in a co-constitutive field of the two." The work of Klaver inaugurates an urban biocultural imagination, which offers an aesthetic and epistemological foundation for a biocultural ethics. Rozzi emphasizes that if we perceive the diversity of beings as co-inhabitants, then the domain of moral considerability is extended beyond human beings, because other-than-human beings cease to be understood as mere passive objects; instead, they are understood as subjects. Chapin and his Alaskan collaborators assert that "the biophysical and spiritual dimensions of indigenous worldviews are linked by an ethic of respect for other people and for living and nonliving entities both locally and globally. This ethic can guide adaptation to current and emerging conditions … within this framework, it would be irresponsible for an individual who recognizes human violations of this ethic of respect not to take actions to improve the respectful relationship between people and the rest of nature." This Alaskan Native worldview concurs with a biocultural ethic that integrates biophysical and symbolic-linguistic domains of reality. Although a biocultural ethic differs from the paradigm and everyday practices of science that prevail today, the integration of the biophysical and symbolic-linguistic domains is present in the work and lives of a few pioneer environmental scientists and ethicists such as Rachel Carson (see Part II in this volume). Within Western civilization it is possible to find foundations for a biocultural ethic from Heraclitus to Rachel Carson, as much as it is possible to find foundations in Amerindian and other non-Western cultures.

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Chapter 2
Biocultural Ethics: From Biocultural Homogenization Toward Biocultural Conservation

Ricardo Rozzi

Abstract The 14th Cary Conference and this book *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action* reconnect the theoretical reason of ecological sciences with the practical reason of ethics to better understand and to more fairly assess the social processes of the changing world in which we co-inhabit today. In this chapter I invite ecologists, philosophers, and other actors to essay an additional integration: the examination of the diversity of ways of understanding the world and their interrelationships with the diversity of modes of judging which ways of co-inhabiting are just or unjust. With a biocultural perspective that highlights the planetary ecological and cultural heterogeneity, I introduce three interrelated terms: (1) *biocultural homogenization*, a major, but little perceived, global driver of losses of biological and cultural diversity that frequently entail social and environmental injustices; (2) *biocultural ethics* that considers –ontologically and axiologically– the interrelations between the habits and the habitats that shape the identity and well-being of the co-inhabitants; (3) *biocultural conservation* that seeks social and ecological well-being through the conservation of biological and cultural diversity and their interrelationships.

Keywords Biotic homogenization • Ecology • Education • Field environmental philosophy • Sustainability

R. Rozzi (✉)
Department of Philosophy and Religion Studies, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-0920, USA

Institute of Ecology and Biodiversity, Universidad de Magallanes, Punta Arenas, Chile
e-mail: rozzi@unt.edu

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Biocultural ethics investigates and evaluates the ecological and social causes and consequences of both *biocultural homogenization* and *biocultural conservation*.[1] These three biocultural terms provide a conceptual framework and a methodological approach for conducting teamwork among ecologists, philosophers and other participants to investigate, and also to reorient, ecosocial paths of environmental change towards a sustainability of life. Biocultural ethics contributes a new eco-philosophical paradigm that transforms prevailing ethics, including environmental ethics, for at least three reasons.

(i) In contrast to the anthropocentrism of deontological and utilitarian ethics that prevail today, the biocultural ethic connects human life with the diversity of beings, considered as co-inhabitants with whom humans co-constitute their identities and attain well-being. It is not simply an extension of utilitarian or deontological ethics to include animals, plants, and other living beings in the community of morally relevant beings, but it is an ethic that involves inter-specific relationships. Under biocultural ethics, the central philosophical question of Western ethics about how should humans inhabit is transformed into how should humans *co-inhabit* in the world.

(ii) In contrast to the land ethic of Aldo Leopold who refers to the human species as a whole, by asserting that "a land ethics changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it," the biocultural ethic shows us that many cultures –including Amerindian, Buddhist, and some Western philosophical traditions– have ecological worldviews that recognize humans, plants, waters, and other beings as co-inhabitants. Biocultural ethics demands an inter-cultural dialogue. The global environmental change we face today is caused by particular agents (social groups, corporations, individuals), not by the species, *Homo sapiens,* in general. Unsustainable practices that are detrimental to the life of human beings and other-than-human beings need to be sanctioned and/or remedied. Complementarily, in the context of global socio-environmental change, the worldviews, forms of knowledge, values, and ecological practices of cultures that are sustainable should be respected, and eventually adapted through intercultural exchanges.

(iii) In contrast to mainstream modern ethics that focus on human habits without considering their habitats, the biocultural ethic couples the human habits with the habitats and the communities of co-inhabitants. The habits, habitats, and

[1] Since the 1960s, the term biocultural has been gradually adopted by the sciences of human evolution (Bowles 1966, Baker 1969, Fischler 1979, Katz 1979, 1980), ecology (Bennett et al. 1975), psychology and anthropology of health (Pepitone 1976, Moore et al. 1980), ecological restoration (Allen 1988, Janzen 1988) and ethnobiology (Baer 1989, Maffi 2001, 2005). In 2000, I coined the term *biocultural conservation* to emphasize that "1) conservation biology issues involve [ontologically, epistemologically, and ethically] both humans and other living beings, 2) biological and cultural diversity are inextricably integrated, and 3) social welfare and biocultural conservation go together" (p. 10, Rozzi 2001). Then I introduced the term *biocultural homogenization* to indicate how the homogenization of cultural habits, particularly in education, leads to the homogenization of habitats, and vice-versa (Rozzi et al. 2008). *Biocultural ethics* projects these concepts from a descriptive domain into normative one (Rozzi and Massardo 2011).

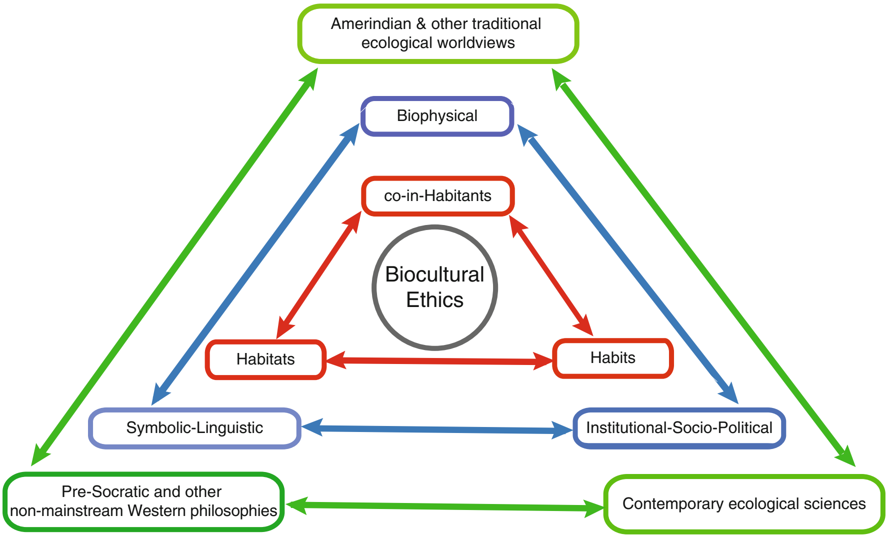

Fig. 2.1 The formal proposal of biocultural ethics can be illustrated by a combination of three inclusive triangles. *Interior triangle*: The "3Hs" of biocultural ethics: Habits, Habitat, and co-in-Habitant. *Intermediate triangle*: The 3Hs' interrelationships involve biophysical, symbolic-linguistic, and institutional-sociopolitical-technological domains. *Outside triangle*: The 3Hs' interrelationships are understood by three families of worldviews: (i) pre-Socratic and other non-mainstream Western philosophies, (ii) Amerindian and other non-Western ecological worldviews, and (iii) contemporary ecological-evolutionary sciences

co-inhabitants (the "3Hs" of biocultural ethics) involve biophysical, symbolic-linguistic, and institutional-sociopolitical-technological domains (Fig. 2.1). Within each of these domains, it is necessary to consider the relations of power and differential responsibilities regarding the causes and solutions of environmental problems. These are not merely descriptive statements but normative statements with the aspiration of practical truth. Biocultural ethics aims to contribute to ecosocial justice through the conservation of biological and cultural diversity.

In the context of global climate change, and more broadly global environmental change, biocultural ethics is particularly relevant because it enables a better distinction of specific responsible agents of environmental problems. It also provides a clearer understanding about the value of diverse sustainable forms of ecological practices, and worldviews that have co-evolved within specific ecoregions. Applied biocultural ethics fosters a greater investigation and valuation of biological and cultural diversity, and their interrelationships, in education programs, policy making, and everyday culture, to counterbalance the linguicide, biocide, and increasing poverty derived from biocultural homogenization.

In the first section of the chapter, I discuss biocultural homogenization, an underperceived, but pervasive, global process that reaches places as remote as the southernmost islands of the Americas, or the high Andean communities in South America. In the second section, I examine the foundations provided by pre-Socratic Western philosophy, and by Amerindian cultures examined with an ecological and biogeochemical perspective for a biocultural ethic. In the third, I discuss biocultural conservation and the Field Environmental Philosophy (FEP) methodological approach that integrates ecological sciences and biocultural ethics into research, formal and non-formal education, and socio-environmental policies at local, national, and international scales.

2.1 Biocultural Homogenization

2.1.1 A Pervasive Socio-ecological Problem, Even at the Far South

I will introduce the concept of biocultural homogenization through a case study at the southern end of the Americas. The sub-Antarctic Magellanic ecoregion has been identified as one of the last 24 wilderness areas remaining in the planet (Mittermeier et al. 2003), which includes glaciers, fjords, highlands, tundra, and the southernmost forests of the world where over 1,000 endemic plant species grow exuberantly (Armesto et al. 1998; Rozzi et al. 2012). Amid these lush landscapes, it strikes us that upon entering into the cities of the Magellanic region we do not find any of the native trees in gardens or parks. When we look closely at the trees of the central plazas of each of the major cities, we recognize trees from Europe, North America, and Asia (Rozzi et al. 2003). Moreover, the flora of the central plazas in the remote Magellanic cities more closely resembles the flora of the plazas in Madrid, New York, or Vancouver, than the flora of the forests that grow a few kilometers outside the austral cities in the sub-Antarctic Magellanic ecoregion. What causes this decoupling between the lush flora of the region and the flora planted in cities? Why are only European, North American, and other exotic species selected and valued for ornamental purposes? Who decides which tree species are planted in squares? To answer these questions we investigated which species of plants were known and valued by decision makers, educators, and other community members in the Magellanic region. The first question we asked them was: What are the first three plants that come to mind? To our surprise, more than 75 % of the responses referred to exotic plants, of which two species concentrated more than half of the answers: roses and apple trees. Among the five most cited plants were also tropical palm trees (Rozzi et al. 2008a). Hence, the floristic mindsets of decision makers gave much more attention to cosmopolitan plants, ornamentally used in cities around the world, than to the unique plants of the region. As a consequence of the habit of knowing and valuing a few cosmopolitan species more than regional plants, the habitats are planted with cosmopolitan trees and flowering shrubs and herbs. In turn, everyday encounters of citizens with cosmopolitan trees and flowers reinforces the appreciation for them, and the neglect of native plants.

Fig. 2.2 Contrast between the Andean native biocultural reality outside the school and the Eurocentric global biocultural reality inside a classroom of a rural school in Cuenca, Ecuador. (**a**) Across the street of the school grows a shrub of *Brugmansia arborea*, a plant native to the Ecuadorian Andes that represents a biocultural keystone species because its flowers and seeds are used by shamans. (**b**) Mothers who are bilingual speakers of Quichua and Spanish-arrive to pick up their children at the school. (**c**) Inside the classroom, the nation-state symbols – the Ecuadorian flag, national seal, national anthem in Spanish, first president of the Ecuadorian nation-state, and roses – stand out. (**d**) On another wall of the classroom, a symbol of the Catholic religion, the Virgin Maria and roses. (**e**) On a third wall, a symbol of North American globalization, a Donald Duck character and a map of the region of Cuenca. For the cultural significance of roses in Christianity, see Michael Touw (1982). For the cultural significance of Donald Duck in the context of global neoliberalism, see Ariel Dorfman and Armand Mattelart (1975)

The positive feedback between cosmopolitan habits and habitats found at the southern tip of the Americas does not represent an exceptional case; it is rather the norm, repeating itself recurrently throughout the continent and the world. For example, in the Andean region of Cuenca in Ecuador, we found that roses and exotic plants also prevail in the classroom decoration and textbooks used in rural schools, while outside the school a rich native flora grows in the paramo (Fig. 2.2). Regarding languages and culture, Spanish and colonial culture prevail in the school curricula, while Aymara and Quechua language and Amerindian cultural traditions are maintained in the paramo outside the school. Inside schools a globally homogenous mind is educated; a mind that acquires globally homogenous habits and, in turn, builds globally homogenous habitats. I call this type of process that generates a positive feedback between cosmopolitan habits and habitats, *biocultural homogenization* (Rozzi 2001).

Biocultural homogenization is a pervasive, but underappreciated, driver of today's rapid global environmental change. It entails simultaneous and interlocked losses of native biological and cultural diversity at local, regional, and global scales. This process leads to the disruption of co-evolutionary interrelationships between cultures and their land, and massive replacements of native biota and cultures by a few cosmopolitan species, languages, and cultures (Rozzi 2003). The problematic character of biocultural homogenization does not reside on cosmopolitan biota, languages and/or cultural habits *per se*. The problem resides instead in the unbalanced relationship that global society creates favoring a narrow set of species, languages, and cultural habits at the expenses of the regional native ones (see Chap. 3 by Simberloff, in this volume).

During the past three decades, biotic homogenization has been investigated by ecologists (McKinney and Lockwood 1999; Simberloff and von Holle 1999; Olden and Rooney 2006), while cultural homogenization has been researched by social scientist or humanists (Schaedel 1979; Petitat 1987; Quijano 2000; Rizvi and Lingard 2000). Biocultural homogenization interrelates these two processes. It requires to investigate sympatric and synchronic coupling of processes of biotic homogenization and of linguistic/cultural homogenization, and to examine questions such as: Why do educators, policy makers, and citizens have so many difficulties perceiving the ecological and social consequences of biocultural homogenization? Why do they fail understanding and respecting the value that regional native habitats and traditional cultural habits and languages have for the identity, autonomy, and well-being of the regional co-inhabitants? In Latin America, I distinguish three core processes associated with recent urbanization and formal education that explain the origin of those difficulties and the fostering of *biocultural homogenization* today: rural–urban migration, linguistic homogenization, and reduction of philosophy education.

2.1.2 Three Drivers of Biocultural Homogenization

2.1.2.1 Rural-Urban Migration

At the beginning of the twenty-first century, for the first time in the history of the human species, *more than 50 % of the world's human population lives in cities* (Flavin 2007). The massive rural to urban migration is a very recent phenomenon (Fig. 2.3a). It has been especially marked in Latin America where urban population has grown from 41 % in 1950 to 79 % in 2010 (UNDESA 2011). This rural-urban migration has severe consequences for both the native habitats and the cultural habits and human well-being. *Regarding the native habitats*, the rural-urban migration

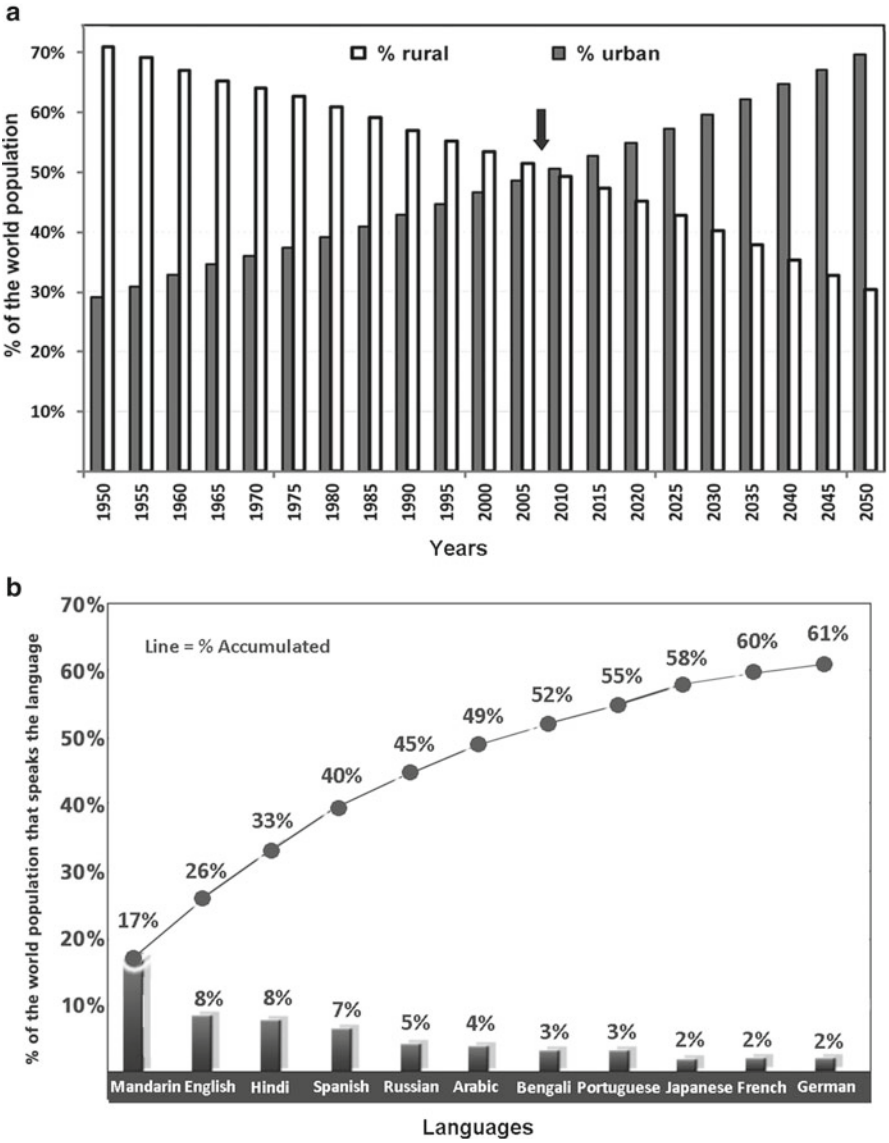

Fig. 2.3 (**a**) Relative percentages of rural and urban world population since 1950 (70 % rural vs. 30 % urban), including estimated percentages until 2050 (30 % rural vs. 70 % urban). The arrow indicates the turning point in 2007 when, for the first time in human history, the proportion of urban population surpassed the rural one. (**b**) Dominant languages spoken in the world in 2010. Bars illustrate the relative percentage of the world population that speaks each of the dominant languages; the figures over the dots on the line indicate the accumulated percentage of the world population that speaks one of these languages (Modified from Rozzi 2012a)

generates a loss of the ancestral human stewards of the land. As native people and rural communities migrate to cities, temperate and tropical forests, high Andean paramo, and coastal habitats are left open today to accelerated processes of land-use changes, including large-scale mining and expansion of monocultures associated with a concentration of the land property (Ceccon and Miramontes 1999; Tobasura 2006; Finer et al. 2008). *Regarding human habits and well-being*, in the cities, displaced indigenous people, peasant and fishermen communities frequently lack access to basic services, such as food, water, shelter, and sanitary conditions; hence, they face extreme poverty conditions that are rapidly expanding in the marginal neighborhoods of metropolis areas in Latin America (Parentelli 1996; Gebara 1999; Rozzi 2001). Additionally, because of the intensive rural-urban migration most populations have lost everyday contact with their regional biological and cultural diversity. The knowledge that most teachers, authorities, new generations of students, and the majority of citizens have about biological and cultural diversity is acquired in urban contexts, distanced physically, emotionally, and ethically from the regional habitats, their communities of co-inhabitants and diverse life habits (Feinsinger et al. 1997; Leopold 2004).

2.1.2.2 Linguistic Homogenization

At the beginning of the twenty-first century, for the first time in the history of the human species, *more than 50 % of the world's human population inhabits in the symbolic-linguistic domain defined by only seven of the dominant languages*: Mandarin, English, Hindi, Spanish, Russian, Arabic, and Bengali (Fig. 2.3b). These seven languages represent only a minimal fraction (0.1 %) of the 6,909 languages that are still spoken around the globe. This linguistic homogenization drastically reduces the spectrum of concepts and worldviews with which biological and cultural diversity are perceived, understood, and valued. In formal education worldwide, less than 10 % of the living languages are taught around the planet (Maffi 2001). Hence, formal education represents a major driver of linguistic homogenization (Krauss 1992; Maffi 2005). In most Latin America countries, indigenous languages are still ignored or only marginally incorporated into formal education, and Spanish continues to be taught as the unifying language of the nation-states. Consequently, monolingualism of the colonial language has been imposed. A linguistic homogenization has been generated, and today linguistic diversity is even more endangered than biological diversity in this continent (Lizarralde 2001). In Chile, for example, 50 % of the native languages are already extinct, and a third will become extinct during this decade (Table 2.1).

2.1.3 Reduction of Philosophy Education

Since the 1970s, under the growing dominance of a neoliberal regime, the Latin American nation-states have transitioned from a period of modernization to one of

Table 2.1 Characterization and conservation status of the Amerindian languages spoken within the Chilean territory at the arrival of the Spaniards

Language name							Number of speakers		
Vernacular	Spanish	English	Linguistic classification	Dialects	Distribution in Chilean administrative regions	Distribution in other Countries	Chile	Total	Conservation status
1 Aymara	Aymara	Aymara	Aymaran		Northern (I & II)	Bolivia, Peru	50,000	>1,500,000	Currently Spoken
2 Runasimi	Quechua	Quechua	Quechuan		Northern (I & II)	Colombia, Ecuador, Peru, Bolivia, Argentina	6,000	10,000,000	Endangered in Chile
3 Uruquilla	Chango		Unclassified		Northern Coast (I–IV)	–	0	0	Extinct
4 Kunza	Atacameño	Kunza	Unclassified		Northern (I–III)	–	0	0	Extinct
5 Diaguita	Diaguita	Diaguita			Northern (III–V)	–	0	0	Extinct
6 Mapudungun	Mapudungun	Mapudungun	Araucanian		Central-South (IV–X)	Argentina	600,000	550,000	Currently Spoken
				Picunche	Central-South (IV–VIII)	–	0	0	Extinct
				Pewenche	Andean South (VIII–IX)	Argentina	5,000	?	Survey needed
				Lafkenche	Coastal South (VIII–IX)	–			
				Huilliche	South (IX–X)	–		?	Survey needed
7 Chono	Chono	Chono			South (X)	–	0	0	Extinct
8 Kawesqar	Kawesqar	Kawesqar	Alacalufan/Fuegian		South (XI–XII)	–	15	15	Nearly extinct
				Kakauhua	South (XI–XII)	–	0	0	Extinct

(continued)

Table 2.1 (continued)

Language name							Number of speakers		
Vernacular	Spanish	English	Linguistic classification	Dialects	Distribution in Chilean administrative regions	Distribution in other Countries	Chile	Total	Conservation status
9 Aoniken	Tehuelche	Tehuelche	Patagonian		South (XII)	Argentina	0	30	Nearly extinct/ extinct in Chile
10 Selk'nam	Selk'nam	Selk'nam	Fuegian		Tierra Del Fuego (XII)	Argentina	0	0	Extinct
11 Yaghan	Yaghan	Yaghan	Language Isolate/Fuegian		Southernmost Archipelagoes (XII)	Argentina	1	1	Nearly extinct/ extinct in Argentina
12 Rapanuí	Pascuense	Rapanui	Austronesian		Easter Island and Continental Chile	–	1,800 & 400	2,200	Survey needed

Data from Lewis (2009), updated from Rozzi (2002) "monetarization" (Larraín 1996). The culture of free-market society has reduced biodiversity to mere "natural resources" (see Chap. 28 by Poole et al., this volume). Philosophy could play a major role to overcome the reduction of the prevailing economic language in formal education. However, the role that philosophy education has played in the region was severely curtailed under the rule of military dictatorships, during the decades of the 1960s, 1970s, and 1980s. During that period the teaching of ethics and philosophy was suppressed and/or drastically minimized in the curricula of primary, secondary and higher education in most Latin American countries. The reopening of philosophy programs has not removed the conceptual barriers to understanding regional processes of biocultural homogenization because philosophy is prevailingly taught from Eurocentric perspectives. Ecological, social, political, economic, and cultural contexts, as well as Amerindian worldviews and Latin American thinkers are omitted (Nascimento and Griffith 2012; Rozzi 2012a, b). Instead, Eurocentric perspectives are being legitimized under the assumptions of objectivity, science, and technology (Castro-Gómez 2005a, b). Today's teaching of philosophy remains largely "blind" with regard to the unique biocultural attributes of the Latin American ecoregions.

2.2 Biocultural Ethic

The "philosophical blindness" about biocultural homogenization favors the continuity of uniform educational programs that end up serving economic mega-projects (e.g., large-scale mining, hydroelectric dams, monocultures such as eucalyptus or soybean plantations, shrimp pools or salmon-culture), which frequently cause massive losses of biological and cultural diversity, entailing socio-environmental injustice. Biocultural ethic counteracts this trend by integrating an ecological-philosophical conceptual framework that understands that the conservation of some regional habitats and life habits is critical for the identity and well-being of human and other-than-human co-inhabitants. Consequently, the conservation of habitats and access to them by communities of co-inhabitants becomes an ethical imperative.

The recovery of the understanding of habitats-habits interrelationships may seem obvious to ecologists, but it is not for philosophers because modern deontological and utilitarian ethics that prevail today address ethical matters mostly in universal terms (see Chap. 16 by Palmer, Chap. 9 by Callicott, and Chap. 20 by Northcott in this book). A biocultural ethic differs not only from the dominant modern ethics but also from the prevailing environmental ethics. It proposes a post-Leopoldian paradigm to better understand and value the role of cultural diversity. For example, in his influential essay "The Land Ethic", Aldo Leopold (1949) proposes a misleading ethical sequence that evolves from the Decalogue to the golden rule, to democracy, and culminates with the land ethic (p. 238). Such a sequence suggests a linear progress of ethics through Western history. In contrast, a biocultural ethic emphasizes that history is not linear, because multiple biocultural worldviews and ethics take place simultaneously in different cultural groups, within and beyond Western civilization, in the past and today.

It is necessary that I explain why I speak of "the recovery" of the understanding of the links between human habits and habitats. These links have been ignored by the dominant modern ethics. However, as we show below, an understanding about the interrelationships among the habits, habitats, and the identity of human and other-than-human co-inhabitants is present in (1) pre-Socratic Greek thought and the archaic meaning of the word *ethos*, (2) ancestral Amerindian and other non-Western worldviews, and (3) recent perspectives of ethological, ecological, evolutionary, biogeochemically, and health sciences (see Fig. 2.1).

2.2.1 Habitats and Habits in the Archaic Meaning of Ethos and in Contemporary Sciences

The word *ethics* originated from the Greek term *ethos*, which in its most archaic form meant a *den*: the abode of an animal.[2] The first written record of the term *ethos* is around 1000 B.C., in the Iliad and the Odyssey, where Homer used the term in its plural form *ethea* to refer to the "habitual haunts of the animals", especially the stables horses (Frobish 2003). Two centuries later, Hesiod expanded the meaning of *ethea* by using it to refer to the "habitual abodes of men," and also to the "customary *habits* of men or gods."[3] Interpreted today with concepts of ecological sciences, we can refer to the two meanings that Hesiod gives to the term *ethos* as "habitat" and "habits."

The two ecological meanings of *ethos* were used with variations by several of the lyric Greek poets in the sixth and fifth centuries B.C. Pindar used *ethos* to refer to humans and wild animals, and added a third meaning to it by introducing the distinction between the habits practiced and the innate dispositions. In the Olympians he wrote that "neither the fox nor the lion can change its *ethos*." Regarding the humans, Pindar affirmed that "it is difficult to conceal one's *ethos*." From these records of the ancient Greek poets, we can learn three facts that are relevant to establish a biocultural ethic:

(a) The original meaning of the word *ethos* refers to a *place*, the abode of an animal; in ecological terms, a *habitat*.
(b) A second archaic meaning of *ethos* refers to *customs*; in ecological terms, *habits*.
(c) The two previous meanings of *ethos* are used to refer to both humans and other animals.

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[2]For the origin of the term *ethos* see Juliana Gonzalez (1996) *El Ethos, Destino del Hombre*. Mexico City: Fondo de Cultura Económica, pp. 9–12. Nolbert Bilbeny (2012, *Ética*. Barcelona, Spain: Ariel) provides an explanation about the terms *êthos* and *éthos*. See also H. G. Liddell and R. Scott, A Greek-English Lexicon, 9th ed. (New York: Oxford Press, 1996).

[3]For a concise historical account of the meaning of the term ethos in the pre-Aristotelian period see Shirley Darcus "Daimon as a force in shaping ethos in Heraclitus," Phoenix 28 (1974): 390–407.

From these three facts, we can conclude that in its origin the concept of *ethos* implied a unified view that contrasts with dualisms that govern modern ethics. Conducted with the lens of an ecological-evolutionary hermeneutic, the etymological research also reveals remarkable coincidences between the meaning of the pre-Socratic term *ethos* and contemporary scientific perspectives. For the foundation of a biocultural ethic, both pre-Socratic and scientific perspectives offer a valuable integration of ecological and evolutionary attributes:

1. *Ethos* means both the place where one lives and the ways in which one lives; in terms of the ecological sciences, this concept integrates the *habitat* and the *habits* of the inhabitants.
2. *Ethos* refers to innate dispositions as well as to practiced or acquired habits; in terms of the biological sciences, it integrates the concepts of genotype and phenotype of the inhabitants.
3. *Ethos* is used to refer to human nature in a way much like the nature of other animals; in terms of evolutionary sciences, the phylogenetic relationships explain the degree of similarity regarding genetic, anatomical, physiological, ethological habits among different animal species, including *Homo sapiens*.

The unifying vision contained in the multidimensional meaning of *ethos* in ancient Greece, however, was lost after the fourth century B.C. with the prevalence of the work of Aristotle. The term *ethos* was used by Aristotle at the beginning of his book two of *The Nicomachean Ethics* to affirm that "moral or ethical virtue is the product of habit (*ethos*), and has indeed derived its name, with a slight variation of form, from that word" (p. 1). Aristotle focuses only on human habits.[4] He does not include non-human animals; nor does he consider the diversity of native habitats and their interrelationships with the diversity of human habits. Instead he focuses on the *polis*, the Greek city-state, and its citizens.[5] Thus, with Aristotle the habitat-habit and human-animal integrations included in the pre-Socratic meaning of *ethos*, are excluded from prevailing Western ethics.

The reduction of the scope of meaning of *ethos* that Aristotle does by focusing on citizens and excluding other humans and other animals, has endured in modern ethics. The major modern ethical schools have had as a model the habits of modern European citizens. This reduction of the scope of ethics has been functional to European colonialism: it has imposed the habits of the conqueror on the conquered "as if" these habits should be cultivated regardless of the habitats and communities of co-inhabitants where they occur. With notable exceptions, such as Bartolome de las Casas, in Latin America the ethics of the conquistadors has had little or no regard for the communities

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[4]See the analysis of Aristotle's Nichomachean Ethics by Arthur Miller in "Aristotle on habit and character: implications for the *rhetoric*," Speech Monographs (1974) 41: 301–316.

[5]A pertinent analysis of Aristotle's focus on the polis is offered by Alasdair MacIntyre (2007) "After Virtue," Third Edition. Notre Dame, Indiana: University of Notre Dame Press. See also "Aristotle's Concept of Ethos, or if not his Somebody Else's," Rhetoric Review 1 (1982): 58–63, by Michael Halloran who highlights Aristotle's focus on the polis as the milieu where the habits are cultivated.

of conquered co-inhabitants. This situation continues in our postcolonial period, under the hegemony of economic megaprojects that pay little attention to the habits and habitats of the communities where homogeneous development models are imposed.

Biocultural ethics proposes a decolonizing turn by problematizing the relationships between human habits, the habitats, and the communities of co-inhabitants. For this endeavor, interdisciplinary teamwork among ecologists and philosophers enables a recovery of the archaic meaning of *ethos* adding novel insights from scientific perspectives. Under an ecological, evolutionary perspective, the meaning of *ethos* includes both the substantive *habitat*, and the verb *to inhabit*. Both meanings become intertwined through the evolution of recurrent forms of inhabiting – i.e., *habits* – in a given habitat. In performing these habits, both the biological and the cultural identity or character of the inhabitants are formed. The moral character is cultivated by habits that involve co-evolutionary relationships that include not only citizens, but also a diversity of human and other-than-human co-inhabitants. The co-inhabitants are mutually modified by their recurrent interactions that shape their habits and habitats. Along interactions with other beings, the *ways of inhabiting* of each being evolve towards *ways of co-inhabiting* within communities of co-inhabitants. Understanding the diversity of beings as *co-inhabitant subjects* (as opposed to mere objects) expands the horizons of the moral community beyond the Western citizen community, and far beyond the human community.

2.2.2 Amerindian Habits – Habitats – Co-inhabitants, Biogeochemical Cycles and Linguistics

The holistic integration of habitats and habits, ecosystems and cultures, is also manifest in ancestral Amerindian ecological knowledge. It is notable how closely interrelated are the biophysical domains and the symbolic-linguistic domains regarding the distribution of habitats, languages, and the naming of places, humans, and other living-beings among Amerindian cultures. Stuart Chapin and collaborators (Chap. 4 in this book) report a close match between the distribution of cultures and the distribution of habitat types in northern North America. A mirror image can be found in southern South America. Compare Fig. 4.1, which depicts the Alaskan habitat types and cultural-linguistic groups, with Fig. 2.4, which shows the close matches of the distribution of habitat types and the distribution of dialects and main communities for the largest south-western South American Amerindian ethnic group, the *Mapuche*.

The Mapuche define themselves as people (= *che*) of the land (= *mapu*). Further, the names of their three main linguistic and cultural groups refer to the habitats they inhabit. The *Lafkenche, Williche,* and *Pewenche* are respectively the people of the *Lafken* or coastal habitats (36–40°S), of the *Willi* or southern evergreen rain forests (38–42°S), and of the *Pewen* or Monkey-Puzzle tree (*Araucaria araucana*) forests on the volcanic Andean mountain range in southern Chile and Argentina (37–40°S).

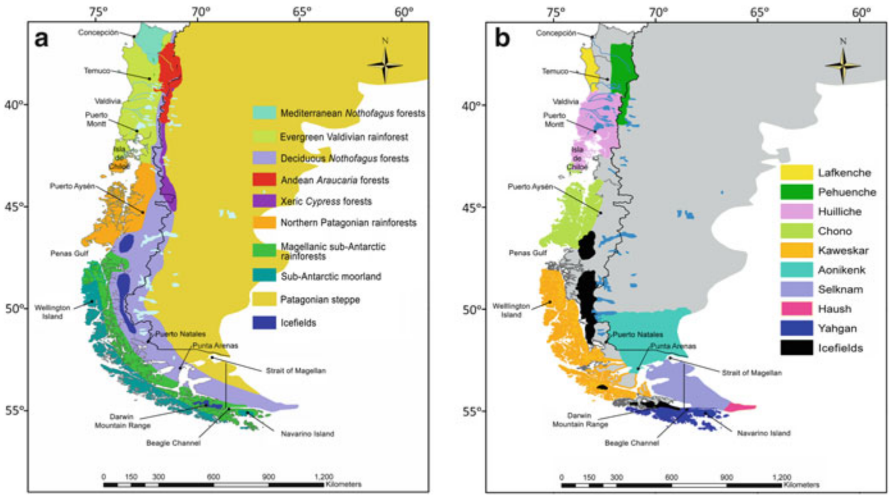

Fig. 2.4 Forest types and ethnographic maps of south-western South America. There is a high overlap between the distribution of habitat types and the distribution of cultures. (Modified from Rozzi et al. 2010)

Like native Alaskans, the *Pewenche* have been defending their territories during the last decades. Since the 1980s they have been opposing the construction of dams on the Bio-Bio river that which would flood their *Pewen* forests (Baquedano 2004). The social organization and ancestral distribution of the *Pewenche* clans is closely associated with the patches of *Pewen* trees on the volcanic soils (Aagasen 1998; Hermann 2006), and an essential habit is the gathering of *Pewen*'s seeds that provide the nutritive foundation of their diet (Tacón 1999). From the perspective of health sciences, it is relevant that *Pewen's* seeds have high levels of cysteine and methionine, the only two amino acids that contain sulfur in their molecular structure. In addition, methionine is an *essential amino acid*; i.e., the human body is unable to synthesize it. Hence a lack of methionine can cause a protein deficiency (Rozzi and Massardo 2001).

In summary methionine is an amino acid that must be obtained through an external nutritive source, such as the *Pewen* seeds. Consequently, the medical science perspective provides a functional explanation of this *Pewenche* habit. The *Pewenche* worldview also converges with an ecological perspective of the sulphur cycle (cfr. Schlesinger 2013). This biogeochemical cycle illustrates that when the *Pewenche* eat the *Pewen* seeds, they ingest the sulfur molecules that come directly from a trees, and indirectly from volcanic rocks and ashes (Fig. 2.5). Through their alimentary habits, the *Pewenche* incorporate into their bodies the molecules that were synthesized by the *Pewen* trees; therefore, biophysically they are people or "*che*" of the "*Pewen.*" In turn, the sulphur atoms of these amino acid molecules synthesized by the Pewen had their origin in the volcanoes of the land; therefore, biophysically they are also "*che*" of the "*Mapu.*" The analysis of the Amerindian names combined with the health and

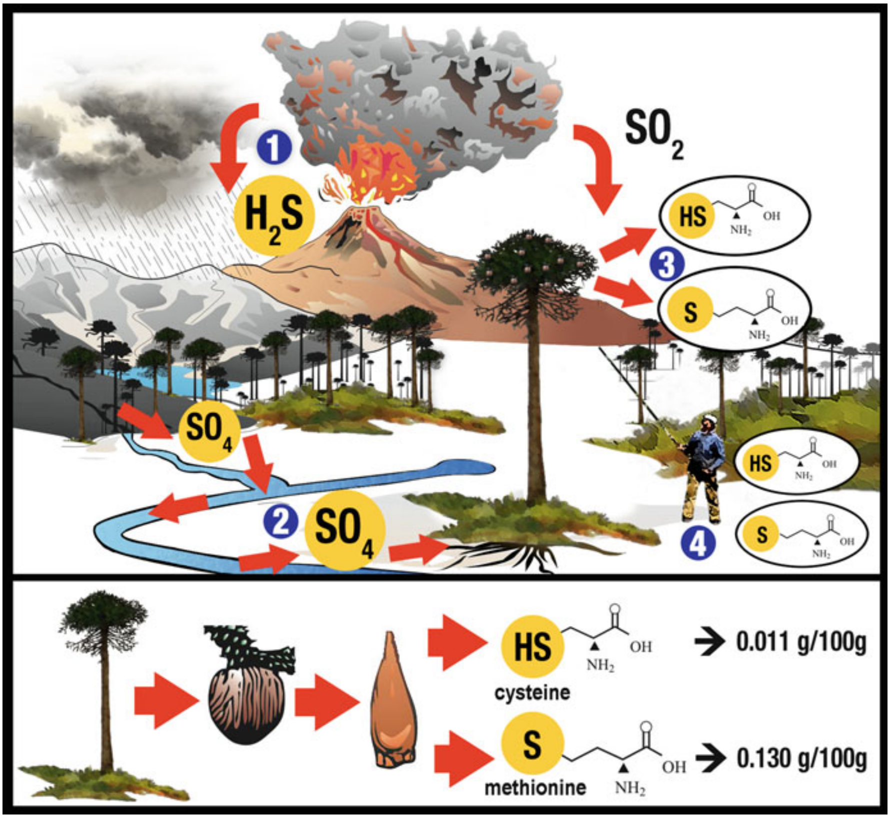

Fig. 2.5 Biogeochemical cycle of sulphur (S), including the *Pewenche* habit of gathering *Pewen* seeds in the *Pewen* forest habitats on the volcanic lands of southern Chile. (*1*) The entrance of sulfur (S) into the biogeochemical cycle comes from the volcanoes and their ash, which is transported by wind and water. Rivers bring the volcanic sulfur to the soils. (*2*) On the soils, bacteria and fungi transform, through processes of oxidation and reduction, molecules of hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) emitted by volcanoes into molecules of sulfate (SO_4), which in this chemical form can be absorbed by the roots of the *Pewen*. (*3*) Once inside the tree, a chain of metabolic reactions begins in the vegetable cells, where enzymes assimilate sulfur from the inorganic molecules of sulfate, incorporating them in a process of synthesis of organic molecules that generate the two essential amino acids that contain sulfur: methionine and cysteine. (*4*) Therefore, when the people *(che)* eat the seeds with the amino acids synthesized by the tree (*Pewen)*, they are also eating the sulfur of the volcanic land (*Mapu*)

biogeochemical sciences analyses show that both the symbolic-linguistic and the biophysical bodies of the *Pewenche* and the *Mapuche* are interwoven with their habits (gathering of *Pewen*'s seeds), their habitats (*Pewen* forests on volcanic land), and their co-inhabitants (*Pewen* trees, volcanoes, humans or *che*).

The comparative analysis between the Amerindian Pewenche worldview and the Western ecological-medical sciences did not intend to validate any of these forms of knowledge. The purpose of the comparative analysis was to achieve an intercultural dialogue and translation, and to accomplish policies that could reconcile contrasting, often conflicting, positions and interests of the stakeholders. The location of the projected dam on the Bio-Bio River was modified after observations added to the Environmental Impact Assessment of the project. However, the *Mapuche-Pewenche* rights to their ancestral lands is still in continuous peril, and their ecological knowledge and values are still largely ignored in conservation, educational, and development policies by the Chilean government (Rozzi and Massardo 2011). The Mapuche worldview and its values are, nevertheless, alive in *Pewenche* voices such as the poet Leonel Lienlaf (1989), who today writes:

Mañkean ñi dungu	**Mañkean's dream**
Umagtuken	My laughter is the midday sun,
lafken pewmamu ina nepeken	my tears are the spring waters,
challwa nepenmu.	my sleep is the rest of love,
Ayeken kümemew,	and my waking up is the life of the fishes.
Ngümaken mawünmew	Thus is my existence,
feley ta ñi mongen,	so is my word,
feley ta ñi nütram,	and the waters continue singing to me.[6]
fewla umagtuan.	

Lienlaf's bilingual (*Mapudungun* and Spanish) poems express the awareness of a common genealogy of human and other-than-human co-inhabitants, whose flows of energy and matter are interconnected. Human Beings and other beings walk together. The pain of one is the pain of the other. The water of the spring waters is the water of the tears. Biological diversity and cultural diversity beat together. The welfare of human beings and other living and non-living beings go hand in hand. In the past and today, among Amerindian as much as among non-mainstream Western cultures, we find that human habits are connected to the biocultural community of co-inhabitants. This connection seems to be the norm, and the current disconnection of global society seems to be an exception, but an exception that today is dominant and needs to be rectified.

2.3 Biocultural Conservation and Field Environmental Philosophy

The richness and value of the intricate South American reservoir of biological and cultural diversity is not appropriately acknowledged by global society today. The rhetoric of modernization and economic growth that governs globalization omits

[6] *Mañkean ñi dungu* (El sueño de Mañkean) in Leonel Lienlaf (1989) *Se Ha Despertado el Ave de mi Corazón*. Santiago de Chile: Editorial Universitaria. Translation from Spanish to English by Ricardo Rozzi.

and marginalizes the majority of humans and almost the totality of other beings. It displaces them from their native habitats and excludes them from the main discourses and laws that govern neoliberal global society. Argentinean liberation philosopher Enrique Dussel (2011) refers to the current era of globalization as *the era of marginalization of the majority*. This exclusion leads to the oppression and/or extermination of the diversity of living beings, languages, and cultures that co-inhabit South America. A higher recognition of the value of biocultural diversity demands an environmental justice that includes poor and marginalized people: the oppressed human beings side-by-side with the oppressed other-than-human beings (see Chap. 19 by Hayward, Chap. 20 by Northcott, and Chap. 21 by Mallory this book). In terms of Brazilian liberation theologian Leonardo Boff (1997) "without a minimum of social justice it is impossible to make ecological justice fully effective; the one involves the other" (p. 45). Boff radically calls for a *dignitas terrae*. Biocultural ethics coincides with Boff in this call because it acknowledges the dignity of the co-inhabitants that are currently marginalized. Biocultural ethics demands incorporating this value of the co-inhabitants subjects into development policies as a matter of socio-environmental justice.

The socio-environmental justice demanded by biocultural ethics would also contribute to achieve socio-environmental sustainability at the planetary level. South American ecosystems play a critical role in the regulation of climate and conservation of biodiversity at the world level. What happens to the climate in Asia and other continents depends in part on the conservation of the forests in the Amazon. In turn, what is happening today in the Amazon depends partly on environmental policies in Asia and other continents. Therefore, today a South-North, East-West, planetary interregional biocultural ethic is imperative.

In the ecosystems of South America a plethora of past and current cultures has developed environmental worldviews and sustainable ecological practices, which are adapted to heterogeneous environmental conditions. The value of these worldviews and practices for environmental ethics has only recently begun to be considered by philosophers. The Cuban intercultural philosopher Raul Fornet-Betancourt (1998) criticizes that the history of philosophy shouldn't be reconstructed on the basis of an expansionary Eurocentric development, but by means of the diversity of all cultures of humankind. Intercultural philosophy is a means for making the variety of voices heard, and achieving a just sustainable global society. Biocultural ethics coincides with Fornet-Betancourt regarding the need of an intercultural dialogue. However, it attempts to take a step further: to gain awareness about the coexistence of diverse life forms, and to recover the capacity of citizens to communicate with the diversity of humans and the diversity of other-than-human beings, as well. This biocultural communication is not merely rational or verbal; it also requires the involvement of corporality, affection, and the experience of co-inhabitation in everyday life.[7] Biocultural communication can be cultivated not only in remote

[7] The Chilean neurobiologist Francisco Varela and his collaborators (1995) developed an epistemology and ethics that integrates affective, physiological and psychic dimensions. Regarding interspecific communication among plants and animals, including *Homo sapiens*, see the recent line of interdisciplinary research in ecological semiotics by Kalevi Kull and collaborators (2009).

places such as Cape Horn or Alaska, but also in the everyday habitats of cities (see Chap. 7 by Klaver, in this volume; Taylor 2010).

Since the 1960s, Latin American liberation philosophy and liberation pedagogy have emphasized the need to enhance the expression of pluri-versal epistemologies and local histories of communities that exist at the borders of globalization (Rozzi 2012b). Liberation philosophy (Dussel 1980), liberation theology (Gutiérrez 1973), and liberation pedagogy (Freire 1970) have criticized both epistemological and economic colonialism. They have focused on the severe oppression suffered by the growing number of poor human communities, who today live mostly in the slums of cities. Biocultural ethics complements liberation philosophy by emphasizing that to achieve equity and sustainability we have to also criticize colonial anthropocentrism, and regain a perspective of co-inhabitation that integrates the well-being of both human and other-than-human co-inhabitants. For this task the collaboration between philosophers and ecologists is essential. Biocultural ethics builds on the tradition of Rachel Carson and Aldo Leopold (see Chaps. 13 and 14 by Cafaro and Meine, this volume), but it also incorporates a geopolitical dimension. Epistemological, political, economic, and ethical arguments and advocacy are being built from within each region, and today these arguments and advocacy acquire an interregional global scope.

At a global scale, biocultural ethics emphasizes that many communities exhibit sustainable and respectful forms of co-inhabitation (Callicott 1994). It also clarifies that many of the major environmental problems are caused by a few identifiable agents (Rozzi and Feinsinger 2001). Therefore, it is distorted, and unjust, to analyze global environmental change in terms of a general problem between humanity and the environment. To rectify this distortion, biocultural ethics needs to identify and to sanction specific agents that are responsible of socio-environmental problems. Complementarily, it also calls attention to better incorporate the diversity of local sustainable ecological practices and forms of knowledge into policy, economy and formal education. Toward this goal, at a local scale, we established the Chilean Long-Term Socio-Ecological Research network (LTSER-Chile) where we have developed a methodological approach that provides a guide for participants to theoretically and experientially understand biocultural ethics: "field environmental philosophy" (FEP) (Rozzi et al. 2012).

The adjective *field* highlights three levels of experience. First, in the field it is possible to perceive and research components and processes of biocultural diversity that are often omitted or distorted in formal education, public policy, and the prevailing discourses of global society. Second, in the field participants gain an integral, *in situ*, perception of biocultural diversity by engaging their senses, emotions, and rationality in the interactions with other beings, embedded in their biophysical, symbolic-linguistic, and/or institutional habitats. Third, and most importantly, in the field "face-to-face" encounters with other human and other-than-human beings transform the understanding of biocultural diversity: it ceases to be a mere concept and begins to be an experience of co-inhabitation, where other beings cease to be mere objects of study and acquire the status of co-inhabitant subjects.

Within the FEP approach, I define subjects as (i) autonomous beings that resist being fully comprehended by scientific models and concepts, and escape determinism by undertaking life-paths different from those scientifically predicted, and (ii) beings that have dignity (*sensu* Boff 1995, 1997), and accordingly demand moral consideration as co-inhabitants. The concept of *co-inhabitant subjects* liberates scientists and other participants from the notion of "control of nature" and the consideration of other living beings as mere "natural resources" (see Chap. 28 by Poole et al. and Chap. 21 by Mallory, in this volume).

The adjective *environmental* in the title of the FEP methodological approach makes explicit the goal of overcoming the reduction of ethics to purely human affairs. It emphasizes that human existence is immersed in co-inhabitation relationships within communities of human and other-than-human co-inhabitants.

Finally, I call this methodological approach field environmental *philosophy*, and not merely field ecology, because it integrates *epistemological* and *ethical* dimensions. Participants address *epistemological* questions to investigate not only biological and cultural diversity, but also the methods, disciplines (sciences, humanities and arts), languages, and worldviews through which scientific and other forms of knowledge about biological and cultural diversity are forged. Participants also conduct comparative *environmental ethics* analyses of selected philosophical, ethnographic, and ecological texts, and investigate the biophysical, symbolic-linguistic, and socio-ecological dimensions of the habitats and habits of the communities of co-inhabitants. The ultimate goal of FEP, however, is that participants do not limit themselves to only learning about biocultural diversity, but also explore respectful, sustainable ways of co-inhabitation.

To effectively implement FEP in collaboration with the Regional Government of the Chilean Magellanic and Antarctic Region, the regional public university (Universidad de Magallanes, UMAG), and a non-governmental organization (Omora Foundation), we created the Omora Ethnobotanical Park in Cape Horn in 1999, and the international Sub-Antarctic Biocultural Conservation Program in 2004.[8] This multiple scale approach enabled the creation of the UNESCO Cape Horn Biosphere Reserve in 2005. Building of institution and infrastructure has enabled *in situ* transdisciplinary teamwork in education, policy and decision making, and innovative ecotourism programs that integrate ecological science and biocultural ethics to achieve biocultural conservation. For example, with the FEP methodological approach the Omora Park team created "Ecotourism with a Hand-Lens" to enhance the appreciation of the austral bryoflora, while at the same time providing a sustainable source of income for local communities in Cape Horn (Rozzi et al. 2008b; Goffinet et al. 2012). Today, authorities, teachers, tourist operators, and the local community of Cape Horn appreciate not only roses and apples, as it was the case in 2000, but they also appreciate mosses, liverworts, and lichens, as well as their ecological, aesthetic, economic, and ethical values.

[8]The international Sub-Antarctic Biocultural Conservation Program is coordinated by UMAG and the Institute of Ecology and Biodiversity (IEB) in Chile, and, by the University of North Texas (UNT) in the USA (www.unt.edu, Rozzi et al. 2006, 2010).

A change of habit (observing and appreciating with a "hand-lens" the little sub-Antarctic flora) stimulated the conservation of a habitat (the "UNESCO Cape Horn Biosphere Reserve"). A trend of biocultural homogenization was reoriented into a path of biocultural conservation. The socio-ecological challenges of global environmental change are vast and pressing. The micro-example at the southern end of the Americas shows, however, that the transdisciplinary approach of FEP enables participants to engage in an integration of biocultural ethics and ecological sciences that goes beyond a purely case-study approach, establishing also a long-term partnership for biocultural conservation. Integrating ecological sciences and biocultural ethics broadens the conceptual and methodological spectrum of long-term socio-ecological research programs. These programs have focused on the integration of ecological and economic sciences (Ohl et al. 2007, Haberl et al. 2009), and to a lesser extent other social sciences, humanities and the arts (Swanson et al. 2008). FEP complements these approaches, and today is being incorporated into sites of the International Long-Term Ecological Research Network and other UNESCO biosphere reserves. Through a long-term work originated at the south of the world, FEP guides collaborations among ecologists and philosophers which today aim contributing to regional and global sustainability of life.

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Chapter 3
Introduced Species, Homogenizing Biotas and Cultures

Daniel Simberloff

Abstract Introduced species tend to homogenize biotas, and this biotic homogenization contributes to a pervasive biocultural homogenization fostered by urbanization and commercial globalization. Antipathy towards biological invasions today is primarily focused on their many ecological, economic, and public health impacts. However, in the late 1800s and early 1900s, aesthetic considerations dominated much of the opposition to introduced species. Aldo Leopold's "land aesthetic," based on detailed knowledge of the ecology of a region and the evolutionary history of its denizens, strongly opposed introduced species on aesthetic grounds just as his land ethic opposed them on ecological grounds. Some authors contend that the animus towards introduced species is partly associated with xenophobia or nativism, and that stated aesthetic or ecological considerations mask underlying xenophobic motives. Evidence for this motivation in current views of introduced species is scant or non-existent. Unease about introduced species because of their role in biotic homogenization is certainly not based on xenophobia. Rather, it springs from the same source as the desire to preserve native languages from extinction and regional cuisines from being swamped by McDonalds and Starbucks. The struggle to redress biocultural homogenization will have to incorporate prevention of many species introductions and effective management of both newly arrived and certain long-established invaders. Technologies exist to aid this effort; the impediments are frequently more sociopolitical than scientific.

Keywords Aesthetics • Biocultural homogenization • Biotic homogenization • Invasion • Xenophobia

D. Simberloff (✉)
Ecology and Evolutionary Biology, University of Tennessee,
569 Dabney Hall, Knoxville, TN 37996-1610, USA
e-mail: dsimberloff@utk.edu

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3.1 Introduction

Introduced species are defined as those moved by humans, deliberately or inadvertently, from one region to another region that is not contiguous. Humans have been doing this for a long time. The Lapita people, colonizing Pacific islands beginning ca. 3000 BP, deliberately introduced Pacific rats, pigs, and other species to many of them (Long 2003; Steadman 2006). The entire mammal fauna of Corsica – over 25 species – is introduced. This process began ca. 5000 BP, including deliberately introduced species such as dogs and red deer and stowaways like the European hedgehog, garden dormouse, and fox; the original mammals (at least seven species) were all eliminated (Vigne 1992). Darwin (1839) in 1832 recorded vast tracts of the Patagonian pampas dominated by massive stands of two plant species – the cardoon (*Cynara cardunculus*) from Europe and north Africa and the giant thistle of the pampas (*Silybum marianum*) from southern Europe and Asia.

When travelers first noted introduced species in the eighteenth century (Chew 2011), these were regarded as curiosities or, by early biogeographers, simply as data enhancing the growing understanding of the distribution of species on earth. Darwin (1839), Marsh (1864), and Wallace (1881) were among the few early scientists to recognize introductions as what would now be called ecological problems. Aldo Leopold became increasingly concerned with the ecological impacts of introduced species after befriending Charles Elton in 1931 (Simberloff 2012a). Although Elton (1958) is often credited with founding the field of invasion biology by pointing to pervasive ecological changes caused by introduced species, in fact biological invasions were not widely recognized as a major global change and conservation concern until the mid-1980s (Simberloff 2010). An international program organized at that time by the Scientific Committee on Problems of the Environment led many scientists who had been working on particular local or regional invasions to recognize the global scope of the problem.

3.2 Objections to Introduced Species

3.2.1 Ecological, Economic, and Public Health Concerns

Antipathy towards introduced species in general or to particular introduced species has had several motivations (Simberloff 2012b). Since the recent advent of modern invasion biology, ecological, economic, and public health concerns dominate both the literature and the media discourse. Famous introduced predators such as the brown tree snake (*Boiga irregularis*) on Guam and the Nile perch (*Lates niloticus*) in Lake Victoria have globally eliminated many bird and fish species, respectively. The Burmese python (*Python molurus bivittatus*) in Florida is a recent large, fearsome invader of this ilk. Invasive plants that dominate certain landscapes, such as cheatgrass (*Bromus tectorum*) in the American West and Australian paperbark (*Melaleuca quinquenervia*) in Florida, are reviled for fostering massive fires.

Introduced parasites like the sea lamprey (*Petromyzon marinus*) in the Great Lakes and whirling disease (*Myxobolus cerebralis*) of trout in the American West, pathogens such as jarrah dieback (*Phytophthora cinnamomi*) of eucalypts in Australia and Dutch elm disease (*Ophiostoma ulmi*) in Europe and North America, herbivores like rabbits in Australia and reindeer on South Georgia – all produce obvious ecological damage and represent hundreds of less publicized cases. More recently invasion biologists have uncovered many instances in which a single introduced species has changed an entire ecosystem, for instance by altering nutrient cycles (Ehrenfeld 2010) or physical structure (Simberloff 2011a), and current research is revealing how invasions acting on the belowground biota can greatly affect the aboveground community (Simberloff et al. 2013).

Economic damage by some invaders also arouses great concern. Pimentel et al. (2002) estimate that the United States alone loses $120 billion each year to costs of damage by and management of introduced agricultural weeds, crop and forest pests and pathogens, and many others. The red imported fire ant (*Solenopsis invicta*), zebra mussel (*Dreissena polymorpha*), and Asiatic clam (*Corbicula fluminea*) each impose damage and control costs of $1 billion annually. In addition, many invasions incur costs that are more difficult to estimate because they entail loss of individuals and sometimes entire species that do not have a direct market value. Populations of raccoons, possums, bobcats, and other mammals have plummeted by 90 % in the Everglades in the wake of the Burmese python invasion (Dorcas et al. 2012) – how do we assign an economic value to these losses? The species and subspecies of birds eradicated by the brown tree snake on Guam will never be seen again – how many dollars was their existence worth? Even without such non-market losses, Pimentel et al. (2002) estimate a global cost of all invasions of ca. $1.4 trillion, 5 % of the summed GNPs of all nations. The public is increasingly aware of these large figures, but even many individuals who are not so well-informed have nonetheless recognized great personal economic costs of particular invasions, such as those of the Formosan termite (*Coptotermes formosanus*) in parts of the United States Southeast, cheatgrass in the American West, the "killer alga" *Caulerpa taxifolia* in the Mediterranean, and the golden apple snail (*Pomacea canaliculata*) in southeast Asia.

Introduced species cause enormous public health problems. West Nile virus in the United States beginning in 1999 and the alphavirus chikungunya in La Réunion beginning in 2006 are both introduced diseases spread by introduced mosquito vectors. Avian influenza beginning in 2003 and swine flu in 2009 are other recent famous invaders. Of course introduced pathogens have devastated human populations at least since the spread of Europeans, who brought smallpox to native Americans, measles to Fiji, and tuberculosis to Tierra del Fuego, all accompanied by staggering mortality (Crosby 1986).

3.2.2 Aesthetic Considerations

As noted above, widespread public and scientific concern with ecological, economic, and public health impacts of introduced species is a relatively recent phenomenon. Aesthetic objections were a dominant theme in the gardening and landscape architecture literature at the turn of the nineteenth century. For instance, in 1882, landscape architect Frederick Law Olmsted and Harvard botanist Charles Sprague Sargent quarreled on aesthetic grounds over Olmsted's desire to use exotics in a rehabilitation project along the Muddy River in Massachusetts (Zaitzevsky 1982). Ecological impacts were not an issue, but Sargent (1888, p. 266) was eloquent about the aesthetic stakes: "It is not easy to explain why certain plants look distinctly in place in certain situations and why other plants look as distinctly out of place…". He claimed that nonindigenous species "inevitably produce inharmonious results." Olmsted (1888, p. 418) admitted that "planting far-fetched trees with little discrimination has led to deplorable results" but would not "taboo all trees coming from over the sea." Even Alfred Russel Wallace, one of the few nineteenth century scientists to lament ecological effects of introduced species, in addition expressed a sharp aesthetic preference for those of his native England: "A hill of gorse, or of heath, a bank of foxgloves & a hedge of wild roses & purple vetches surpass in *beauty* anything I have ever seen in the tropics" (Raby 2001, p. 159).

As Aldo Leopold became progressively more concerned with ecological impacts of introduced species following his meeting with Elton, he also increasingly expressed an aesthetic distaste for foreign plants and animals (Simberloff 2012a). Callicott (1983) attributes this change to a "land aesthetic," "a systematic theory of natural beauty and the criteria for its appreciation" (Callicott 1994, p. 170) that Leopold developed simultaneously with the maturation of his land ethic. Callicott (1983, 2008) describes this land aesthetic as a rejection of the formalist "surface aesthetic" that long governed Western perceptions of natural beauty, as epitomized by classical European landscape painting (see Chap. 10 by Lintott and Carlson, this volume). Leopold's aesthetic, by contrast, rested heavily on a profound understanding of the ecological structure and dynamics of a natural entity, as well as its evolutionary history – in short, it marched apace with his land ethic.

Leopold's writings are rife with trenchant depictions of the aesthetic discords wrought by introduced species, and he frequently appealed to aesthetic metaphors when describing the advantages of native over introduced species (Simberloff 2012a). Some passages drip with sarcasm: "Through processes of plant succession predictable by any botanist, the prairie garden becomes a refuge for quack grass. After the garden is gone, the highway department employs landscapers to dot the quack with elms, and with artistic clumps of Scotch pine, Japanese barberry, and Spiraea. Conservation Committees, en route to some important convention, whiz by and applaud this zeal for roadside beauty" (Leopold 1949, p. 268). Leopold argued that, because introduced species did not coevolve with the native communities in which they are embedded, they are highly prone to be ecologically disruptive. Hence they are inimical to land health, and by definition they could not accord with his land aesthetic (Simberloff 2012a).

3.2.3 Xenophobia

While ecological and economic impacts, as well as aesthetics, have at various times been prominent reasons for antipathy towards introduced species, the degree to which xenophobia has been a motive is not always so clear. Several historians, philosophers, sociologists, anthropologists, and garden and landscape architects have attacked the field of invasion biology as ridden with xenophobia. They see activities to counter introduced species as either displaced nativism or at least springing from the same sentiments as nativism and mixing with it (Simberloff 2003, 2011b). Historian Philip Pauly (1996), for instance, contended that, during the Progressive Era, "attitudes towards foreign pests merged with ethnic prejudices: the gypsy moth and the oriental chestnut blight both took on and contributed to characteristics ascribed to their presumed human compatriots" (p. 54) and that "it should be clear that attitudes about foreign and native organisms were intimately linked, through both everyday experience and analogies of policy, to views on 'alien' and 'native' humans" (p. 70). In this instance, Pauly simply ignored the widespread public and scientific concern with ecological and economic impacts of specific invaders (including the gypsy moth and the chestnut blight) that clearly inspired the laws and activities he decried (Simberloff 1996, 2003). Raffles (2011) similarly charges those who combat biological invasions with blind nativism, pointing to benefits of some of the most reviled invaders, as well as ecological damage caused by certain native species, but he presents no evidence.

In other cases, particularly in the late nineteenth and early twentieth centuries, there can be little doubt that some of the animosity towards introduced species is linked to xenophobia (Coates 2006). For example, Jens Jensen, prominent American landscape architect, declared, "The gardens that I created myself shall, like any landscape design it does not matter where, be in harmony with their landscape environment and the racial characteristics of its inhabitants. They shall express the spirit of America and therefore have to be free of foreign character as far as possible… the Latin and the Oriental crept and creeps more and more over our land, coming from the South, which is settled by Latin people, and also from other centers of mixed masses of immigrants. The Germanic character of our race, of our cities and settlements was overgrown by foreign [character]. Latin has spoiled a lot and still spoils things every day" (Jensen 1937, cited in Wolschke-Bulmahn 1995).

Stated aesthetic preferences for native species are often said to be masking xenophobia or nationalism. The German garden architect Joachim Wolschke-Bulhman accuses the garden architect Willy Lange (1864–1941), an early advocate of "nature gardens," of nationalism and racism because Lange forswore use of exotic plants (Wolschke-Bulmahn and Gröning 1992; Wolschke-Bulmahn 1992, 1995, 1997a, b). Lange believed that native plant gardens somehow suit the temperaments of the native people of a region. Even Wallace, who pointed early on to the ecological devastation wrought by some invaders, was accused of being a nationalist, based on his aesthetic attraction to English plants (Helmreich 1997).

At least as early as von Humboldt (1806), some artists, critics, and philosophers have asserted that peoples of particular regions have innate psychological traits (including aesthetic preferences) shaped by the climate and habitat in which they originally dwelled. Although the implied genetic basis for such aesthetic preferences seems highly questionable today, one can easily imagine that familiarity with particular landscapes, particularly during one's formative years, can lead to aesthetic predispositions even without a genetic basis. Certainly Wallace did not advance a genetic explanation for why he found English plants so appealing. Leopold's land aesthetic could also explain why at least some residents of a region, those well educated in the ecology and evolution of the local biota, would find introduced species aesthetically discordant. Surely not all objections to introduced species on aesthetic grounds are in fact expressions of xenophobia. Because of their upbringing, different peoples favor different foods and can barely stomach certain traditional dishes of other cultures. Yet we do not call Americans revulsed by surströmming or durians xenophobes. Why should aesthetic tastes be viewed differently in this respect than culinary tastes?

3.3 The Biocultural Homogeocene

Antipathy towards introduced species has also been inspired not by their foreign origins *per se* but rather by the fact that their very presence, even if it increases local biodiversity, tends to lessen differences between regional biotas and therefore to obliterate a form of biodiversity. Putz (1998) envisions the increasing dominance of non-native species culminating in the "Homogeocene era," in which biotic differences among regions are gradually erased as all areas come to be dominated by a set of global animal and plant "weeds." McKinney and Lockwood (1999) termed this process "biotic homogenization," and they and others have provided statistics on the degree of this homogenization for various biotas (e.g., Lockwood and McKinney 2001; Olden et al. 2006; Marchetti et al. 2006). For example, pairs of American states now share, on average, 25.2 freshwater fish species, whereas before European settlement these same areas shared on average 9.8 species (Rahel 2000). Urbanization is one of the driving forces of biotic homogenization, because the urban habitat tends to be far more similar between globally separate regions than does natural habitat (McKinney 2006) – cities everywhere are largely constructed to meet the requirements of the modern industrial and economic society that increasingly dominates the globe. Thus urban-adapted species tend to thrive in cities even where they are not native; rock doves (*Columba livia*), originally from Europe, north Africa, and western Asia, are now found in almost all countries, the quintessential urban bird and homogenizing element.

Ritzer (1993) has termed the homogenization of cultures through increased global domination by multinational corporations "McDonaldization," and it is striking that Hettinger (2001) used the same metaphor for the threat posed by introduced species. In Hettinger's view, to engage public support for programs to reduce biological invasions, rather than focusing simply on the non-native origin of introduced species, one should point to the diminution of the world's distinct biotas as analogous to the commercial globalization that inspires actions to keep McDonald's out of India or Walmart out of New England towns. Coates (2011) made the same argument, in this instance using Starbucks as the symbol of globalization, with respect to the British campaign to prevent the American gray squirrel from eliminating the native red squirrel. As he put it, it is "socially and culturally progressive as well as ethically sound – to preserve national and regional distinctiveness and embattled minorities in a world of rampant globalization that threatens us with suffocating sameness. In other words, the campaign involves the same commitment to cultural survival, community identity and diversity that fuels the championing of local cheeses and apples against the tasteless universalism of the products of international agribusiness" (p. 46). Antipathy towards introduced species on this basis is not inherently xenophobic, as it is targeted not on the foreignness of introduced species *per se*, but rather on how their very presence (over and above any ecological impacts) tends to obliterate diversity. Certainly the right of societies to attempt to maintain their cultural distinctiveness has been widely accepted, as witness, for example, proclamations by the Council of Europe (2000) and UNESCO (2001). Can society not also wish to maintain biotic distinctiveness without being accused of xenophobia?

The term "biocultural diversity" was perhaps coined in 1996 at a conference in Berkeley. This concept recognizes biological, cultural, and linguistic diversity as aspects of the same phenomenon, as adumbrated by the Declaration of Belém (1988) to the effect that an "inextricable link" exists between cultural and biological diversity (Maffi 2010). By 2001, an edited volume (Maffi 2001) contained many explorations of the connections among biological, cultural, and linguistic diversity and possible causal relationships among them. Among recognized threats to both cultural and linguistic diversity were homogenization (Norgaard 2001). Rozzi et al. (2008) then extended the notion of biotic homogenization to the entire associated complex of biocultural diversity.

Rozzi (2012) suggests that biotic homogenization and urbanization, along with linguistic and cultural homogenization, are leading to "biocultural homogenization." With more than half of the world's population now living in cities, the majority of inhabitants have limited intimate contact with the native species of the region they inhabit, but instead perceive nature to be the globally distributed species adapted to urban environments. The three most common species in New York City are the London plane tree, Norway maple, and Asian callery pear (http://www.milliontreesnyc.org/downloads/pdf/trees_count_summary.pdf), while "A Tree Grows in Brooklyn" refers to Asian tree-of-heaven, *Ailanthus altissima* (Smith 1943). The London plane tree, a hybrid between a North American species and an Asian one, is also the most common street tree in many European cities, such as Paris, Barcelona, Amsterdam, and Hamburg (http://www.etsu.edu/arboretum/totw.html). Norway maple is the most common tree in Toronto (http://www.itreetools.org/resources/reports/Toronto_Every_Tree_Counts.pdf) and Pittsburgh (http://www.pittsburghpa.gov/green/trees.htm). Leopold (1940) railed against the fact that the Wisconsin State capitol square is planted with Norway maples; in Vermont, where the native sugar maple is the state tree, the walkway to the capitol is planted with Norway maple (S. Kuebbing 2013, personal communication). Similarly, Rozzi et al. (2003) found that city squares in the Magellanic region at the extreme southern tip of South America were utterly dominated by exotic species.

Rozzi et al. (2008) exemplify biocultural homogenization by surveys of residents of the small Chilean city of Puerto Williams, by some measures the world's southernmost city. Even when native plants are so common that they cannot fail to be noticed, most respondents give European or other exotic names, rather than the name used by the original indigenes. For instance, the dominant native shrub, *Ribes magellanicum*, was called zarza-parrilla by Spanish conquistadors because its leaves reminded them of those of a Spanish grapevine, while Anglican missionaries called it wild currant because it reminded them of European currants (Rozzi et al. 2008); the native name, "upush," is barely known, as Spanish has largely supplanted the Yaghan language. When asked for the first five plant species that came to mind, most inhabitants mentioned cosmopolitan introduced species – most frequently roses and apples. Only among Yaghan native people and elderly residents were native species most commonly listed. Further, except for these groups, residents had difficulty mentioning any plants that grew in the region, and when they did provide names, they were largely exotic species. In addition, when these other residents could name a native plant, they invariably used its Spanish name. The irony is that this area is actually a global hotspot for native biodiversity of other sorts of plants, including mosses and liverworts.

If diversity among ecological communities is valued for its own sake over and above species diversity, then it is not xenophobic to deplore the effects of introduced species in reducing such community-level (β) diversity. In this view, Brown (1989, p. 105) errs in assuming that the only justifiable objection to non-native species is their ecological impact: "This xenophobia needs to be replaced by a rational, scientifically justifiable view of the ecological role of exotic species." It is not xenophobic to feel that species are not completely interchangeable so long as they serve the same ecological function. In fact even the 1992 Rio Convention on Biological Diversity recognizes the inextricable link between biological and cultural diversity (Posey 2001) as well as the threat posed by introduced species (United Nations Environment Programme 1992; see article 8h). Objection to the homogenizing effects of species introductions, then, is not only analogous to objecting to the loss of cultural diversity, it is in fact part of the same phenomenon: concern with loss of biocultural diversity.

3.4 Return to the Heterogeocene?

One can easily get the impression that little can be done to prevent the advent of the Homogeocene, except perhaps to delay its arrival. Davis et al. (2011) suggest that many activities against invasions, especially those targeting species already established in their new homes, are futile. Mark Gardener, former director of the Charles Darwin Research Station, Galapagos, graphically captures this pessimism: "It's time to embrace the aliens. Blackberries now cover more than 30,000 ha here, and our studies show that island biodiversity is reduced by at least 50 % when it's present. But as far as I'm concerned, it's now a Galapagos native, and it's time we accepted it as such" (Vince 2011, p. 1383).

In fact, although the challenge posed by invasive species is immense, many management programs have succeeded (cf. Simberloff 2009). There is a tendency to point to failed eradication campaigns (of which several have been well-publicized, such as those in the United States targeting the gypsy moth (Spear 2005) and the red imported fire ant (Buhs 2004)) as if eradication is the only possible solution and the situation is hopeless when eradication fails. In fact, invasions can be minimized in several ways. The Convention on Biological Diversity (United Nations Environment Programme 1992) enunciated the appropriate guiding principles, with prevention of introductions being the first line of defense, early warning and rapid response (including possible eradication) when this defense is breached, and long-term management at low densities if a species becomes established (Simberloff et al. 2013).

Stringent regulations to keep species from being introduced in the first place are too infrequent. Two sorts of regulations are needed: those governing planned introductions (e.g., ornamental plants, game fish) and those aimed at limiting pathways that could bring hitchhiking organisms (e.g., insects on cut flowers, plant pathogens in timber, aquatic invertebrates in ballast water). New Zealand has mandatory risk assessment by expert committees for planned introductions and substantial border inspections to inhibit smuggling or unplanned introductions. These measures have prevented many introductions, including some that would likely have become invasive (Simberloff et al. 2013). No other nation reaches this level of security, however. In the United States, planned introductions are subject to quarantine to prevent inadvertent introduction of hitchhiking pathogens or pests, but no risk assessment is required for invasion potential. Any species can be imported so long as it is not on one of two black lists. The animal list, based on the Lacey Act of 1900, is a highly inadequate, reactive tool that lists very few species (Fowler et al. 2007). The black list of the Federal Noxious Weed Act (1974), superseded by the Plant Protection Act (2000), has approximately 100 species, a minute fraction of plant species known to be invasive. Stakeholders with interests in importing species or goods that might inadvertently carry them have consistently stymied proposed legislation to tighten these regulations.

Even with effective barriers to prevent invasion, a certain number of introduced species would overcome them. The next line of defense should be an early warning – rapid response system to monitor for invasions and generate a rapid decision on what to do about them. The effort is limited in all nations by the difficulty of detecting small, often very inconspicuous, populations and the severe limit on resources to hire personnel to seek them (and to train such persons to recognize them). To an extent the manpower shortage can be redressed by use of volunteers, as has been done effectively in some areas (e.g., New England, U.S.A.; Victoria, Australia). Even if an early warning system detects an incipient invasion, this need not trigger an eradication attempt, given limited resources. Instead, the system would probably lead to a risk assessment for likely impact and a study of feasibility of eradication. However, several factors dictate the urgency of these activities. First, because some invasions spread very quickly, the window of opportunity for eradication, which is far more likely to succeed before a species has spread widely, may be very short. Second, many introduced species remain restricted and ecologically innocuous for decades before suddenly spreading widely and becoming major pests (Crooks 2011). At least some of these time lags are broken by a changed physical environment or the arrival of a second introduced species that facilitates the first introduced species – a form of invasional meltdown (Simberloff and Von Holle 1999). In other words, a major invasion may be contingent on subsequent events. Finally, several invasions in fact were producing damaging ecological impacts from the very beginning, but the impacts were sufficiently subtle or novel that their extent was not recognized until much later (e.g., species that change soil nutrient regimes; Ehrenfeld (2010)). All these factors argue for very rapid action unless the cost would be prohibitive. A substantial risk assessment might take far too long, and in any event, if it is based on the perceived impact of the introduced population, it would not account for the possibility of an invasional meltdown. In short, a philosophy of "shoot first, ask questions later" may be appropriate for dealing with most quickly discovered introductions (Simberloff 2001).

Although eradication has been depicted as having a low probability of success (Dahlsten 1986), and several high-profile failures (Buhs 2004; Spear 2005) have buttressed this view, in fact of more than 1,000 attempted eradications, 86 % have succeeded, and these even include some long-established invaders (Genovesi 2011). The fact that the many successful eradication efforts are rarely as well publicized as the failures are tends to propagate the notion that eradication is an unpromising approach. Consider, for example, the scant publicity accorded the successful eradication of the "killer alga" (*Caulerpa taxifolia*) in California in comparison to the many accounts of failed attempts to eradicate the same species in Europe, which were even reported in the United States (e.g., Simons 1997; Naik 2001; cf. Meinesz 2001). When the species was detected in California the threat and early failed eradication projects were widely heralded (Perry and Mehta 2000; Scoch 2000). The successful eradication in California (Anderson 2005) in 2006 was reported only on an interior page of a local newspaper (Lin 2006) and unnoted in the European press (Simberloff 2009). Similarly, the threat posed by the arrival of the Asian longhorned beetle (*Anoplophora glabripennis*) in North America was cited in numerous prominent media reports. The successful culmination of a 9-year eradication campaign in Chicago was scarcely reported and only in the Chicago region, although a recent successful eradication of the same beetle in New Jersey was noted in the *New York Times* (Foderaro 2013). This contrasts with innumerable reports of the failure so far of campaigns against the beetle in Massachusetts and New York.

When eradication fails or is not an option, many possibilities exist for the long-term maintenance of introduced populations at levels that are not ecologically or economically damaging. These fall primarily in the categories of physical or mechanical control, chemical control, or biological control (Simberloff 2009; Clout and Williams 2009). All of these technologies have seen both substantial successes and also major failures, but there have been incremental improvements in all of them. Other techniques are used widely but only for particular taxa. For example, the sterile insect technique has been widely employed both to eradicate invasive insect populations and to manage them at low levels (Vreysen et al. 2007), and sex pheromones have been used to disrupt mating and thereby control several lepidopteran species (e.g., Witzgall et al. 2007). Completely new methods, rather than incremental improvements in existing technologies, have achieved successful control of certain invasions (Simberloff et al. 2013). A flurry of activity on new methods using genetic manipulation (Thresher et al. 2013) is already in the field-testing stage for dipteran and fish populations.

Aside from technological impediments, two supervening problems beset the use of many maintenance management and eradication techniques. First is the question of whether the target organisms are morally considerable, and to what degree. I have treated this issue in some detail (Simberloff 2012b; cf. MacClellan 2012). The key point is that a substantial number of people object to killing individuals of other species, even if the latter are damaging ecosystems or even threatening populations or species with extinction. For the most part this concern is focused on sentient animals, especially mammals, but some individuals would extend moral considerability even to plants. Contraceptive techniques (which are still primarily in the development stage and cannot yet be effectively implemented in the field) would resolve the issue for many people, but not all. Agar (2001), for instance, views thwarted reproduction as an infringement of the "biopreferences" at the heart of his conception of moral considerability.

The second issue derives from biocultural homogenization. Some introduced species have been so pervasive for so long that many do not even recognize them as introduced, or, if they do, view them as a constitutive part of the cultural landscape (Nuñez and Simberloff 2005). Heated controversies over removal of introduced boar from Hawaii (Burdick 2005), eucalyptus from California (Cronon 1996; Williams 2002), smooth and glossy buckthorn from the Chicago area (Shore 1997; Helford 2000), and horses and burros in the western United States (Wills 2006) exemplify this issue. In each of these instances, the introduced species is extremely common, causes demonstrable ecological harm, and yet is beloved as a traditional component of the landscape with substantial cultural importance. Some introduced species, such as horses in Patagonia (Musters 1964) and among the American Plains Indians (Ewers 1955; Fowler 1987), have become cultural icons to the extent that it is inconceivable to inhabitants that they could be problematic. Kentucky is the "bluegrass state" even though *Poa pratensis*, which is now called "Kentucky bluegrass" throughout the United States, is not native in Kentucky (Carrier and Bort 1916). Capella (1998) describes a group of native people in Patagonia who call their area "el país de Las Manzanas" (the country of apples), even though apples were introduced. Similarly, the Alutiiq on Kodiak Island, Alaska (Tennessen 2012) and Australian Aboriginal people (Trigger 2008) have incorporated certain introduced species in cultural culinary and hunting traditions. Cases such as these have driven Rodman (1993) and Hettinger (2001) to suggest circumstances under which an introduced species could be considered an "honorary native."

Cultural memory can change very rapidly (Olick and Robbins 1998), suggesting that overcoming cultural attachment to introduced species, even invasive ones, will be a daunting task. Inculcating ecological understanding and a sense of respect for the native species of a region will similarly be an uphill climb. That it may not be impossible is demonstrated by the efforts of Rozzi et al. (2008) to recover the bioculture of the Magellanic region of Chile through biocultural educational programs at preschool through university levels, based on their Field Environmental Philosophy approach. The effort has even gone so far as to rename Puerto Williams "Upushwaia," after the native Yaghan name, upush, for the dominant indigenous shrub, *Ribes magellanicum*. Whether such efforts can be replicated in many other regions remains to be seen. The splitting of former nations such as the Soviet Union, Yugoslavia, and Czechoslovakia along cultural lines and the simmering independence movements among some culturally and linguistically distinct regions, such as Catalonia, that have long been parts of other nations are prominent aspects of recent political history. These actions seem not to have engaged or been motivated by biocultural considerations, but it is not inconceivable that such a linkage will be drawn as the separations progress.

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Chapter 4
Traditional Knowledge and Wisdom: A Guide for Understanding and Shaping Alaskan Social-Ecological Change

F. Stuart Chapin III, Patricia Cochran, Orville H. Huntington, Corrine N. Knapp, Todd J. Brinkman, and Lily R. Gadamus

Abstract Alaska is warming twice as fast as the global average. These environmental changes interact with social and economic changes and have particularly strong impacts on rural indigenous communities that depend on their biophysical environment for food, access to the land and sea, and their sense of identity. Many of the observations of indigenous hunters, gatherers, and elders are consistent with those of western science, providing a strong foundation for understanding and adapting to ongoing changes. However, a commonly expressed worldview of many Alaska Natives differs from perspectives that are common in western science.

F.S. Chapin III (✉)
Department of Biology and Wildlife, Institute of Arctic Biology, University of Alaska Fairbanks, 410A Irving 1, Fairbanks, AK 99775, USA
e-mail: terry.chapin@alaska.edu

P. Cochran
Alaska Native Science Commission, 429 L Street, Anchorage, AK 99501, USA
e-mail: pcochran@aknsc.org

O.H. Huntington
Tanana Chiefs Conference, Wildlife and Parks,
122 First Avenue, Suite 600, Fairbanks, AK 99701, USA
e-mail: orville.huntington@tananachiefs.org

C.N. Knapp
University of Alaska Fairbanks, PO BOX 752054, Fairbanks, AK 99775, USA
e-mail: corrieknapp@yahoo.com

T.J. Brinkman
Scenarios Network for Alaska and Arctic Planning, University of Alaska Fairbanks,
3352 College Road, Suite 200, Fairbanks, AK 99709, USA
e-mail: tjbrinkman@alaska.edu

L.R. Gadamus
Kawerak, Inc., PO Box 948, Nome, AK 99762, USA
e-mail: lilyray7@gmail.com

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This indigenous worldview recognizes people as integral components of the ecosystems they inhabit, connected by both biophysical and spiritual ties and motivated by respect for the natural environment and its human, non-human, and spiritual residents. This ethic of respect and reciprocity dictates a responsibility to foster the long-term well-being of all of Earth's residents. This is consistent with a paradigm of stewardship that seeks to shape trajectories of change in ways that foster ecological resilience and human well being. We suggest that indigenous worldviews offer perspectives that can contribute substantially to efforts that foster global sustainability.

Keywords Alaska • Climate change • Indigenous • Reciprocity • Traditional knowledge

4.1 Introduction

Air temperatures in Alaska are increasing twice as fast as the global average. This has led to a shrinkage of summer sea ice, a shortening of the snow-covered season, warming and thawing of permafrost, which together have altered the structure and functioning of northern ecosystems and impacted their human and non-human residents. These ecological changes include more extensive wildfires, upward and northward movement of treeline, outbreaks of forest insects, and changes in the distribution and abundance of animals on which rural people depend for food. These facts are well documented, and the trends are expected to continue or accelerate (ACIA 2005; IPCC 2007; Shulski and Wendler 2007). They also suggest that northern ecosystems may be approaching or already have crossed tipping points into new system configurations (Lindsay and Zhang 2005), with important (but poorly understood) consequences for rural Alaskan communities.

Hunters from indigenous communities frequently describe their observations of the thinning sea and river ice that makes harvest of wild foods more dangerous (Ford and Furgal 2009; Loring and Gerlach 2010; McNeeley and Shulski 2011; Moerlein and Carothers 2012), changes to permafrost that alter spring run-off patterns, changes in seasonality of vegetation and animal movements (McNeeley and Shulski 2011), a drying landscape with increasing wildfire (Chapin et al. 2008; Ray et al. 2012), a northward shift in seal and fish species, and rising sea levels with more extreme tidal fluctuations (Downing and Cuerrier 2011; Krupnik and Jolly 2002; McNeeley 2012). These and other indigenous observations indicate a widespread awareness that climate is changing in ways that were not anticipated from traditional knowledge. Although western and indigenous observers often make similar observations, the context for interpreting their significance frequently differs.

Environmental and ecological changes are nothing new to Alaskan indigenous residents, who have lived off the land and sea for thousands of years. Over the millennia indigenous people have developed a traditional knowledge that allowed

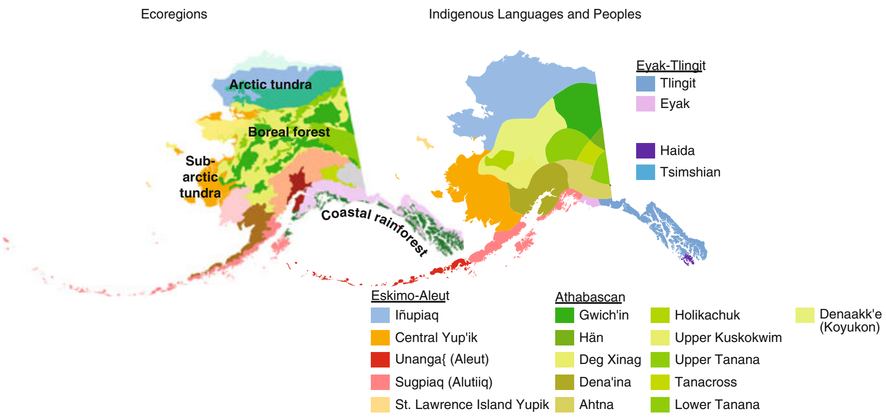

Fig. 4.1 Maps of ecosystems and cultural (linguistic) groups in Alaska. The close correspondence between these maps shows the tight linkage between ecosystem and society (Chapin et al. 2009)

them to survive, and often thrive, in the landscapes and seascapes of the North (Huntington and Watson 2012; Langdon 1986). Moreover, the weather, environment, and plant and animal populations are so variable, both seasonally and among years, that indigenous people have developed skills to cope with a wide range of conditions. These include use of a shifting suite of subsistence resources, flexibility in hunting locations, and sharing of harvested resources. Given the close connections between indigenous people and environment and the rapid environmental changes occurring in Alaska (Fig. 4.1), Alaska Natives are well poised to observe climate change, understand its ecological and societal consequences (Krupnik and Jolly 2002), and develop potential response strategies.

More challenging than the northern environmental changes are the socio-economic and cultural changes encountered by Alaska Native Peoples. Russian and European colonization of Alaska initiated a relationship between people and the land that differed fundamentally from that of its original inhabitants, who were an integral part of the ecosystems that they occupied (Watson et al. 2003). For example, Russian fur traders on the coast of Alaska and Canadian fur traders in interior Alaska viewed ecosystems as a source of materials to be extracted and exported for profit. Similar motivation launched a fishing industry in coastal Alaska and a gold rush in interior Alaska in the early twentieth century, which stimulated a large population influx of Euro-Americans (Naske and Slotnick 1987). European diseases reduced the Native population of Alaska substantially, causing huge social disruption. This coincided with missionary efforts to convert people to Christianity as a replacement for traditional beliefs (Jetté 1911).

The introduction of non-indigenous worldviews and efforts to convert Native people to these views set the stage for policies of assimilation that continue today. In the 1950s compulsory education required that families shift from their traditional semi-nomadic lifestyle to permanent residence in a single location for most of the year.

Public education was intended to provide the skills and knowledge needed to succeed in white society, for example by teaching English and punishing children for speaking their own language or celebrating their own cultures. In 1971, the United States federal government settled the land claims of Alaska's Native people through the Alaska Native Claims Settlement Act (ANCSA), through which Native corporations were established. The new corporations, a novel institutional framework for Alaska Natives, received title to 45 million acres of land and payment for the remaining approximately 300 million acres of land, which were transferred to state and federal ownership. Through ANCSA, Native Alaskans gave up management of natural resources on government land, including traditional hunting and gathering practices (Ross 2000). Standardized tests in public schools, Alaska state laws and regulations that do not recognize the federally mandated rights of indigenous tribes, and the expectation that indigenous people will adopt and use western institutions for self-governance and infrastructure maintenance perpetuate these pressures for assimilation.

Despite pressures for assimilation, ANCSA precipitated a growing pride and advocacy for indigenous traditions and worldviews that guide tribal governance and management in most rural communities. These indigenous traditions are being incorporated, to a greater or lesser degree, in many schools in Alaska. Nonetheless, the tension between traditional worldviews, which are generally strong in rural communities and Euro-American worldviews, which dominate in cities and in most state agencies, present ongoing social and legal challenges for people living in rural communities.

Although most Alaskans live in cities, the majority of the land area is sparsely populated by a largely indigenous population living in small communities with no road access and no connection to the electrical grid. Excluding the oil-rich North Slope, rural Alaska is the most extensive area of poverty in the United States, in terms of household income (frequently \$5,000–\$15,000 per household), yet has the highest costs of fuel (e.g., \$7–12 per gallon) and other commercial goods because of the physical isolation of these communities. In rural areas, people depend on motorized transport such as boats, snow machines, and four-wheelers. This technology makes harvest of wild foods more efficient but also requires participation in the cash economy in villages where few jobs are available. Given these stark economic realities, indigenous people in rural Alaska depend directly on the local environment for food, transportation, and survival and have a strong interest and need to understand and manage the consequences of climatic and socio-economic changes.

In this chapter, we suggest that the traditional worldviews of Alaska Natives provide a guide (Fig. 4.2) that is well-suited for adapting to the changes occurring in rural Alaska and provide general lessons that global society should assimilate to move toward more sustainable trajectories of change. We then suggest changes in governance that would improve opportunities for communities to adapt effectively, based on their own worldviews, to the rapid changes occurring in the modern world.

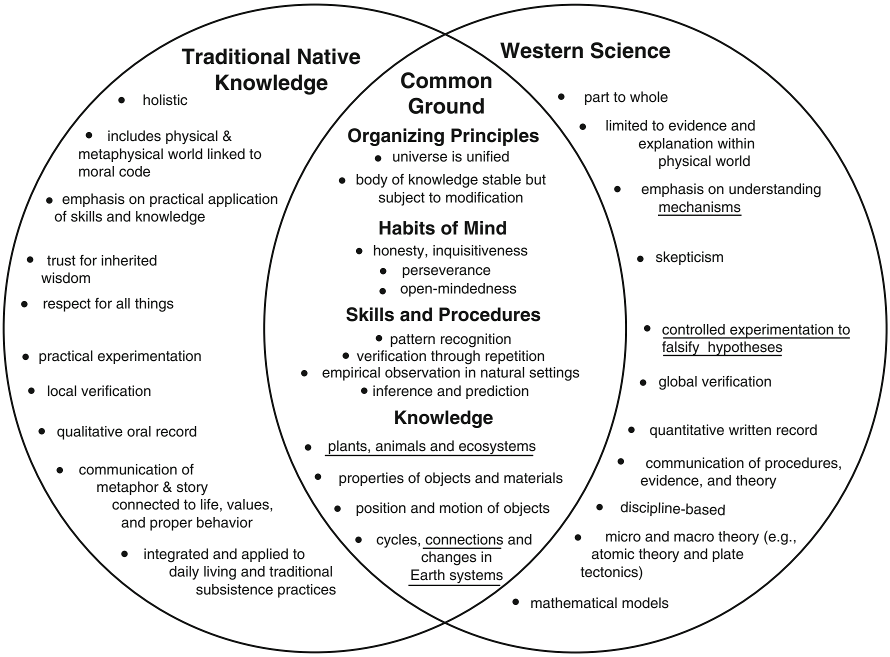

Fig. 4.2 Similarities and differences between traditional Native knowledge and western science (Sparrow et al. 2006) (Modified with permission from Stephens (Stephens 2000), with the modifications underlined)

4.2 Alaska Native Worldviews

Just as in any society, there is a breadth of worldviews among Alaska Natives. However, certain elements frequently emerge. These reflect a holistic framework that has only recently been recognized by western scientists as an important alternative to reductionism. Indigenous cultures view ecosystems as complex self-organizing entities in which all things are connected – the land to the air and water, the earth to the sky, the plants to the animals, the people to the spirit (Deloria 2001b; Wildcat 2009). All components have synergistic roles (Deloria 2001a), similar to the western concept of complex adaptive systems (Levin 1999). The indigenous worldview recognizes connections between the Inuit hunter who falls through the thinning sea ice, melting glaciers in the Andes and the Himalayas, and the flooding of low-lying and small island states (Galloway 2010; Nakashima et al. 2012). This indigenous perspective is consistent with the recognition of Earth as a coupled social-biophysical system in which arctic changes exert important feedbacks to the Earth System (ACIA 2005; IPCC 2007).

There are also important differences between indigenous and western scientific worldviews. Alaskan indigenous perspectives often emphasize *relationships* between people and other living and non-living entities ("how to"), whereas western science tends to emphasize *facts* ("what is") (Cochran et al. 2013). Alaskan indigenous cultures thus recognize important relationships between people and other living and non-living entities and the ethical responsibilities to act respectfully toward them (Huntington and Watson 2012). For example, an ethic of respect dictates that hunters should not harvest more fish or game than are needed for their families or those (e.g., elders) with whom they share. Both traditional stories and modern news reports indicate a spectrum of commitment to this ethic, just as there is in any society toward its guiding ethics. In some communities catch-and-release fishing or use of satellite collars to monitor animal movements are viewed as disrespectful "messing with the animals" rather than treating animals respectfully as a source of food, when an animal "gives itself" to the hunter or fisher (Morrow and Hensel 1992). Analogously, if fishers obey fish-closure regulations that prohibit fishing to protect declining salmon stocks, they are not respecting the harvest opportunities that fish are providing. Not to fish under these circumstances is thought to be disrespectful and might cause the fish not to return in the future (D'Oro February 15, 2013).

Given these important differences between western and indigenous worldviews, it is important *not* to attempt to merge them into a single framework but to recognize respectfully what each has to offer in solving the challenges faced by modern society. Since western-based science is not well-equipped to validate traditional knowledge conclusions about the natural world, indigenous worldviews and ways of knowing have been largely ignored and thus unwittingly marginalized in western scientific literature and assessments (Cochran et al. 2013; Huntington 2000; Huntington et al. 2005; Huntington and Watson 2012).

Native cultures and sense of identity are directly tied to the places where people have lived for generations through observations, riddles, stories, dances, art, language, music, and traditions (Huntington and Watson 2012; Wildcat 2001). The plants and animals in these places are viewed as relatives that share the world – not as resources to be exploited (Morrow and Hensel 1992; Wildcat 2009). This strong sense of place and sense of connection to the organisms that inhabit this place makes climate change, expanding wildfire, and other human impacts a much deeper and more personal consequence than in communities that view the environment primarily as a place to live, work, and extract resources (Huntington et al. 2006; Ray 2011). Respect for elders and the natural environment, for example, are commonly held community values, and traditional stories of biophysical and spiritual ties between people and nature reflect these values across most of Alaska's indigenous cultures, despite important cultural and environmental differences in the specific ways in which people interact with their environment (ANKN 2012; ANSC 2003–04).

The biophysical and spiritual dimensions of indigenous worldviews are linked by an ethic of respect for other people and for living and nonliving entities both locally and globally. This ethic can guide adaptation to current and emerging conditions (Huntington and Watson 2012). Within this framework, it would be irresponsible for an individual who recognizes human violations of this ethic of respect not to take actions to improve the respectful relationship between people and the rest of nature. This is strikingly different than the norm in western science, in which scientists are expected to objectively document the facts, recuse themselves from taking social action, and deliver the information to policy makers and civil society, which can then independently decide whether or not to take action (the loading-dock model of science). In this sense, indigenous worldviews may be better suited than western science to shape the rapidly changing future in ways that enhance ecosystem resilience and human well-being.

Given the enormity and urgency of global environmental and social changes, many western scientists are increasingly recognizing the importance of developing more effective linkages of knowledge to action. We suggest that indigenous worldviews provide guidance in fostering this needed paradigm shift. Stewardship is an emerging framework for actively shaping pathways of change in social-ecological systems to enhance ecosystem resilience and human well-being (Chapin et al. 2011; Steffen et al. 2011). This framework blends the knowledge from science with the social justice concerns that emerge from religion, conservation, political ecology, and other roots and has much in common with indigenous worldviews.

4.3 Connecting Western Science with Indigenous Worldviews

Given the substantial differences between western science and indigenous worldviews, how can western scientists and managers learn from traditional knowledge and wisdom, and how can people work effectively across cultures to address shared concerns? Rather than attempting to provide general solutions, we describe some of our own observations and experiences at the interface between traditional knowledge and western science. In this section, each of the coauthors provides complementary perspectives on the roles played and lessons provided by traditional knowledge and western science.

Patricia Cochran: "The Alaska Native Science Commission (ANSC) is a non-profit organization with a mission to endorse and support scientific research that enhances and perpetuates Alaska Native cultures and ensures the protection of Indigenous cultures and intellectual property. ANSC was established in 1994 through a grassroots resolution from the Alaska Federation of Natives Annual Convention. One of its major goals is to provide information to Alaska Native communities regarding science and research that impacts their health, life, culture, and environment. ANSC has conducted meetings with Native communities throughout all the regions of Alaska to identify and address science-related issues and concerns and to document traditional knowledge on a first-of-its-kind searchable database (www.nativescience.org and www.nativeknowledge.org). ANSC utilized "traditional talking circles" with a trained facilitator to gather information for the websites. The Talking Circle has been used throughout history but has gained prominence as a teaching tool, a therapeutic tool, and a support-group system. As an advocate for Native Science, ANSC provides leadership and vision to assist communities in development and sustainability by providing training and technical assistance and facilitating a climate for developing partnerships between researchers and communities. At the international level, ANSC collaborates with indigenous communities to bring together scientists, Native leaders and others, to share information and experience in the development of opportunities for continuing collaborations. These collaborations have led to partnerships such as the Indigenous Peoples' Global Network on Climate Change, UNEP's Many Strong Voices alliance between the Arctic and SIDS, and the creation of the Arctic Alliance, an alliance among Arctic Indigenous Peoples' and NGOs."

Orville H. Huntington: "Most Alaska Native students who are taught to conduct research to monitor and manage fish and wildlife populations begin with a foundation of skills and knowledge as tribal hunters and gatherers, who have first learned from their Native Elders and their own experience on the land. Unlike the Western scientists who are educated in schools, there is a particular spiritual component to our ways of knowing that we rely on to live our lives in harmony with nature. This spirituality is fundamental to the ways that our Native American tribes observe, act and live within our holistic ecologies, resulting in both direct and indirect management of many natural systems on our Mother Earth (Deloria and Wildcat 2001; Huntington and Watson 2012). The ancient ways of our people were and always will be steeped in riddles so that our ways can be retained in our long-term memory and oral tradition. Whenever our Native American Elders spoke of observations in nature, about luck (or lack thereof) and stories of intuition, it was with strict conviction and knowledge of our inter-relationships between our natural and spiritual worlds. Although many have spoken about how our ways affect us in our living world, this knowledge is not in any textbook, is rarely understood or used, and is referred to as "anecdotal" by western scientists (Huntington and Watson 2012). However, any western scientist can learn from the knowledge that is held in trust by Native American tribes for their people, and this way of knowing may be shared with ethics of respect. Social theory and participatory research practices that emphasize respectful communication can inform academics of ways to draw more effectively upon the expertise of Indigenous peoples to expand understanding of issues like the societal impacts of climate change. More than being a source of "data" or a symbol of humanity's ruin in the face of climate change, Indigenous peoples and their wisdom can inform the ethics through which all human communities may live. Tribes have used this information to set regulations, and there needs to be time given to understand all that is said, rather than rushing to complete projects, finish degrees, and publish findings (Watson and Huntington in prep)."

Corrine N. Knapp: "I have spent the last few years traveling to several small communities surrounding Denali National Park to document the observations of long-term local residents about climate change and how observed changes are influencing their livelihoods and sense of place. In both native and non-native communities I documented observations of changes in river ice conditions, pond depth, vegetation growth and distribution, and weather patterns. However, when I asked what the impacts of these changes are, non-native communities spoke most often about impacts to livelihoods or disruption of their sense of place, while native communities described mutual changes to their sense of place and personal identities. This reflects the holistic worldview described earlier, in which changes to the ecosystem are simultaneously changes in personal identity. This difference is explained by native worldviews that accept change as a component of healthy systems, view people as integral to natural systems, and have a deep commitment to particular places which is spiritual, biological, cultural and historical. The acceptance and integrated response to change is in opposition with western models of conservation, whose goal is to keep the system static in order to preserve it. Climate change is already shifting the distribution of resources that the National Park System was established to protect. Native worldviews suggest that adaptation may need to start with greater awareness of how climate change impacts our personal and collective identities, both as individuals and for institutions such as the National Park Service."

Todd J. Brinkman: "Approximately 10 years ago, I began researching ways to link western science with traditional knowledge to more effectively address wildlife management problems. More specifically, I focused my attention on hunting systems, i.e., the changing relationships among hunters, game species, and the environment. Many western-science philosophies to manage hunting systems were developed in mid-1900s to help dwindling game populations recover from uncontrolled exploitation during the late 1800s and early 1900s (Geist et al. 2001; Organ et al. 2010) and were designed to elevate game abundance to maximize sustainable harvest (Lancia et al. 2005). In many cases, western science has been very successful. For example, white-tailed deer, geese, and elk are now considered overabundant in many regions where they were absent in the early 1900s. Through interviews with Alaskan indigenous hunters, I learned that sustaining adequate levels of game is only one piece of the puzzle and that seasonal distribution of game and sufficient access to game are equally important. For instance, a surplus of game will not be of value to local hunters if game isn't in the right place at the right time (during culturally important times or when regulations allow harvest) and if people don't have sufficient access to the location of the surplus. While western-science tools are often effective at monitoring game abundance at population-wide spatial scales over annual or decadal time scales, traditional knowledge is more effective at explaining interactions within hunting systems at local spatial scales and at monthly or seasonal time scales. For example, western science research showed that the Alaska bowhead population has been increasing exponentially around 3 % per year since the late 1970s (George et al. 2004). However, sea ice characteristics (e.g., lead openings, pressure ridges) are becoming less predictable and more dangerous to travel on, and sea ice conditions may be a better indicator of harvest opportunities than are whale numbers (Brinkman et al. in review). To fully understand and manage this whale hunting system, we need to factor in the perspectives of both western science and traditional knowledge."

Lily R. Gadamus: "Over the last 6 years, I have interviewed several hundred hunters and elders from 13 tribes representing four major Alaskan cultural groups (Athabascan, Yu'pik, St. Lawrence Island Yupik, and Inupiaq). Although each person had their own use patterns, personal values, and perspectives, there were certain common trends: (1) careful observation of landscape, weather, plants, animals, and ocean conditions to improve the odds of staying safe and harvesting successfully; (2) the humility to avoid boasting about past hunting success or predicting future hunting success; (3) a focus on direct observations and caution about making generalizations or speculating; (4) a recognition of the spatial and temporal variability of natural conditions; (5) respect for the observations of others; (6) a long-term perspective on personal use areas and sensitivity to fine-scale changes; (7) an ethic of respect for animals and other hunters; and (8) a strong sense of place and an attachment to healthy, productive local environments. Those of us who are struggling to make decisions or generate information about climate change under time pressure and in the absence of good place-based information could learn from these principles. I would recommend we practice (1) respect for the vastness and variability of our natural environment, and the humility to avoid speculating about things that we cannot know; (2) recognition of the limitations of our own experience, and an interest in the observations of those who are different from us; (3) recognition that place matters, an interest in fine-scale features and historical conditions, and the use of caution when generalizing; (4) respect for traditional knowledge, direct experience, and observation; (5) a commitment to observation-based model validation; (6) respect for the long-term use patterns of indigenous Alaskans; and (7) a precautionary approach to industrial activities that may disrupt existing ecological and human use patterns."

F. Stuart Chapin: "When I first began working with Alaska Native communities a decade ago, I considered this an excellent opportunity to learn from people who had spent a lot of time on the land about the ecological consequences of climate change in Alaska. Indeed, the observations of hunters were generally consistent with those of western science and often extended what was known at the time. For example, rivers are getting wider and shallower, due to permafrost thaw in the riverbanks; break-up in spring no longer scours the river banks but melts in place, resulting in less disturbance and loss of early successional moose habitat along riverbanks (O. Huntington). These patterns were not known by western science at the time. However, more interesting was the deep ethic of respect for the land and wildlife, as described above, that clearly guided local patterns of harvest, desired education of youth, and commitment to local place. The resulting patterns of relatively sustainable resource use provided a model for behaviors that I had given up expecting to see among most Americans. Another important lesson from my indigenous mentors was the importance of spirituality as a key mechanistic ingredient explaining social-ecological dynamics. As an ecologist, I always sought mechanistic explanations for biophysical phenomena. I have learned that spiritual issues are critical to perceptions and behavior and the sustainability of human interactions with the rest of nature as well as influencing the epistemological framework that dictates the questions asked and the goals pursued. Although there is a well-developed literature on the key role of perceptions (Cruikshank 1998; Miller et al. 2008), I would probably not have discovered or internalized these messages as thoroughly had I pursued science entirely through western channels. These lessons from my mentors have fundamentally changed the research that I do."

4.4 Partnerships to Move from Knowledge to Action

Since everything affects everything else in an indigenous worldview, trajectories toward stewardship or sustainability must simultaneously consider the entire suite of stressors and problems and the full complement of potential interactions rather than a more siloed approach that would consider subsistence, energy costs, climate change, and education as separate issues. Given this complexity, how does society get traction on complex issues such as sustainability? Historically, universities have approached this largely through *outreach* that offers one or a set of potential problem-specific solutions, such as gardening or renewable energy. Another frequent set of interactions between the university and communities involves investigator-driven research, in which an investigator chooses an issue that seems important, finds funding (generally without local consultation in the study design), goes to the community to conduct the study, and often does not report the research results back to the community. Many communities resent this relationship with universities.

We recently initiated an experiment that seeks to reverse this historical relationship between the university and rural Alaskan communities through a Community Partnership for Self-Reliance and Sustainability (CPSS). This partnership involves the Alaska Native Science Commission (ANSC), the University of Alaska Fairbanks (UAF) and four Alaskan indigenous communities (Igiugig, Koyukuk, Newtok, and Nikolai). The goal of the partnership is to foster *inreach* from communities to the university to develop collaborations that implement each community's vision for self-reliance and sustainability, based on potential solutions chosen by communities and implemented with assistance from the university and agencies. ANSC provided a trusted tribal connection to engage communities; the university provided a source of technical expertise; and the communities provided the vision for sustainability goals and pathways. This approach is similar to interactions between scientists and indigenous peoples in Patagonia (Rozzi et al. 2010).

This experiment is based on the assumption that each community is the best judge of its long-term sustainability vision and the barriers that are critical in moving toward this vision. In addition, active community engagement in defining sustainability visions is essential for effective buy-in and implementation. During three visits to each community, two ANSC leaders and a UAF graduate student and faculty member went through the following steps: (1) listen to sustainability issues identified by tribal leadership and the community as a whole and ask questions to clarify understanding; (2) listen to community priorities and offer suggestions of ways that UAF expertise might address some of these; and (3) establish collaborative connections between community leaders and appropriate UAF research groups to guide and implement community solutions. A community member identified by the tribal council and a graduate student working with each community were critical to effective communication and progress at every stage.

Each of the four communities had at least one critical self-reliance issue that differed from issues identified by the other three communities and was not addressed by any government program. This included village relocation in Newtok, acceptance of Koyukuk's strategy of adapting to flooding by protecting infrastructure in place, rights to pure water in Igiugig, and rights to fish for salmon in Nikolai. In addition, all communities shared common concerns about some issues such as the high cost of energy. Each community found *different* ways to address this problem. Nikolai installed smart meters that enabled each household to monitor their electricity use to avoid high payments above some threshold; Newtok designed energy-efficient housing; Igiugig integrated multiple forms of renewable energy in their energy system. All communities identified and initiated key innovations before the collaboration began, and the partnership served primarily to facilitate further design refinements and implementation and the sharing of innovations among communities. The major product of the partnership has been the building of trust and enthusiasm about collaboratively addressing opportunities identified by communities. The success of individual projects remains to be determined.

4.5 Conclusions

Rapid environmental, economic, and social changes in Alaska profoundly affect rural indigenous communities that depend on their biophysical environment for food, access to the land and sea, and sense of identity. Although many indigenous observations are consistent with those of western science, there are also important differences. Commonly expressed indigenous worldviews recognize people as integral components of the ecosystems they inhabit, connected by both biophysical and spiritual ties, and motivated by respect for the natural environment and its human, non-human, and spiritual residents. This ethic of respect and reciprocity dictates a responsibility to foster the long-term well-being of all of Earth's residents. This is consistent with a paradigm of stewardship that seeks to shape trajectories of change in ways that foster ecological resilience and human well being. This perspective can contribute substantially to efforts that foster global sustainability.

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Chapter 5
Traditional Ecological Values, Knowledge, and Practices in Twenty-First Century Hawai‘i

Peter Vitousek and Kamanamaikalani Beamer

Abstract We discuss traditional values, knowledge, and practices of the first people of the Hawaiian Islands – as those values are understood and implemented in relation to global society. Prior to European contact, Hawaiian society was dynamic, innovative, and socially, spiritually, and culturally complex; Hawaiians supported large populations in hierarchical societies maintained by large, intensive, and evolving agricultural systems. Hawaiian society was irrevocably changed by contact with the world, and Hawaiian organizations must now walk a difficult line in reflecting both the economic and legal forms of Western organizations and the values of Hawaiian society – while recognizing that change (innovation) itself is a traditional feature of ancient and modern Hawaiian society. One such organization, Kamehameha Schools, is the largest private landowner in Hawai‘i; Kamehameha has extensive holdings of agricultural and conservation lands as well as high-value commercial properties. Kamehameha has organized its resource management around a "five-value" framework; instead of managing its lands simply to provide income to support its educational mission, Kamehameha evaluates all of its conservation and agricultural land in terms of its community, economic, cultural, environmental, and educational value – and explicitly optimizes its management to provide the most benefit across all five values. We suggest that this approach itself represents an innovative application of traditional values in the context of a twenty-first century society.

P. Vitousek (✉)
Department of Biology, Stanford University, Stanford, CA 94305, USA
e-mail: vitousek@stanford.edu

K. Beamer
Hui ‘Āina Momona Program, Hawai‘inuiākea School of Hawaiian Knowledge & Richardson School of Law, University of Hawaii-Manoa, Honolulu, HI 96822, USA
e-mail: beamer@hawaii.edu

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He ali'i ka 'āina; he kauwā ke kanaka/Land is the chief; man is its servant.
Land has no need for man; but man needs the land and works it for a livelihood
(Pukui 1983)

We chose to include traditional values and practices as well as traditional ecological knowledge in this essay. In part our focus reflects the observation that all knowledge is embedded in values and practices, in the science of ecology as well as in any indigenous culture. Equally importantly, we perceive a global society on an unsustainable path – environmentally and culturally – and we believe that knowledge alone has proven to be inadequate to motivate the changes that would take us towards a more sustainable path. We believe that the necessary social and ecological transformations will come from changes in values and practices, at least as much as from any growth in knowledge, and here we explore one way in which traditional values, practices, and knowledge might contribute to these transformations.

Also, we focus on the Islands of Polynesia, especially Hawai'i. Prior to European contact and subsequent globalization, the Pacific islands represent worlds in which human-environment interaction played out in full, often in isolation, in populous and socially complex societies. What environments and which values/practices/knowledge were associated with more – and less – sustained Polynesian societies, in the centuries prior to the disruptions of colonization and globalization?

We are:

Kamanamaikalani Beamer, a native Hawaiian scholar, educator, and Hawaiian cultural practitioner. He is one in a long line of the Beamer family who has contributed to the perpetuation, growth, and advocacy for things Hawaiian. Kamana is a cultural geographer whose work has been focused on traditional Hawaiian resource management, governance, and land tenure (eg. Beamer 2008).

Peter Vitousek, a third-generation resident of Hawai'i; he was born near Manoa, on the Island of Oahu, and (in Hawai'i) now resides in Volcano on the Island of Hawai'i. Peter is an ecologist who has worked in both site-specific and global biogeochemistry for nearly four decades; for the past 25 years, his research has evaluated the ecosystems of the Hawaiian Archipelago as a model system to understand aspects of how the world works (eg. Vitousek 2004).

We share an interest in Hawaiian agriculture prior to European contact; Kamana helped to restore and maintains a series of irrigated kalo (taro) fields in Waipio Valley, Hawai'i, while Peter is working to restore a rainfed uala (sweet potato) field system in Puanui, Hawai'i. We also share in the First Nations Futures Program, a fellowship program for Native Hawaiian, New Zealand Maori, and now Alaska

Native Fellows with interests in natural and cultural resources. The program seeks to develop and support people who can navigate between the values and practices of their societies and demands of our globalized twenty-first century society.

Our perspectives are shaped by the systems we study. Polynesian society was innovative and dynamic, populous and complex. Polynesian navigators reached Hawaii from the south with a set of ideas, technology, plants, and animals that they had carried with them across the Pacific. Once they reached Hawaii (and other islands), their social and material culture encountered new sets of conditions – and as they adjusted to the conditions of Hawaii and the contingencies of their societies, they became Hawaiians. Epic chants and cosmogonic genealogies were used as sources of knowledge that linked Hawaiians to their islands in familial, metaphysical, and material forms (Kame'eleihiwa 1992). Hawaiians invented new technologies and practices, including systems of marine aquaculture and large, highly intensive rainfed field systems that are found nowhere else in Polynesia, and indeed are remarkably intensive in a global context. They also developed complex hierarchical societies; Kirch (2010, 2012) suggests that the interplay of innovations in agriculture and resource use on the one hand with innovations in social organization on the other led Hawai'i into becoming a set of states (nations) as opposed to a collection of chiefdoms, at least two centuries prior to European contact. The innovative nature of Hawaiian society continued after European contact, when the chief Kamehameha adopted some European technologies to Hawaiian ends, and unified the archipelago under his leadership. Even after the disruptions of European colonization and the devastation of introduced diseases, Hawaiian society continued to adapt and evolve (Beamer 2008). Other Polynesian societies adapted and evolved as well – New Zealand Maori innovations in warfare are amazing in their depth, and in their successes against British troops and settlers (Belich 1986).

One implication of the innovative and dynamic nature of Hawaiian society is that it makes little sense to talk about going back to traditional knowledge, values, and practices at the time of European colonization. Traditional knowledge is neither timeless nor immutable; Hawaiian knowledge and practices would have evolved from 1778 (European arrival) to the present had Europeans not arrived, as they had evolved continuously up to 1778. Moreover, contact with the world is now a fact of Hawaiian society – and that contact has been actively absorbed into and influenced Hawaiian knowledge, values, and practices. (Of course some values and practices have been imposed on Hawaiian society as a result of imperialism. Still, Hawaiian culture has evolved in contact with the world, would have evolved had it not contacted the world, and is no less "traditional" for its changes.)

Our experience in studying Hawaiian land and society also leads us to consider the knowledge, values, and practices of large systems and societies. Many discussions of traditional ecological knowledge focus on small groups of people, in villages or rural landscapes (Berkes et al. 2000). Traditional knowledge in these systems is important, and there are significant practical and ethical challenges inherent to the interaction of science and traditional knowledge in these systems. However, our focus is on large indigenous institutions or societies – here primarily Kamehameha Schools in Hawai'i – that are in deep and continuous contact with the world. We ask two related questions – how can such institutions and societies sustain themselves while in contact with the homogenizing power of the modern world? And, what can such institutions or societies bring to living more sustainably in the world, through their values, practices, and knowledge?

Kamehameha Schools is a large trust that exists to support the education of Hawaiian children and youth, most prominently in several private schools and growing number of community education programs. Princess Bernice Pauahi Bishop founded Kamehameha Schools. Upon her death, she was last lineal decedent of Kamehameha I, the founder of the Hawaiian Kingdom and the chief principally responsible for the unification of the islands. Being the great-granddaughter of the Kamehameha I and his lineage of aliʻi (chiefs), Princess Pauahi inherited large land holdings from senior members of her line. Having no direct heirs to her wealth and lands, she benevolently left the majority of her holdings to support a trust dedicated to the education of people of Hawaiian ancestry. The trust founded the Kamehameha Schools in 1887, when Hawaii was still an independent and sovereign Kingdom; the Schools continued through the overthrow of the Hawaiian monarchy in 1893, annexation by the United States in 1898, and Hawaiian statehood in 1959. Today Kamehameha Schools is an educational system that maintains over 20 preschools throughout the Hawaiian Islands, three K-12 campuses, and that spends over $120 million annually toward improving the education of Native Hawaiians. Through careful stewardship, the assets of the Trust now exceed $9 billion, and Kamehameha Schools is involved in nearly every aspect of the economic life of Hawaiʻi. Along with its significant endowment and financial portfolio, the Kamehameha Schools landholdings include roughly 160,000 ha of agricultural and conservation lands, which together include about 9 % of the land area of Hawaiʻi (King and Roth 2006).

In the 1990s, Kamehameha Schools went through a time in which it can be fairly said to have lost its way – and it was forced to reform, through the dissatisfaction of the Hawaiian community it was supposed to serve, and through the intervention of the federal government (King and Roth 2006). As it reformed, its leadership thought long and hard about what it means to be a permanent indigenous organization in the modern world. Their analysis and consideration is ongoing, and will continue. However, Kamehameha Schools did develop a vision and a set of metrics that we believe to be worth considering as an illustration of what one large and engaged indigenous organization perceives to be the values that it should be guided by, as it interacts with the modern world.

Before its reformation – and before it lost its way – Kamehameha Schools followed the model outlined in the Fig. 5.1, a model that is followed by most asset-based institutions, very much including private universities. The assets of the trust are viewed as existing to provide income; that income is then used to carry out the mission of the organization, whether it be supporting the culture, stewarding lands, or (in the case of Kamehameha Schools) primarily the education of Hawaiian children and youth. As a trust, its trustees in fact had a fiduciary responsibility to produce income (to support the mission) and to maintain the asset base of the trust (Hannahs in press). By any standard measure, Kamehameha was successful in its primary mission – the asset base grew, the school thrived, and generations of Hawaiians were educated, empowered, prepared for college, and moved into positions of influence in Hawaiʻi and elsewhere. In fact, until the late 1990s when additional

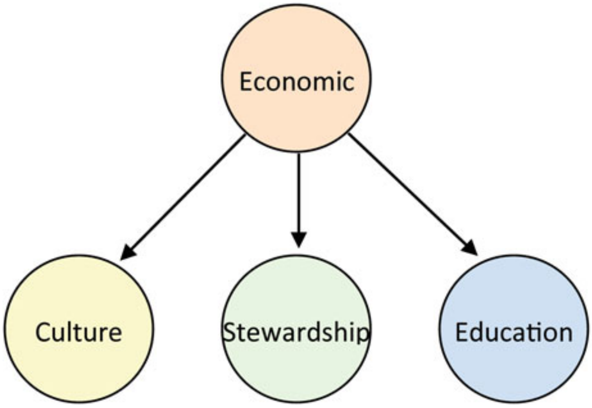

Fig. 5.1 Graphic reflecting the older management philosophy of Kamehameha Schools, where economics were maximized for the benefit of education (Revised from Hannahs in press)

schools formed to support similar causes through Hawaiian language immersion and Hawaiian-culture focused charter schools, Kamehameha schools was largely responsible elevating Native Hawaiian achievements in education and securing post-secondary degrees via its educational system and networks of scholarships and guidance counselors.

Of course maximizing return on its assets often placed Kamehameha into the position of a developer; its lands were used to produce income, and more intensive use meant a greater return. Well-educated and empowered Kamehameha graduates began to question that tradeoff, asking if the standard ways of developing land could be consistent with traditional values, knowledge, and practices of Hawaiian society. After the reformation of Kamehameha's leadership, its new trustees and newly-empowered staff adopted an established western practice – they commissioned a strategic planning process to evaluate how the trust *should* manage its assets. That process brought many members of the Hawaiian community into a deep and prolonged consideration of what the organization should be – most importantly, how its lands should be managed. In the course of these discussions, the community – and institution – recognized that as Hawaiians, their actions should be governed by the perspective of having a familial relationship with the land, and its life. Any actions on the land should account for the reciprocity of human-land interactions; the land feeds people, people have a responsibility to take care of the land.

The challenge of course lies in translating that perspective (and many related ones) into guiding principles and practices for a modern institution. One important way this translation was addressed is by considering multiple values of Kamehameha's assets (again, particularly its land). Assets must provide income; the institution needs income to maintain the excellence of its schools. However, as an educational institution Kamehameha can use its lands to support education directly, without first monetizing it. Students can learn ecology, soils, and agriculture on the land; they can learn to appreciate it. They can learn how Hawaiian culture once managed land, before the arrival of Europeans and others; they can learn how land can be managed under modern "best practices"; they can learn to find ways to navigate managing land from an indigenous perspective in the modern world (Hannahs in

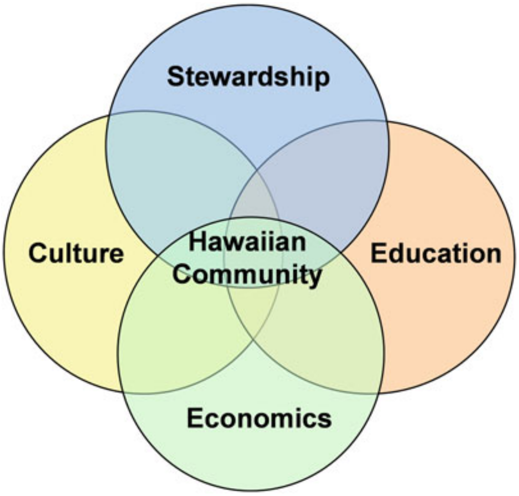

Fig. 5.2 Graphic representing the broader management vision of Kamehameha Schools

press). Similarly, land assets can support environmental values – watersheds can provide clean water for drinking or for agriculture, or to support native stream biota or to feed beautiful waterfalls. Land can support cultural values, sustaining significant gathering, artistic, or agricultural practices; land can also support the livelihood and well-being of Hawaiian communities. This broader perspective is summarized in Fig. 5.2, which puts the Hawaiian community at the center, surrounded and supported by values derived from the land.

Most importantly, these multiple values have been implemented in practice, on the lands owned by Kamehameha. The organization has explicitly traded off economic benefits for other values, sometimes to the chagrin of other Hawai‘i businesses that are driven by economics. More systematically, they have evaluated all of the lands in their inventory, considering each parcel's value in terms of each of the five values – using explicit scores and metrics for each value. These five values have also set the framework for the teams who manage Kamehameha's 160,000 ha of Hawaiian land. In many cases lands are managed in regionalized socio-ecological divisions in ways consistent with indigenous Hawaiian land management and tenure, while individual parcels are evaluated for potential educational, cultural, economic, environmental, and community returns, prior to any land use decision. Management teams have been organized to best utilize the essential needs of both the ‘āina, or land (literally that which feeds) and man. These management teams are fully aware that while there may be immediate economic gains to be had by (for example) filling in marine estuaries to build marinas or ocean-front gated communities, the adverse intergenerational impacts on ‘āina, community, culture, ecology, as well as the estuary's potential for education often outweigh the nearly guaranteed lucrative economic profits.

One concrete example of Kamehameha's current management system is those lands managed through the ‘Āina Ulu program. This program is an educational

Fig. 5.3 Paepae o He‘eia staff hosts a group of learners on their site, which consists of 32 ha on O‘ahu

strategy which links resource management and place-based education with community capacity building; it represents a concrete example of the opportunities created by broadening value frameworks to seek a synthesis of multiple returns. The program's objective is simple – to create a seamless flow between stewardship and education. To achieve this goal, the program nurtures and supports community based non-profit organizations by providing them with a land-base, access to technical and resource-management assistance, assistance in the development of stewardship and educational planning. It also empowers these organizations to work in and with mainstream educational schools.

One program participant is Paepae o He'eia, a 501c3 non-profit that was established by several native Hawaiians who organized around a traditional Hawaiian fishpond that at one time had been slated for marina development. The group's vision is to "perpetuate a foundation of cultural sustainability for communities (‘ohana) of Hawai‘i through education"; its mission is to "implement values and concepts from the model of a traditional fishpond to provide physical, intellectual, and spiritual sustenance for our community." (Fig. 5.3). Since its inception, nearly three-quarters of the once dilapidated 32-ha fishpond have been restored. The fishpond is now producing fish that feed people; it has also been a vehicle for the rejuvenation of the traditional knowledge underlying fishpond management, and the traditional practices through which people interacted with this innovative aquacultural system.

Over 4,000 students and community members were touched by Paepae's program in the last fiscal year alone. While clearly the work of Paepae is extraordinary, it is just one of over a dozen such ʻĀina Ulu programs. The ʻĀina Ulu program (and related programs concerned with natural area stewardship (Malama ʻĀina)) simply could not have developed were it not for Kamehameha's self-assessment and redirection of its land management responsibilities in accordance with a broader five-values framework.

More broadly, the five-value framework has allowed for innovation on multiple fronts. It has made Kamehameha Schools more successful in its mission – by allowing KS to become a better institution, enabling it to enhance achievement of its educational and endowment missions while engendering community respect. That respect comes not only from the Native Hawaiian community served by Kamehameha, but from modern Hawaiian society as a whole and (increasingly) from a broader national and international community. Many environmental scientists have argued (perhaps wistfully) that society should not privilege financial gain over other values; Kamehameha is an $9 billion dollar organization that is actively and explicitly managing its assets on the basis of educational, environmental, community, and cultural values as well as economic values. We suggest that it is not coincidental that an indigenous organization has taken on this challenge in practice – and not a coincidence that other indigenous organizations (eg. the Ngai Tahu Tribe from Te Waipounamu, Aotearoa (the South Island of New Zealand)) have been quick to adapt and then adopt the approach.

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Chapter 6
Tradition as Benefit or Barrier? The Case of Christian Religion in the Formation of Environmental Ethics in the United States

Susan Power Bratton

Abstract The interaction between ecosystem science and religion should ideally operate as a two-way conversation. Religious tradition has historically served as reservoir for ecological information, and informed environmental regulation. For Christians, tradition, including sacred texts, can generate ethical focus, such as emphases on food, agriculture and land ethics. Christians, however, largely delayed response to climate change until it began to generate public scientific controversy. Although, since the release of the film *An Inconvenient Truth*, ultra-conservatives have acted as detractors, Christians have tackled climate change across a range of theological positions, from feminist and liberation-oriented to Evangelical. Churches have served as bases for grassroots programs extending from institutional green energy generation, to taking simple individual steps to mitigate greenhouse gas release. While able to motivate every-day people and generate "natural saints", the Christian response to ecological issues is too dependent on conflict and media attention, restates common place strategies rather than exercising ethical or social imagination, and has frequently limited its vision to its traditional ethical strengths. Ecologists, in turn, confine religion to generating respect for nature rather than allowing it to mandate action, overlook the subtle interfaces between humanity, landscape and nature in religious myth, and too easily assume more conservative or tradition bound communities are less willing to accept ecological thinking. Religious ethicists can improve their response to global environmental issues by developing a better understanding of how ecologists discern regional and global biotic change. Ecologists can improve their communication with religion by understanding it more holistically and pursuing cooperative strategies.

S.P. Bratton (✉)
Department of Environmental Science, Baylor University,
One Bear Place #97266, Waco, TX 76798-7266, USA
e-mail: susan_bratton@baylor.edu

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Some ecologists and scientists from related disciplines identify with faiths varying from Buddhism to a regional American Indian religion to one of the denominations of Christianity. Others are suspicious of religion in general, or prefer to separate religion from science on the grounds religion is irrational, has perpetrated long battles over the legitimacy of Darwinian concepts, or favors tradition over progress. Religion has, however, historically served as reservoir for ecological information and continues to be a major influence in how entire societies prioritize their obligations to nature and to their fellow human beings. The purpose of this chapter is to consider the interaction between ecosystem science and religion as a two-way conversation, and to investigate means for expediting information exchange, particularly in the context of religious "tradition."

Applied ecologists have sometimes invoked regional religions, such as those of pre-conquest Native Americans, as more ecologically astute and respectful, than the world religions adapted to urban cultures and international dispersal. Regional religions indeed accumulate information on local ecosystem function and structure, and have long cultural memories of past overharvest or environmental disasters, imbedding these phenomena in instructional myths about malicious transcendent beings or greed and other human foibles. Regional religion in a relatively stable geographic and ecosystemic context can effectively constrain abuse of natural resources, not just via regulation but also via celebration. The First Fish ceremony of the Pacific Northwest, tribes historically allowed escapement of spawning salmon at the head of the runs, as the entire community terminated fishing to participate in feasts and a ceremonial return of salmon bones to the river. Such rituals encourage cooperation with community norms concerning intensity and timing of harvest (Taylor 1999; Bratton 2006, 2012).

Regional religion and scientific ecology often have difficulty communicating due to differences in language, imagery and assumptions about community organization. Religions personify or deify natural processes, creating very complex characterizations and interrelated bodies of myth. Stories about capricious gods and goddesses who represent earthquakes, seasonal floods or tsunamis retain critical information about environmental risks, just as offerings of seed or fruit teach care of the soil and concern for all living. Legends of Pele, the Hawaiian volcano goddess are not about magma alone, but also about human nature, as Kamapua'a, the pig god associated with precipitation and lush vegetation, courts her across Hawaiian landscape from the rainforest to the rocky coast. Kamapua'a, the Hawaiian supernatural being who is half pig and half god, is a shape-shifter capable of turning himself into not just a boar, but a fish and various plants. His legends describe him rooting like a wild hog, while also conveying protocols for sacrifice of hogs and other species. When Pele who rebuffs her hog-faced suitor with fountains of flame, he threatens to douse Pele's fires with precipitation. Pele's relatives fuel up a volcano, in order to thwart Kamapua'a, so he seeks the aid of his oceanic sister who sends fog and rain. An army of hogs over run Pele's domain and the flaming crater fills with water. The pig-god then has his way with Pele and they divide the island of Hawaii into two regions – she takes the leeward or dry side and he takes the windward or wet side, with its rainforest and prime hog habitat (Beckwith 1970, 201–206). Imbedded in the legend is an ecologically perceptive description of vegetation recovery after volcanic disturbance and of the relationship of the trade winds and topography to vegetation. A tumultuous human-style courtship becomes a metaphor for the interactions between volcanism and the oceanic climate. The myth also contains a lesson about keeping potentially destructive pig populations at bay. In the end, water overcomes fire, steam rises from the flame red streams, and not too long after, ferns begin to sprout from wet crevices. In the sacred union, Hawaii's ecosystems are formed.

Religious ecological narratives usually incorporate specific repertoires of management techniques and reflect the social structures in which they originated (Bratton 2006, 2012). From a scientific perspective, it is difficult to separate the natural from the social in religious symbolism. Religious emphasis on tradition is one of the reasons regional belief system are effective in environmental conservation in their original settings, and often unravel as environmental constraints when faced with rapid cultural and economic change. Religion recounts lists of keystone species in a chant, or portrays the proper interface between hunter and hunted in a dance etched in corporate memory. Science in general rejects this dependence on heritage, and religious filters vetting innovation. From the religious perspective, however, science often fails to consider the complex underpinnings of human values and rushes into ethical discourse based on single issues or the views of a handful of interlopers who have no long term commitment to community welfare.

6.1 World Religions, Tradition and Flexibility

World religions, adapted to geographic translocation and urban contexts, can cause radical loss of ecological memory and regulation as they displace regional religions (Martin 1978). Through time, however, not just Christianity, but trans-continental religions, such as Buddhism and Islam, syncretize with regional religions, develop folk variants, and evolve rituals and mythology reflecting specific environmental settings. World religions can and do "bioregionalize". From the perspective of scientific ecology, the most modern and progressive sects usually provide the easiest route to dialog, yet those with the richest mythology and ritual traditions are often the most in touch with agricultural practices, seasonal change, and critical natural resources.

Even Christianity, with its heritage of university educated ethicists and theologians, responds most passionately and immediately when it draws on its most beloved traditions, sacred texts, and iconography. Christianity's engagement with agricultural management, for example, goes back to its Hebrew foundations, and Biblical texts cover topics as diverse as trimming vines, controlling oxen, burning fields, and offering bread, wine and first fruits to God. In the New Testament Book of Acts 11:27–29, the prophet Agabus predicts a worldwide famine. The disciples, working through the early church system of elders, organize relief for other Christians in Judea, the region around Jerusalem. Contemporary Christian ethics has, on average, encouraged exploration of agro-ecology, produced a steady stream of historically credible Biblical interpretation, and thoughtfully weighed critiques of industrialized farming. The concrete demand for daily bread has muted disagreements between conservatives and liberals, and the readership for volumes, such as Walter Brueggemann's (2002) *The Land*: *Place as Gift, Promise, and Challenge in Biblical Faith* encompasses a range of denominations, and Christian environmentalists from the Protestant mainline to Evangelical "centerists".

A leading Christian voice in food and land ethics, Norman Wirzba (2006, 2011), has reinterpreted Christian rituals and the sacred calendar, as responses to the problems generated by consumerism and post-modern life style. He reestablishes the Eucharist in its role of expressing right relationship with food, including pursuing its just distribution, and respecting the fruits of the land. The Sabbath celebrates creative process, and counters consumerism's demand to squander time and ignore the material as inherently holy. Bahnson and Wirzba (2012) draw on long established Christian ethical strategies, such as reconciliation, to renew and restructure concern for environmental care. They point to faith-based organizations, such as ECHO, located in Florida, who experiment with methods for low technology tropical agriculture, and train aid workers to practically and sustainably enhance production. Mallory McDuff (2010) emphasizes not just feeding the hungry, but providing healthful food, promoting simpler living and establishing church gardens as spiritual acts and essential ministries. In Christian terms, consideration of food production transfers easily into models of sustainability and proper consumer behavior (Hartman 2011). The invocation of Biblical models and traditions empowers such ethical arguments, especially among more open minded Evangelicals, and reduces divisions among co-religionists all committed to be responsible householders and land stewards.

A grassroots invocation of Christian iconography emerged in southwestern US farm worker protests of employment conditions, including exposure to pesticides, when they erected images of the Virgin of Guadalupe at roadside shrines, invoking her long established role as protector of the humble and undefended. The secular environmentalist might, however, miss her symbolic role as a divine mediator with natural productivity. The original vision of Nahuatl-speaking Juan Diego, in 1531, was on Tepeyac, a former shrine to the Aztec goddess Tonantzin, where he encountered the Virgin in a remarkable garden. Tepeyac is an altepetl or "watery mountain," reflecting the importance of seasonal rains and associated with the regeneration of vegetation, particularly the critical maize crop. In Central American religion, the sacred mountain or hill is a granary, where ancestors live inside the earth, guarding the seeds, and thereby future harvests. Both Aztec and Spanish cultures read the light-infused visionary locale, where bright colored birds sing, and precious jade or jewels are scattered on the ground, as a font of nature, the afterlife, and perpetual renewal. As Lois Burkhart (1997) concluded Tepeyac became "Sunshine Mountain" a "world ritually transformed to reveal the sacredness and preciousness immanent in created nature." Appearing in celestial robes, wearing the waist sash of a pregnant Aztec woman, and offering Juan Diego a *tilma* full of fresh roses to carry as proof to the skeptical Franciscans, the Virgin of Guadalupe invokes the importance of the earth and its fecundity, and simultaneously encourages humans to care for the land and each other. While her foundational role was as a replacement for Aztec blood sacrifice, she has become the perfect saint to protest pesticide exposure.

6.2 Tradition Struggles with New Issues

As historic accounts document, American environmentalism has roots in liberal Protestant volunteerism, social activism and aesthetics (Worster 1985; Stoll 1997), and Christians joined the public discussion of the environmental crisis, in the 1960s (Fowler 1995). Encouragement of multi-religious responses was underway by the 1980s, when the World Wildlife Fund sponsored a meeting in Assisi, Italy, and book series, and has continued with efforts such as Mary Evelyn Tucker initiating a series of tradition-specific meetings and volumes on ecology and religion (for example, Tucker and Williams 1997). In contrast to ethically responsible agriculture, atmospheric and climate change did not become a spiritual and religious issue until the 1980s (Martin-Schramm 2010; Houghton 2009) and mainstream Christianity did not seriously join the fray for another quarter century. Alternative religions, such as New Age, embraced the Gaia hypothesis, delegitimizing it in the eyes of more orthodox Christians. While Christians were concerned about energy, potential depletion of oil reserves and the landscape destruction wrought by strip mining were more immediate than the more ethereal and distant impacts of greenhouse gases. AuSable Institute, Mancelona, MI, which provides ecological and environmental field courses for a consortium of Christian colleges and universities, installed an earth-sheltered class room building in the early1980s, and contemporaneous Christian over-views of stewardship or earth-keeping covered fossil fuels and the greenhouse effect as one of many challenges (Wilkinson 1991). For a majority of Christians, however, the plethora of scientific models for change, and the apparent conflicts with economic development inhibited focus on both the issue's looming importance, until Al Gore's film, *An Inconvenient Truth* (Guggenheim 2006) generated both a media barrage and politically conservative backlash, including economically opinionated Christian conservatives.

On average, religious interpreters are continuing to avoid the scientific specifics and prefer to translate secular social scientific interpretation into religious language in order to relate climate science to consumer lifestyles. The ultra-conservative wing, which is roughly congruent with the anti-Darwinian camp, has largely skipped detailed theological analysis, and, following the mold of Intelligent Design, attacked the science as untrustworthy. Jerry Falwell Jr., for example, invited Lord Christopher Monckton to speak at the 2012 convocation at Liberty University, which claims

Biblical inerrancy as a doctrinal foundation (Mayhew 2010). Monckton (2006) critiqued *An Inconvenient Truth* for "exaggerations" and "explicit lies," and referred to the film as "a mawkish, sci-fi comedy horror film dreamt up by a PR guy." Monckton countered a United Nations report by depicting climate modeling as undependable.

Perhaps more confusing, than commentaries reading like replays of the chemical industry's 1960s attacks on Rachel Carson's *Silent Spring*, is the diversity of the religious response struggling to take climate science seriously. Feminists and liberation theologians are attempting to summarily overhaul the iconography, polity, and hermeneutics of Christianity, as well as address past failures to cultivate justice. The holism of ecology and the emphasis on the ecosystem as more than the sum of its parts are attractive, yet ecological concepts of hierarchy are less easily adapted to the mission of radical cultural change. Invoking its scientific origins, Anne Primavesi (2008) has adopted the Gaia model of planetary balance, perhaps without recognizing the extent to which "balance" might be scientifically contested. She argues the historic Christian image of the divine is imperialistic, and, as an alternative, proposes more integrative and caring Gaian responses and gift events, where Christians show greater concern for the community of life. Sallie McFague (1993, 2008) has advocated a cosmology based on the earth as the body of God, thereby locating the humanity in its realistically earth-bound context, and replacing the culture of desire, with one of sustainability. While their acceptance of the research on climate itself is high, the mythic weave and the blending of arguments for reducing greenhouse gas emissions with revisions of church polity may pose barriers to communication with scientists interested in ecosystems as carbon sinks (Table 6.1). Reading between the lines, however, ecofeminists, such as McFague (2013), take on the culture of consumerism in the US and other industrialized nations. McFague counters with a pragmatic ethic of restraint, and consideration for the needs of all.

Ethicists from more mainline theological positions also analyze societal failure, usually without restructuring denominational governance. Northcott (2007) has a solid grasp of climate science and of the implications of western economic policies for development of energy alternatives. Rather than overhaul Christianity, he holds Neo-liberalism and the western affection for free-market economies responsible for the dependence on fossil fuels. Northcott has asserted Christians could restrain the pace of life, and root themselves further in their home communities, benefiting their spiritual formation as well as average winter temperatures in Scotland. Also writing from a Protestant mainline perspective, Carol Robb (2010) utilizes the political context of the New Testament, and cites Jesus and Paul addressing the oppression of the Roman government, to advocate for contemporary Christian resistance to today's dominant global economic and technological trajectories, including the increasingly dire state of climate refugees. Robb (2010) does not challenge Christian cosmology, but holds that Christianity's historic missions of relief for the poor and freedom for the captive are compatible with climate and ecological activism. Miller (2010), in an analysis compatible with Roman Catholic moral teachings, similarly invokes incarnation and social justice.

Table 6.1 Comparison of Christian approaches to climate change

Perspective	EcoFeminist	EcoFeminist	Science savey	Science savey evangelical	Activist
Author	Primavesi	McFague	Northcott	Hayhoe and Farley	McDuff
Concepts	Gaia model Planetary balance Christian cosmology imperialist Need ethic of gift events	Earth as body of God Put humans in earth-bound context Replace culture of desire with sustainability Counter consumerism with ethics of restraint	Neo-liberalism is the problem Modify free market Christians restrain pace of life Root in home communities	Science demonstrates climate change The impacts on humans are tragic The earth will end in fire God is redeemer and humans cannot assist Christians should address greenhouse emissions as necessary house-cleaning improving the lives of ourselves and others Take simple steps	Activism above theology based in denomination Promote justice Treat green spaces as sacred spaces Learn via eco-pilgrimage Educate youth as teaching ministry Bear witness via environmental advocacy

Perspective	Mainline	Mainline	Evangelical	Roman Catholic social justice	Roman Catholic liberation/ecofeminist
Author	Martin-Schramm	Robb	Spencer and others	Miller	Parentilli, Gebara
Concepts	Jesus drew on God's energy Climate change results in injustice Norms of sufficiency sustainability, participation, solidarity Set good institutional examples	Historic meaning of New Testament Jesus's challenge to Rome Counter global trajectories Critiques current economic models	Redemption Jubilee God's plan for Creation Servant kingship Vision Stewardship	Incarnation Social sin Social justice Sacramental	Needs of the poor inform the vision Women's optic critical Latin America must speak for itself to counter misguided North

Lutheran ethicist James Martin-Schramm validated the importance of forming a more astute energy policy by interpreting Biblical texts as if they addressed energy issues. For Martin-Schramm (2010, 2) “God’s redeeming and liberating work is also described in dramatic and energetic ways….:” including Moses parting the Red Sea and the disciples experiencing a mighty wind at Pentecost, thus God’s power can be equated with “redemptive energy.” Like Robb, he points to reducing anthropogenic atmospheric modification as responding to God’s call for justice. Martin-Schramm then provides an overview of current US and international climate policy, and its inadequacies. As a model for other Christian organizations, he uses his home institution’s (Luther College) efforts to reduce its carbon footprint, including difficulties in purchasing a wind turbine, generation of biodiesel with campus waste, financial savings with geothermal for new buildings, and a bike share program.

Katherine Hayhoe, a professional atmospheric scientist who has served as a reviewer for the Intergovernmental Panel on Climate Change, teamed up with Andrew Farley, Evangelical pastor and author of books for Christian laity, to produce an easy-to-read discussion of climate change aimed at the church mainstream. The majority of the text (2009) is a careful explanation of why, from a scientific perspective, the long term trends are real and are generating serious social concerns, such as communities being driven off disappearing coast lines. As Evangelicals, Hayhoe and Farley (2009) do not blame Christian shortsightedness for rising seas and drowning polar bears, and they concur with the Biblical prophesies that the Earth will, at an unknown future time, pass away in fire to be redeemed by God. They argue, however, that limiting greenhouse gas emissions is a form of necessary house cleaning, benefiting both Christians who make the effort, and the people and ecosystems worldwide who may suffer from the accelerated rate of climate change. Individual Christians should actualize their ethical commitments through small steps leading to more sustainable energy use. Ironically, Hayhoe and Farley (2009) combine one of the most apocalyptic and Biblical literal theological positions with one of the most scientifically lucid explications of environmental processes. While they argue humans cannot assist an omnipotent God in redeeming the earth, they discourage any notion that climate change will accelerate the arrival of the Last Days or directly perpetrate the earth’s demise, thus dissuading Evangelicals from burning more coal and petroleum to speed the Second Coming of Christ. Spencer et al. (2009) similarly deploy relatively literal Biblical interpretation, cite stewardship, redemption, jubilee, and servant kingship as motives for action. Choosing Isaiah 40–66 to guide their vision of the climate future, they dodge the apocalyptic in favor of God’s call to right action in the present tense.

To mention one further approach, Mallory McDuff (2010) rather than tackling climate crisis from the top, commends people of faith who engage in environmental advocacy as a form of bearing witness, identifies green building as creating sacred space, and designates drawing on solar energy to power a church as Christian stewardship. She points to projects such the Interfaith Power & Light, which assists churches in conducting energy audits, improves energy efficiency, and draws on renewable sources, as connecting climate change to sacred space. For McDuff (2010) visiting a mountain decapitated by mining or touring a toxic waste dump in an economically disadvantaged neighborhood is a form of pilgrimage, and educating youth about energy conservation and climate is as legitimate a Christian form of instruction. McDuff, a wildlife ecologist, identifies the righteous action, and then assigns it to an appropriate Christian ethical mandate.

McDuff's overview of activism reflects an aspect of Christianity often best actualized in the international context. Christian practitioners of liberation theology, or of one of the many other schools of social ethics, tackle the issues directly at the congregational, diocese or denominational level. Boff's (1997) *Cry of the Earth, Cry of the Poor* has been influential in raising Christian environmental awareness, particularly in Meso- and South America. The election of the first South American, Pope Francis, as the head of the world's largest Christian denomination, in 2013, is an expression of practical concerns, such as support for the disenfranchised and the need to counter the damage environmental mismanagement can inflict on those least able to speak for themselves. Rozzi (2012) argues that South American environmental thought, including the eco-theological path, arises from *biocultural roots* and that Latin American Christians have been particularly adept at grasping the keystone nature of eco-justice. In South America, women have often taken the environmental lead, theologically or in unsung positions within congregations. Gladys Parentilli (1996) and Ivone Gebara (1999), for example, have used their ministry experience with women living in poverty stricken regions to develop a distinctively Latin American theology generated by the "optic" or perspective of women. As they point out the poor receive the least benefit from greenhouse gas producing industries, and will be the first people harmed by the unintended ecological consequences.

6.3 The Religious Response

The outpouring of Christian responses to climate change in the wake of the Al Gore film points to three weaknesses in religious response to the findings of ecosystem science. First, religious social ethicists are too dependent on media-hype, talk-show clashes, and arguments over academic findings in choosing issues for explication and analysis. Perhaps as a lingering bad habit from the Darwinian wars, the science isn't interesting unless it is contested. The state of the oceans, global over-draft of freshwater, and megacity sprawl are also critical challenges to ecosystem health. Yet folks who doubt the existence of water pollution are sparse, compared to those disparaging global warming, so aquatic ethics doesn't begin with a battle over belief. A better understanding of how ecologists discern regional and global biotic change, and an appreciation of the full range of systems they study would enrich the religious response, and further enable it to address the needs of the "neighbors."

A second weakness is not reaching beyond religious justification for caring, fitting the issue into a theological school or being satisfied with mere ownership of the problem. Again, religious thinkers can learn from ecological effort to grasp ultimate causes and its wrestling with its periodic self-recognized failures to connect with the economic pressures and political oversights generating unconstrained environmental degradation. Too frequently, the process is the opposite, religious commentary merely restates the common place strategies for conservation, never integrating the proposed improvements in environmental care, with its myths, rituals or polity. The call for "deeper green" religion (Gottlieb 2006; Taylor 2010) is an ethical corrective, originating within the religious communities themselves, intended to draw attention to contemporary issues. The Christian community would also benefit from more interchange between the North Americas and Europeans, and Christians serving their home communities in other parts of the world.

A third weakness is religious attention is attracted to the themes most deeply imbedded in its own traditions. Christians, for example, respond to the plight of "climate refugees" and the potential for climate shifts to differently impact the cultures least responsible for the increasing levels of greenhouse gases. Christianity's heritage of international missions, relief for the poor and dispossessed, and dedication to agricultural production has become a point of connection with atmospheric processes. The current religious dialog, with some exceptions like Hayhoe and Farley (2009), has less emphasis on relatively undeveloped ecosystems, such as coral reefs and the Arctic pack ice, and the biodiversity they support, thereby skirting the linkages between basic environmental change and the human outcomes. EO Wilson's (2006) call to preserve God's diverse creation has not fully infiltrated Christian analysis of atmospheric crisis. Ironically, the Christian ethicists who have been inclined toward linking atmospheric modification to sacred texts have largely ignored the Biblical passages which literally concern ecological energetics or climate, such as Abraham departing from Canaan because the land would not support both his flocks and those of his brother Lot, and the numerous commentaries on severe drought.

A strength of religious ethics is its potential to motivate everyday people, from farmers and construction workers to corporate executives and senators, to consider their own behavior interfaces with the needs of their neighbors – from next door to across the planet. The Virgin of Guadalupe provides hope, not just for persisting through a labor conflict, but for reconciliation of humanity with the land itself. Religion can influence day-to-day ethical decision making beyond the reach of federal regulations, congressional lobbies, and best scientific advice. Bratton (2000) has suggested the churches should call "eco-deacons" committed to environmental care. Mallory McDuff (2010) describes what the "natural saints" from average congregations can do when they set their hearts to it, attempt to repair the environmental degradation in their own backyards, and renew their community life in the process.

6.4 The Ecological Response

Ecologists meanwhile enjoy religion as colorful celebration imbuing regard for nature, while hesitating to award it ethical, much less regulatory authority. Lynn White's (1967) essay on Christianity's environmental failures, in emphasizing the dynamic between respect for and fear of nature, diverted attention from the communitarian aspects of religiously mediated environmental care, including those of regional religions. Western science has been a competitor with religion for control of natural resources, rather than pursuing a cooperative strategy. The First Fish Ceremony is futile as a quaint relict of a rich heritage, and effective only if all fishers join in honoring the salmon.

A second bad habit of secular scientists and environmentalists is accepting talking ravens and animal chiefs as conveying environmental wisdom yet missing the mission of the Indian woman in the deep blue cloak and similar icons. The Virgin of Guadalupe's role as protectoress of soccer teams and family automobiles can divert attention from her heritage in natural aesthetics and care for both the disenfranchised and the fruits of the Earth. Understanding religion more holistically, in terms of sacred landscape, time and story, and as a nuanced integration of humans with their biotic and physical environment will provide deeper insights. Religion's lessons about human nature are, in the end, as useful to environmental care as the lessons about natural process.

A third weakness of some scientists is assuming more conservative or tradition-bound religious denominations or communities are less willing to embrace ecological thinking, or even that world religions are ecologically useless. Although this essay uses Christianity as an example of emerging climate dialog, other world religions are tackling the issues. Stanley et al. (2009), for example, provides a compendium of commentaries on climate by such respected Buddhist thinkers as the Dali Lama and Thich Nhat Hanh, and applies Buddhist wisdom and prayer traditions, such as the Bodhisattva path and the Mandala of the Four Energies, to such intractable threats as the melting of the Himalayan glaciers. As Hayhoe and Farley (2009) prove, projecting Jerry Falwell Jrs.' role as climate change detractor on all Evangelicals does not understand the variety of social ethical approaches emerging from "Biblically-based" theological lineages. While the ecofeminists have been particularly astute in drawing attention to the relationship between characterization of the divine and beliefs concerning humanity's responsibilities to the environment, some of the most accessible interpretation of ecological science, in terms of lay readers, has emerged from the Evangelical wing. Further, for historic and socioeconomic reasons, such diverse camps as Evangelical Anabaptists and Catholic liberation theologians offer proximate links to commercial agricultural labor, while ecofeminists are more often addressing middle class consumers. Trends in American religion are complex. Protestant Evangelicals were approximately 24 % in 1972, and have grown to almost 30 % of the US population in 2006, Roman Catholics are relatively stable through recent time at 25–27 %, and the Protestant mainline denominations have declined from 28 % in the early 1970s to 14 % in 2008 (Chaves 2011, 85–87). Despite the greater "survivorship" of Evangelicalism, American belief in Biblical inerrancy has declined from 40 % in 1980, to fluctuating around 30 % after 2000, while the interface between politics and Protestantism has become increasingly polarized (Chaves 2011, 33–35). The diversity of religious responses to ecological concerns might superficially appear to be intellectually inept clutter, yet properly addressed it offers the advantages of outreach to diverse constituencies, aesthetic and stimulating modes of communication, and voluntary participation of entire religious organizations and congregations in environmental problem solving. From a political perspective, the more scientifically astute Evangelical and Roman Catholic climate commentaries comprise an important attempt to educate the greater percentages of US (and worldwide) Christians.

6.5 Conclusion

In conclusion, religious ethical environmental response is often the most empowered and ecologically friendly when drawing on the mystical, metaphorical and transcendent – exactly the point where science is the most skeptical. Religion can both be constrained by tradition, and can utilize its heritage to create novel responses to current environmental dilemmas. Professional and academic ecologists can best provide guidance by tolerating religion's inherent social complexity and encouraging religious leaders and ethicists to gain a broad, basic and scientifically sound understanding of the anthropogenic disturbances and stresses affecting the world's ecosystems.

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Chapter 7
Environment Imagination Situation

Irene J. Klaver

Abstract Engagement with a place can foster interdisciplinary research and exploration. Becoming familiar with the place combines developing an understanding of situational specificity and a larger cultural mentality. When members of different disciplines come together in a place, they combine, inter-compare, and hone their concepts and give rise to more robust understandings. Certain cultural practices and structures facilitate environmental connections and enable a cultural imagination in the direction of an environmental imagination. Not only designated parks or nature areas foster an environmental imagination, but also infrastructural features can be designed and experienced as technologies of environmental engagement. A most commonplace piece of infrastructure, a storm water retention pond, can be a place of engagement, a situation in which one encounters natural entities as well as other people. The experiential boundary between hydrological infrastructure and natural landscape feature can become porous and lead to a green and grey hybrid infrastructure *and* a public space, a place of encounter, fostering a bio-cultural nexus. Such a porous boundary fosters erosion of boundaries between disciplines, between humanities and sciences, between the public and academia.

Keywords Environmental imagination • Engagement • Situation • Culture • Infrastructure

Texas has no "real" lakes. All its lakes are human made. They are reservoirs. The small ones are ponds, mostly detention or retention ponds, built for flood control. We walk our dogs at such a pond most evenings before dinner, right here in Denton,

I.J. Klaver (✉)
Department of Philosophy and Religion Studies, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-5017, USA
e-mail: klaver@unt.edu

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Fig. 7.1 Flood detention pond SCS #16 in Denton, Texas; a little, messy public space

Texas, a small town north of Dallas. We have done this for years. Our pond is a little, messy public space (Fig. 7.1). All kinds of folks and 'feathers' are hanging out there. Tonight there was an over-sized white pickup truck with a big fishing rig, a bulky guy and his toddler son. Two Yellow-crowned Night Herons stood statue-still along the pond's edge peering into the murky water, equidistant from their young one, a scraggly grey stubby version of its parents, peering into the water too. A Saudi student was sitting on a little carpet learning English from the Oxford Picture Dictionary book, sipping a water pipe (Fig. 7.2). A Latino family, kids playing in the mud, petting our dogs, while mom and dad tend to a fishing line. And there are the ducks: Clan McDuck. We have observed the clan growing from just two ducks into an odd collection of nine. One morning after Easter a young couple dropped off two white ducklings, according to our buddy Chuck, the fisherman. A retired underwater petroleum rig welder, Chuck now spends a good part of his days at the little lake. He is a reliable source of information about what is going on during the hours we are not there. 'When they drove off,' he said, 'the duckies followed the car, but couldn't keep up.' That was 3 months ago. Now they are huge white ducks. On many a nice day people toss some food to the resident ducks; Professor Laura, another regular at the little lake with her two tiny terriers, Jack and Wesley, feeds them systematically each and every day in the evening. She buys them whole wheat bread, from Baird's Bakery outlet store. Two weeks ago, we ran into her and she told us that she was going to visit her daughter in Singapore for 3 weeks. Could we feed the ducks? The next night when we came home late, a huge white plastic bag was sitting at our front porch with 15 loafs of Ms. Baird's whole wheat bread!

Fig. 7.2 Student from Saudi Arabia and ducks at the "little lake"

Tonight there was a little kerfuffle in the pond world: one of the brown mallards was dragged under water by a giant snapping turtle. A young African-American man heard the duck screaming and hit the turtle on the head with his long fishing rod. With the help of our canoe paddle the duck was set free. She swam to the shore; her leg was seriously hurt, however. The other ducks quacking around the hurt duck, we left her sitting low in the grass. We'll see if she makes it through the night. There are coyotes, an occasional bobcat, a fox, and snapping turtles, clearly. The great horned owl might be very interested too. We walk back to the car with the dogs. Two young Chinese women are all giggly over the two big white ducks. I give them my left over bread. They kneel down and the ducks come over, eating from their hands. We drive off with the windows down. The sun is setting, the beaver begins his evening swim, the frogs start croaking, and a high-pitched Killdeer scream punctuates the air. In the rear view mirror I see the Chinese girls making duck pictures with their iPhones.

With this small-town-based everyday vignette I set out to expand the toolbox for "Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action."[1] During our Cary Conference we discussed in depth the advantages of a closer collaboration between sciences and humanities. We identified various reasons for more cooperation. Amongst those that kept surfacing were the following. Teamwork broadens and improves both scope and quality of knowledge. The collaboration of different disciplines has more potential to bridge local and global issues on different scales, thus facilitating a bio-cultural capacity to cope with global change.

[1]I want to thank Laura Ogden for many thoughtful discussions during our morning walks on the gorgeous grounds of the Cary Institute of Ecosystem Studies in Millbrook, NY, during the Cary Conference XIV, May 2011, and Brian O'Connor for his close reading and suggestions. Photo credits: all photos produced by Brian C. O'Connor and Irene J. Klaver.

Also the nature of inter-disciplinarity was a crucial recurrent theme. It does not mean that each cook stays in their own kitchen and the research results of various disciplines are just added to each other—a philosophical sauce poured over ecological data, scientific seasoning added to an ethical stew. No, a fruitful interdisciplinary collaboration entails working as a *team*, developing an integrated and synergistic project over time. It means building trust; *co*-developing questions, methods, concepts, and narratives; writing grants and project proposals *together*.

How are we to facilitate such collaborative relations? I see as a pivotal element the realization of situations in which the various groups regularly meet, get to know each other and work together. One can think of UNESCO Man and Biosphere (MAB) sites and Long Term Ecological Research (LTER) sites: they create situations, that is, places and structures to listen to each other, to the specificities of the place, and to the diverse human and more-than-human communities that constitute the place. This facilitates fostering a feel for each other, a crucial foundation for social political cultural economic and ecological research and analyses. From this basis further questions emerge, as well as a sense for restrictions and possibilities, resilience and fragilities. In the last part of this essay I will come back to the opening vignette and explore how small-scale everyday places also afford experiences where different worlds meet and actually engage with each other. Engagement with the place, rooted in a familiarity grown over time, is the crucial feature, in the large-scale well-structured research site as well as in the almost accidentally emerging local meeting place.

The humanities (in all their diversities) are often seen as contributing to this engagement and familiarity through their communication skills, including a variety of writing styles and visual media, providing multiple links between science and society. While this is certainly the case, humanities' role cannot be reduced to a mere ancillary companion to 'real science,' conveying the scientist's research to a larger audience. That would deny that the humanities are concerned with fundamental research in their own right. Environmental philosophy considers practical as well as basic theoretical questions, varying from issues of rights and values to ontological and epistemological investigations into the nature-culture relation, including questioning the dualism that is implied in this very phrasing of nature versus culture. Furthermore, an image of the humanities as a mere go-between—to tell the sciences what lives in society and notify society what solutions science has come up with—conjures up an impression of academia and society as separated realms. Clearly this relation is far more complex and also here—as with interdisciplinarity—a more interactive approach is called for. Society and academia both benefit from a further integrated way of working and understanding: community engagement (in various directions) influences the type of questions asked, the narratives written, the topics (and experiences) researched or taken into consideration.

For these reasons we need to cast the net of relations between the fields of ecology and philosophy and between academia and society widely. Only then can we deal constructively with environmental changes and challenges. The complexity of the issues warrants a multiplicity of perspectives.

I add a cultural perspective to our toolbox for "Linking Ecology and Ethics." Becoming familiar with a place combines developing an understanding of situational specificity and a larger cultural mentality alike. In the social sciences mentality or mindset is also called cultural imagination or social imaginary. In the following I zoom in on this latter aspect. I will develop a notion of cultural imagination in the direction of, what I call, environmental imagination. This includes understanding how cultural practices and structures can facilitate or impede a relation with one's environment.

In J. Baird Callicott's chapter this larger encompassing cultural context was related to worldviews. Both worldview and environmental imagination seem to privilege the realm of vision—at least, insofar as imagination is connected to images and imagery. However, cultural imagination or social imaginary goes beyond the visual into a *syn*-aesthetic understanding of the way we conceive our world. It focuses on how we are *engaged in* the world, instead of *looking at* the world. It acknowledges us as situational beings: we are intrinsically part of a larger context, a larger world. This being *in*, or being *with*, I will explicitly explore here. How does being in certain situations afford particular experiences, activities, perceptions, and modes of knowledge? With these questions in mind, I will bring us back to the experiential situation of the little lake I sketched at the beginning. Where LTER and MAB sites are important, it is as vital to realize simple everyday life situations where people experience and are engaged in an ordinary way with (a slice of) their natural environment.

How to create ordinary practices, places, and technologies of engagement? Dealing with these questions provides additional tools to our collaborative quest. It broadens the notion of ethics in the direction of *ethos*, attitude or habit, which in its Latinate form is related to *habitare*, living in a place (Rozzi et al. 2008). Humans as situational beings are *in situ*, in a certain site or place. Such an expanded sense of ethics as ethos means that our endeavor of linking ecology and philosophy has also ontological (exploring the realm of being), epistemological, political, cultural and experiential components. This provides further tools to conceptualize and practice ways of thinking and working together as ecologists and philosophers.

An excellent example of this place-based approach is the work Ricardo Rozzi describes in his chapter. He and his fellow researchers have been involved in the community of Cape Horn on the southern point of Chile, not just as academics, but *in situ* as inhabitants. Over the years indigenous Yaghan community, government authorities, teachers and researchers have fostered mutual familiarity and have become engaged in the conservation of habitats at local, and regional scales, culminating in the creating the Omora Ethnobotanical Park in 1999, and the UNESCO Cape Horn Biosphere Reserve in 2005.

Facilitating people's engagement with their environment is not only a question of raising awareness, political commitment or education, but also of joy, curiosity, and wonder about one's environment in everyday life. It creates stories. Situations are embedded in stories, which require and create a setting for specificity, for specific practices and technologies of engagement. Perhaps most significantly I want to think beyond a mere functionalistic approach of ecosystem services and planning, and beyond a mere reactive discourse of adaptation, toward a more proactive stance of creating overtures, possibilities, aspirations, gestures that initiate relations, participation, stories, connections, inventiveness, ingenuity; of creating situations where engagement and sociality including the possibility of anonymity come back in, where we think, feel, argue; where we plan for the encounter, which also means, plan for the unplanned, for leaving things open, for creating openings, places where things happen, where people meet each other and the 'more than huma,' for the unexpected, for a *Lebensraum*, i.e., a place that is alive, where we experience and taste life, where the political aspect is part of nature, call it 'a controlled de-controlling of control,' call it wildness instead of wilderness, call it the un-thought of nature and culture, call it possibility on the edge of necessity. This might sound exciting, or grotesque—but what is at stake is the necessity of these encounters, to get a sense for what matters in nature, in ecology, in politics, in a culture in which nature is an intrinsic part of culture again, to start rethinking and re-living nature and culture.

In the following triptych I sketch pathways for this encounter, for the creation of situations. I begin with a short sketch of the power of environmental philosophy conceived broadly, I will segue into a theoretical framework of environmental imagination, and after these theoretical groundings, I come back to the place in my opening vignette. The 'little lake' in Denton, Texas, is a most common place, an infrastructural storm water feature one can find in every American town. I show how infrastructure like this can function as a technology of environmental engagement. I see this as part of a larger, river basin awareness—what I call a watershed mentality. This mentality can be fostered in many ways, from large and expensive urban renewal projects to small-scale levels of local storm water management. The art is to create situations where one can experience more than a built and controlled environment, and develop a sense of environmental imagination.

7.1 What Is Environmental Philosophy?

Environmental philosophy is invitational and transformational: it in-vites thinking into life as well as life into thinking (Klaver 2007). Life is *vita* in Latin—the same *vita* as in vital and in vitamins. An in-vita-tion leads to new connections, new situations, or a renewal of existing relations, which entails change and transformation. This affects how we understand things. As Wittgenstein (1971) says, "understanding […] consists in the very fact that we 'see connections.'" This is the case for philosophy in general; it makes connections, reveals relations between entities, thoughts, and events, thus elucidating our understanding.

Environmental philosophy has (re-)opened certain realms of relevance to philosophical inquiry by foregrounding our connections to places and situations, to the more-than-human world. It situates details into exquisite specificity, accommodating the broadest or most general invitation: of life itself, including our relation to the conditions of life.

Environmental philosophy is an interdisciplinary and interactive endeavor, taking place at the interface of multiple institutions and practices. It deals with global issues on a local level and with the effects of local issues on a global scale. This involves science, policy, economy, law, ethics, aesthetics, religion, history, etc. An environmental philosopher is a specific generalist, someone who can connect various relations, sees the multiple angles in a particular perspective, the world in a grain of sand.

An environmental philosopher is a translator *and* an initiator: translating various concerns along multiple perspectives opens up new situations and affords us the freedom of ongoing new beginnings. It is crucial to an understanding of the various viewpoints, positions, places and experiences of others. Environmental philosophy enlarges the category of the "other" beyond human beings. It enlarges ethics in the direction of ethos, resonating with "habitat," "inhabitants," and "habits" (Rozzi et al. 2008). It questions certain mentalities and provokes and evokes different modes of knowledge and experience, to enhance cultural imagination into environmental imagination.

7.2 What Is Environmental Imagination?

Philosophically the imagination has run the gamut from a faculty of the mind, connected to a flight of fancy, a far inferior mental process than the faculty of reason, to the seat of creativity, at the root of science and art.[2] It gained increasing philosophical attention in the last decades of the twentieth century.[3]

Within environmental philosophy, the imagination has been taken up occasionally. In *Respect For Nature* environmental philosopher Paul Taylor (1986), working from a biocentric egalitarian approach to other species, was one of the first to attribute a crucial role to the imagination in providing "genuine understanding" of other species by "imaginatively" placing oneself in the position of the other organism so that one can look at the world from its standpoint. Sara Ebenreck (1996) thematizes explicitly the important potential of the imagination in her article "Opening Pandora's Box: The Role of Imagination in Environmental Ethics" and points at the powerful influence of metaphorical constructs of nature. As did Paul Taylor, Ebenreck sees the activity of the imagination as a vehicle to envision the perspective of other than human beings. She broadens the workings of imaginative empathy by referring to the imaginative visions of indigenous cultures. Despite this larger cultural connotation, Ebenreck ultimately sees the work of the imagination as an activity of the individual, just like the work of reason. Her important contribution lies in the fact that the imagination is no longer considered to be inferior to reason but

[2] Part 2 is based upon my previous writings on environmental imagination. See Klaver (2012, 2014).

[3] See, for example, the works of Casey (2000), Kearney (1988, 1998), Sallis (2000), and the Stanford Encyclopedia of Philosophy (2011). See also Foster and Swanson (1970).

receives a complementary status. Roger King (1999) also foregrounds the imaginative power of metaphors and narratives in his article "Narrative, Imagination, and the Search for Intelligibility in Environmental Ethics." He explicitly adds the significance of narratives for the articulation of environmental ethics and the creation of "discursive spaces" for environmental discourse.

The formative relation between space or place and narratives or metaphors has been most carefully examined by literary scholar Lawrence Buell (1995), who coined the very term 'environmental imagination' in his work *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture*. The book became a seminal text for environmental literature, or ecocriticism, one of environmental philosophy's sister disciplines in the humanities. In detailed literary analyses Buell shows how deeply intertwined human history and the environment are—the latter not just a framing or staging for the first. According to Buell, a writer's imagination is profoundly influenced by the specifics of a place, such as its geological, biological, geographical, historical, and ecological characteristics. Where Buell's focus was on Anglo-American imagination, ecocriticism has expanded its horizons over the years to include global, postcolonial and environmental justice themes as, for example, in the work of Ursula Heise (2008).

Here I expand this sense of environmental imagination further by connecting it to a social political body of literature around cultural imagination. Benedict Anderson's work on the imagination in the context of the nation state is crucial here. In his influential book *Imagined Communities* Anderson (1983) defines the nation as an "imagined political community." He calls it *imagined* "because the members of even the smallest nation will never know most of their fellow-members, meet them, or even hear of them, yet in the mind of each of them lives the image of their communion." That is, they experience themselves to have similar interests and they identify themselves as being part of the same nation. The nation-state became a powerful master narrative or imaginary in the Western world in the modern age, replacing the two previous dominant Western imaginaries of the religious community and the nobility. Anderson shows convincingly how nationality, nation-ness and nationalism became powerful "cultural artifacts" and "once created, they became 'modular,' capable of being transplanted … to a great variety of social terrains, to merge and be merged with a … wide variety of political and ideological constellations."

Edward Said develops a similar sense of the "imagined" in his concept of "imagined geographies" which refers to the spaces that are created through certain discourse, texts and images. In his book *Orientalism* Said (1995) reveals how the constructed colonial view of the Orient based upon popularized images and travel writings functions as a structure of power, a tool to control and to subordinate certain geographical areas.

As with Buell's imagination, Anderson and Said's imaginaries are not simply located in the individual subject but are part of a larger dynamic. Anthropologist Arjun Appadurai most explicitly explores this sense of imagination as a property of collectives, instead of as a faculty of the gifted individual. Collective representations, according to Appadurai, are not subjective inventions, fantasies or desires, but objective facts, leading to a plurality of imagined worlds. He takes Anderson's sense of imagined communities from the nation-state to a globalized world, emphasizing the active workings of the imagination as a social practice.

> The image, the imagined, the imaginary—these are all terms that direct us to something critical and new in global cultural processes: the imagination as a social practice.… a form of work (in the sense of both labor and culturally organized practice), and a form of negotiation between sites of agency (individuals) and globally defined fields of possibility (Appadurai 1996).

For Appadurai, Anderson and Said cultural imagination bespeaks a social-political or *culture*-based field, while for Buell it is primarily a place-related, or *nature*-based dynamic. This nature-culture difference seems to reflect the debate between natural determinism versus social constructivism in the social sciences and humanities. However, the picture is a bit more complex: for Buell and other ecocritics the experience of place is also culturally (and historically and politically, etc.) mediated,[4] and, vice versa, social-political-cultural analyses do note that events take place *somewhere*. Still, one could say that the latter have a tendency to underestimate the significance of the natural environment, while the former might tend to over-emphasize it. Bringing these perspectives together facilitates seeing them on a continuum rather than in a dualistic or dichotomous fashion. It accentuates that they are in fact deeply intertwined and predicated upon each other, co-constitute each other (Klaver 2001).

Co-constitution is at the heart of the work of French philosopher Maurice Merleau-Ponty. He shows how oppositions are mutually constitutive or co-constitutive. Already the Pre-Socratic thinker Heraclitus emphasized this approach; he pointed out how we only experience the cold because we know the heat; if temperature would be constant we would have neither concept. Similarly with night and day: we experience light because there is dark. Merleau-Ponty contrasts this mutually *constitutive* approach to a long tradition of Western philosophy to see oppositions in terms of mutually *exclusive* dualisms. Especially the dualism between subject and object has been pervasive, deeply imbedded in Western thought, and at the root of a variety of interlocking dualisms, such as activity (or agency) versus passivity, resonating in culture versus nature. A dualistic mindset comes with a value attribution, with an implied sense of superiority (culture, agency) versus inferiority (nature, passivity) and hence an implied legitimation for use, domination and exploitation. The inert material or natural object is waiting for the human intentional subject to do something with it. It became the basis for a Western conception of passive nature, ready to be used by culture. This approach was radically re-thought by Merleau-Ponty in the early 1960-ies.

In his latest work, the *Visible and Invisible*, Merleau-Ponty (1968) describes his philosophy as developing "the *fungierende* [*operative*, I.K.] *or latent* intentionality which is the intentionality within being." Intentionality is no longer located in the human subject, neither is it now placed in the object, but it is operative *between* the two. For example, seeing a glass of water makes me realize I am thirsty. This shifts the locus of intentional agency from a sheer focus on the individual subject as agent to, what I

[4] For excellent work on the intricacies of mediation and imaging, see Grusin and Bolter (1999) and Grusin (2010)

call, a *situational* agency. Intentionality is *operative* in a *situation*: the reason why I do something is related to a variety of experiential vectors; intentionality arises in the very interaction of inward and outward forces, neither merely in me (voluntarism), nor completely outside me (determinism), but in a co-constitutive field of the two.

Similarly, I see environmental imagination as *operative* imagination, understanding operative in Merleau-Ponty's sense of the word. Environmental imagination is not simply located in the individual, neither in the environment, but is operative, arises out of the interplay between the two. Larger cultural and material constellations or patterns (of being) co-determine how we experience and conceive of things. As operative intentionality, operative imagination always takes place in a situation, and is in that sense a situational imagination. Within embedded practices and events we imagine our future, present and past.

This brings us back to the importance of situations. The question now becomes: how can a particular situation facilitate an environmental imagination? For this I will return to the beginning, to our little lake, our local storm water detention pond. I will locate the detention pond in its larger watershed and relate its increasingly storied life to the shift in mentality that is occurring around urban watersheds. This shift gestures at the rise of an environmental imagination. Local everyday situations can be places of affordance and create the potential for fostering such an environmental imagination in the most mundane practices and infrastructural places, at the interface of nature and culture.

7.3 Modeling Environmental Imagination in a Situation

7.3.1 Modeling Grey to Green Infrastructure to Public Space[5]

For the first time in history more people live in urban areas than in rural communities. One consequence of rapid urbanization is the distancing of people from the other creatures of the planet. Another consequence is an unprecedented rise of impermeable surfaces in the form of roads, parking areas, rooftops, etc. Storm water washes over these surfaces, picking up chemical and microbial pollutants—such as oil and fertilizers—before draining into the storm water collection system, a public drainage system with (usually) publicly maintained pipes, culverts, gutters, and the like. Where wastewater—water from sink, toilet, shower, dishwasher, washing machine, etc.—is generally treated by a wastewater treatment plant before it is released into any water body, storm water flows in most places directly and untreated into streams, rivers and lakes. This is especially the case in highly developed and urbanized countries such as the United States where, according to the National Research Council (2008), "storm water runoff from the built environment remains one of the great challenges of modern water pollution control."

[5] I want to thank Aaron Frith for his assistance in researching Green Infrastructure in Sect. 7.3.1.

To deal with storm water in a more sustainable way the notion of "green infrastructure" gained currency in the late 1990s in both public and management discourse on storm water and wastewater management. The President's Council on Sustainable Development (1999) identified green infrastructure as one of five opportunity areas for sustainable community development, defining it as "the network of open space, airsheds, watersheds, woodlands, wildlife habitat, parks, and other natural areas that provides many vital services that sustain life and enrich the quality of life."

In the United States, the transition from the grey infrastructure of sewage and drainage systems to a green infrastructure has been driven in part by the United States Environmental Protection Agency (EPA). In 1987, Congress revised the Clean Water Act to bring storm water runoff under federal regulation. The EPA maintains a National Menu of Storm Water Best Management Practices, varying from public education/involvement to illicit discharge detection and elimination. It has issued a *Strategic Agenda to Protect Waters and Build More Livable Communities through Green Infrastructure* (2011).

What is under-developed in these approaches is the potentiality for a cultural component in the projects. How could they be designed in such a way that they enhance the capacity for environmental imagination, for developing a watershed mentality, for facilitating cultural and natural diversity on the local everyday level? How could they not only become green, but also create situations, places of encounter? Here our small-scale storm water feature comes back in, as part of an average Texas town in the midsize Trinity River watershed in North East Texas. Lets begin with a sketch of its larger river basin.

7.3.2 The Trinity River Basin and Its Big Cities

Texas has no natural lakes. All its "lakes" are reservoirs, water stored behind dams. Texas is a river state. The state has many charismatic rivers, such as the Rio Grande and the Brazos. The Trinity River is not one of them. "The Trinity's muddy" goes a line in the traditional "Texas Rivers Song" made popular by Lyle Lovette. While the other Texas rivers in the song run "glossy and gliding" or "weaving and winding;" the Trinity is just "muddy." Cowboy stars such as John Wayne, Gene Autry, and Roy Rogers appear in popular movies with the names of other Texas rivers in their titles. Not so for the Trinity River. Its star, its 'charismatic mega-fauna' is the ancient Alligator Gar, a scaly predator lurking in its muddy waters (Fig. 7.3).

Originating in North Texas, the Trinity flows southward through the coastal lowlands, merging its murky waters into the Gulf of Mexico. Along the way it serves the residents of the Dallas/Fort Worth region, one of the fastest growing metropolitan areas in the United States, as well as residents of Houston and many smaller towns, agricultural users, and the water needs of a large watershed.

Floods long gave reason to want to "control" the waters of the Trinity. The 1908 flood in Dallas led to a large scale re-routing and harnessing of the river, creating the longest cement structure in the world at that time. Also water quality had a dark

Fig. 7.3 Mega fauna of the Trinity River, a 1-m long Alligator Gar

history: in the 1920s with two major slaughterhouses in Fort Worth and growing populations in both cities, the number of typhoid fever cases were rising to a level that caused the Texas Department of Health to call the Trinity River a “mythological river of death.” Still in the 1960s parts of the river were so polluted that the United States Public Health Service called the stretch of 150 km downstream of Dallas “septic.” With the Clean Water Act in the early 1970s also the Trinity became cleaned up and laid dormant in the cultural imagination as a forgotten river.

Today, the Trinity River is clean and controlled. It has become one of the most heavily developed watersheds in Texas and provides drinking water for approximately half of the State’s population (with six million people in the Dallas/Fort Worth (DFW) area in 2010).

Just as many cities around the world Dallas and Fort Worth have begun to embrace the civic and architectural potential of their waterways and are planning large-scale urban development around the Trinity. The Trinity is slowly percolating into the cultural imagination: from ‘Mythological River of Death,’ to basically forgotten, the river is increasingly perceived as an asset. Glossy brochures featuring Dallas’s Trinity River Corridor plans and the Trinity River Vision Master Plan of Fort Worth (“A Vision for the Future and a Plan for Success”) advertise a newly found river identity around “a new place to work, live and play.” Like all self-respecting river cities, Dallas has planned a so-called “signature” bridge—in this case designed by no one less than Spanish architect Santiago Calatrava (Fig. 7.4). The bridge now spans the river in the center of Dallas, while a new active urban mixed-use waterfront is supposed to “create a vibrant, active community” in Fort Worth. Words such as urban revitalization, restoring, reviving and reinventing, flow off the brochures’ pages, describing a new relation with the Trinity through river

Fig. 7.4 Opening day of the Santiago Calatrava-designed bridge spanning the Trinity River in Dallas (March 2012)

front property, hiking trails, fishing ponds, and constructed white water boating sections. The Trinity is no longer just muddy.

This comes with new opportunities and new challenges. Gentrification is a major issue: who will ultimately benefitting from this process and who will be disadvantaged? Also, who is able to participate in the decisions? Here I focus on the possibility of a re-engagement of citizens with their river, and the potentiality of the emergence of an environmental imagination around the river. Through various modes of recreation, there might rise an opportunity of re-creating a new identity around the river. If and how that exactly will happen is still to be seen.

Where these are rather high-end plans, water basin relations happen at multiple scales and in multiple fashions, and for most people in less spectacular, more low-key, everyday ways. In the following I describe how a small storm water feature, or retarding pond, has the potential to turn a hydrological infrastructure into a biocultural nexus and to foster an environmental imagination.

7.3.3 *Emerging of a Cultural Nexus and Environmental Imagination Around an Ordinary Storm Water Pond*

Storm water ponds have become part of modern urban development: you may see them along the road, in shopping complexes, suburban neighborhoods, and industrial

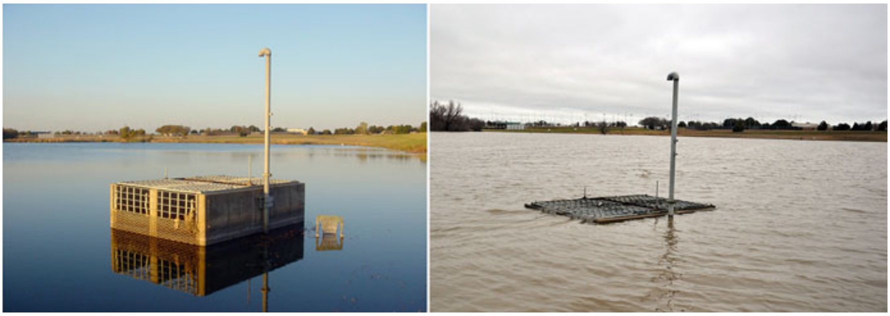


Fig. 7.5 Portion of the hydraulic infrastructure of "little lake" in fair weather and rain

centers, because they lead to a substantial increase in impervious surface area. This has serious hydrological consequences, such as a higher rate and volume of run off, and less infiltration into the soil of pollutants and hence a degradation in water quality. Storm water ponds have been designed to mitigate these effects and to provide storage for storm water. Some are designed to hold water year-round, others are designed to be dry again a couple of days or weeks after a storm.

Major flood events in the small town of Denton, Texas, which sits in the Trinity River watershed at the northern edge of the Dallas-Ft. Worth metropolitan area, led to a flood prevention program in the early 1970s. Two storm water features were created called "Soil Conservation Service's (SCS) Hickory Creek Basin Retarding Ponds #16 and #17," designated as North Lakes Park. Retarding pond SCS #17 and much of the land around it were developed for recreation with structured picnic areas, a fishing dock, soccer fields, paved parking areas, a recreation center, and a golf driving range. In a way, a miniature and low-budget precursor of the current master plans around the river in the big sisters Dallas and Fort Worth.

The area around the other pond, SCS #16, has been left essentially undeveloped, except for one small dirt parking area and a disc golf path. A haphazard accidental community of herons, fishermen, dog walkers, brushy vegetation, kids, paddlers, beaver, migratory birds, ducks, disc golfers, turtles and skunks has emerged around the infrastructural feature, fondly called by some 'their little lake.' SCS #16 or the 'little lake' supports a varied community that thrives in the relatively unstructured inadvertent wildness of the place.

For many people who have stumbled upon SCS #16, it has become an integral part of their everyday life with its own interface between beaver, heron, human, snake, fish, water, disc golfers, and flood management. The experiential boundary between hydrological infrastructure and natural landscape feature becomes blurred in such everyday activities. SCS #16 presents a green and grey hybrid infrastructure *and* a public space, a place of encounter (Fig. 7.5).

It sets the stage for 'accidental' natural and cultural opportunities and occasions that have supported unexpected and continuing natural and cultural engagements. Such hybrid technological-natural structures dissolve strict separations between human built/technology and nature, between various social-economic groups, and between different practices (dog walking, disc golfing, fishing etc.). SCS #16 demonstrates the capacity inherent in structures, such as local retardation ponds, to enhance the lives of local residents beyond the pond's sheer hydraulic role.

7.3.4 Reclaiming the Infrastructure: Accidental Hybrid of Wildness and Community

In an era of rapid urbanization, infrastructural entities such as storm water retarding ponds could provide much needed ecosystem services as well as public spaces, fostering a *cultural nexus* around water bodies. The narrative of the social constructs around SCS #16—the purpose and plan that enabled its material creation, the measure of maintenance required to keep up the lake and its environs, and finally the use of the lake area as public space for the community of Denton—provide conceptual and strategic means by which water in urban settings may be reclaimed as more than just an essentially hidden flood protection mechanism. SCS #16 operates as a piece of hybrid infrastructure. It has become a place of affordance. It affords the appearance of the local wild. It enables people to change habits of simply driving past a detention pond in some way labeled "OFF LIMITS!" Daily concepts and actions can be changed, and can be re-practiced to include the appearance and experience of the local wild (Fig. 7.6).

SCS #16, the hydraulic feature, is physically visible from the road. It is just one block from one of the primary travel and commercial routes in the city of Denton and it sits on a road that borders a newly developed large shopping area that has a concrete retarding pond behind a fence. SCS #16 is also visible in the sense of not being closed off either by legislation of "No Trespassing" ordinances (except late at night) or by categorization into an essentially private arena for exclusive use by soccer teams or fishermen or biologists.

We have the opportunity to forge new ways of living along riverbanks, enjoying the river, studying its watershed, and exploring its environment. The Trinity does not have the "excitement" of many great rivers. Yet, it is a crucial watershed for millions of people. It is muddy conceptually, and that is part of its charm. In its unassuming presence it blurs boundaries and in this we find an important message for urban watershed planning.

The "little lake" at SCS #16 gives us a small-scale everyday low level starting place for ways of engaging in our relationship to our watershed (Fig. 7.7), ways of studying our river basin and ourselves, ways of being within our watershed, and ways of promoting consciousness of our watershed environment. Part of its muddy secret is to allow in urban planning for some places to stay relatively un-planned.

Nature has, in a sense, reclaimed the infrastructure, providing a space for culture, while keeping an edge of wildness. We can explore a scale of recreational activities in which we relate the expansive metropolitan urban renewal projects in Dallas and Fort Worth with smaller scale interventions such as this one.

Fig. 7.6 Birds enjoying "little lake:" Scissor-tailed Flycatcher, Little Blue Heron, and Great Egret

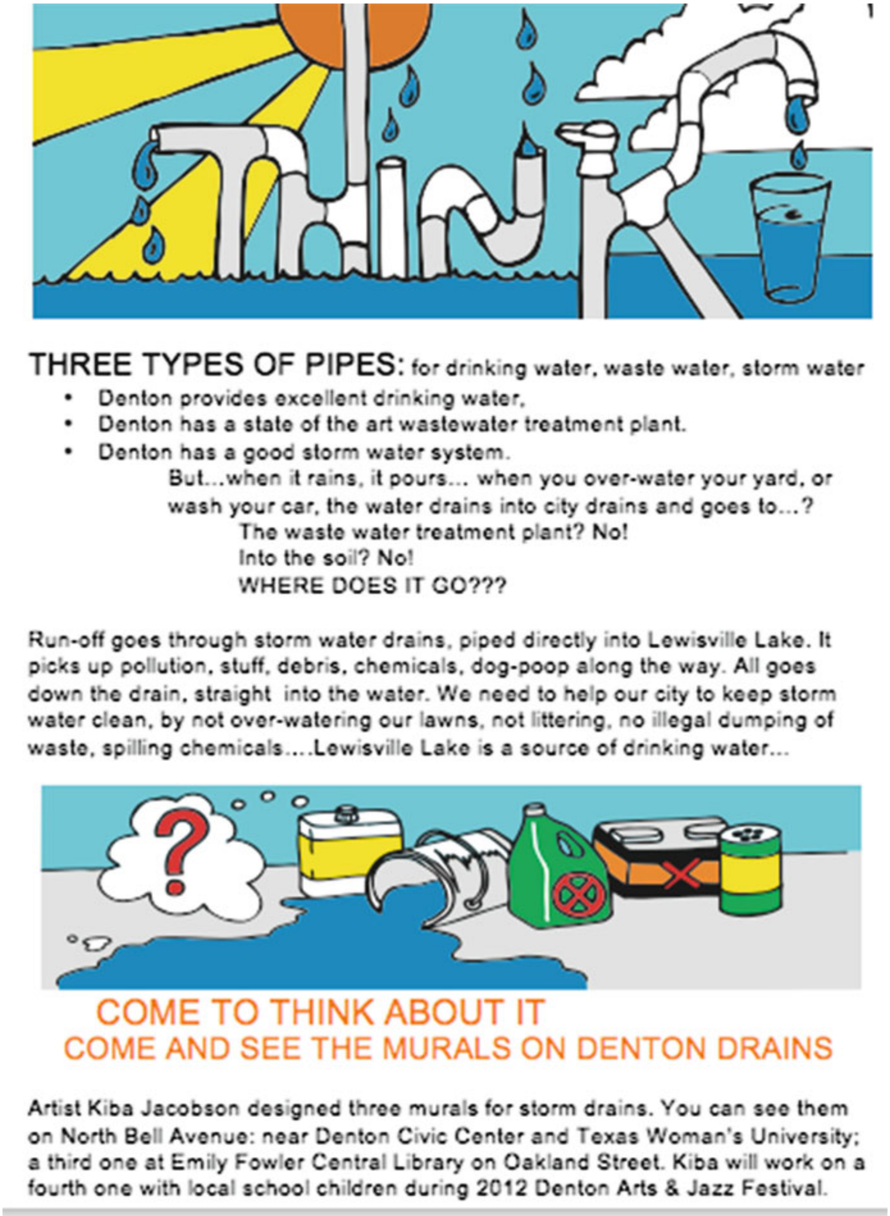
Fig. 7.7 People enjoying "little lake:" Prom night celebrating, full moon picture taking, and walking dogs

Nature in these small unpretentious little places is no longer 'foreign' or 'external', but intimate and physically immediate, fostering a connection with the environment and its inhabitants—some locals of Denton, the beavers, ducks, migratory birds, frogs, turtles, and so on. The capacity of SCS #16 to enrich citizens' lives through diverse low-key cultural activities is as important as its hydraulic retention capacity. The small cluster beaver, birds, turtles, frogs, ducks, and fish at the little lake in the Trinity watershed afford links to a "nature" not ordinarily available to city dwellers (Fig. 7.8). Nature and the people of Denton, Texas, have reclaimed a part of their hydrological infrastructure. It is turned into a technology of engagement, fostering a dynamic bio-cultural situation and allowing people to develop an environmental imagination.

Fig. 7.8 Life of "little lake:" beaver-cut tree, Killdeer close to its eggs in the gravel, turtle

Many situations have rolled out of this initial engagement. One of them made even the NBC television news: the collaboration with visual artist Kiba Jacobson and the City of Denton Watershed Protection Manager, environmental scientist David H. Hunter, of the Water Utilities of the City of Denton. As philosopher I did the general conceptualization for the project "Situation of Participation: Reclaiming the Infrastructure," and researched the issues with David and his crew, who hassled with all the practical political issues and we further researched with Kiba the final design for the infrastructural murals on Denton storm water inlet and outlet structures of Hickory Creek in Denton's civil center area. School children helped painting. http://www.nbcdfw.com/video/#!/weather/stories/Decorating-Storm-Drains/148971645 (Figs. 7.9 and 7.10).

The narrative of the openings vignette situates the details, forms an exquisite specificity, exquisite empiricism. It creates a picture of a place that has become a place of affordance, a place where people experience each other and the other.



THREE TYPES OF PIPES: for drinking water, waste water, storm water

- Denton provides excellent drinking water.
- Denton has a state of the art wastewater treatment plant.
- Denton has a good storm water system.

But...when it rains, it pours... when you over-water your yard, or wash your car, the water drains into city drains and goes to...?

The waste water treatment plant? No!

Into the soil? No!

WHERE DOES IT GO???

Run-off goes through storm water drains, piped directly into Lewisville Lake. It picks up pollution, stuff, debris, chemicals, dog-poop along the way. All goes down the drain, straight into the water. We need to help our city to keep storm water clean, by not over-watering our lawns, not littering, no illegal dumping of waste, spilling chemicals....Lewisville Lake is a source of drinking water...

COME TO THINK ABOUT IT

COME AND SEE THE MURALS ON DENTON DRAINS

Artist Kiba Jacobson designed three murals for storm drains. You can see them on North Bell Avenue: near Denton Civic Center and Texas Woman's University; a third one at Emily Fowler Central Library on Oakland Street. Kiba will work on a fourth one with local school children during 2012 Denton Arts & Jazz Festival.

Figs. 7.9 and 7.10 Flyers for outreach about storm water; artist working with children painting banners for storm water drains

Figs. 7.9 and 7.10 (continued)

Together the ecologist and the philosopher, researching the *logos* of the *oikos*, our home place, a living technology of engagement, initiate new possibilities by bridging nature and culture, by creating wonder, curiosity, and overtures to wonder and curiosity; this leads to further beginnings, questioning the taken-for-granted, which has often been our material realm, our infrastructure, the natural world, the background, the soil we live on, the water we drink, the water within us.

Philosophy and ecology meet in this questioning, in creating situations, in acknowledging situations, where they come together to question more deeply, in the watershed, the particular specificity of a detention pond, an infrastructural feature, a living technology, a technology of engagement.

This ecologist does not just create facts, this philosopher does not just create thoughts; rather, together they create knowledge, questions, feelings, commitments, connections, experiences, togetherness, encounters, overtures, situations, flourishing, places of particularities, conservation for habitats, public spaces where one meet each other and the other, or where one can be anonymous and left alone, where the river is a bridge, where a detention pond is a bridge. They feed science, the city planners, the ducks, the imagination. They create mindfulness.

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Part II
Ecological Worldviews: Aesthetics, Metaphors, and Conservation

Chapter 8
Introduction to Ecological Worldviews: Aesthetics, Metaphors, and Conservation

J. Baird Callicott

Abstract Although the scientist has succeeded the shaman and the priest as the custodian of unimpeachable knowledge of an esoteric reality beyond the ken of ordinary mortals, science is a social institution embedded in a larger worldview, from which it draws metaphors that reflect and reinforce that worldview. Thus to turn a critical eye on such scientific metaphors as "exotic," "alien," and "invasive" species is vital both to understanding and conserving the natural environment. Seizing on this dialectical relationship between science and worldview, Aldo Leopold essayed to reform the prevailing worldview to reflect the conceptual contours of evolutionary biology and ecology. Although now most renowned for his development of an evolutionary-ecological worldview and "land ethic," Leopold was an engaged naturalist, deeply involved in conservation policymaking. Likewise, Rachel Carson was more than a critic of DDT and other organochlorine insecticides, she too deserves a place alongside Henry Throeau, John Muir, and Aldo Leopold in the pantheon of environmental philosophy and ethics. While moral values are certainly critical drivers of human behavior in regard to the natural environment, aesthetic values are perhaps even more critical. They have played a central role in the national-park movement, not only in North America but all over the world. Thus careful reflection and realignment of aesthetic values, as well as moral values, within the emerging evolutionary-ecological worldview is vitally important to conservation as the twenty-first century unfolds.

Keywords Aldo leopold • Environmental aesthetic • Metaphors • Rachel Carson • Worldview

J.B. Callicott (✉)
Department of Philosophy, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-0920, USA
e-mail: callicott@unt.edu

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There is a reigning myth about science in the popular imaginary that is probably a modern projection of a proclivity buried deep in the human mind. It once was manifest in the magisterium of the shaman, then of the priest, now of the scientist, as Lisa Sideris points out. Science, so the myth now goes, has access to a Knowledge of a Truth about a Reality that transcends ordinary human knowledge, truth, and reality. This myth was reinforced by twentieth century philosophy—first by Logical Positivism and then by the Philosophy of Science. According to the Positivists, science provides two types of True Knowledge: (1) The exfoliations of the axioms, definitions, and postulates of formal logico-mathematical systems, which are "analytically true." (It is analytically true, for example, that the interior angles of a triangle equal two right angles.) And (2) "synthetic" empirical propositions, the elements of which (designators of objects and the relationships among them) correspond to the designated objects and the relationships among them. (It is true that "the cat is on the mat" if indeed the cat is on the mat.) In canonical philosophy of science, True Knowledge (or something close to it) is generated by the formulation of hypotheses, rigorous deductions of empirical consequences there from, and gathering observational or experimental data that indicate that those consequences obtain or do not obtain. If they do, the hypothesis is confirmed, if not it is falsified. Never mind that some sciences, including ecology as well as geology, are forcibly shoehorned into this mold derived from physics as the paradigmatic science.

Science, however, is a human institution, embedded in a larger human society, which is in turn embedded in an even more encompassing worldview. And science is in a dialectical relationship with the larger worldview in which it is embedded. For example, one likely condition for the rebirth of Western science (which was initiated by the ancient Greeks) in the sixteenth and seventeenth centuries was the biblical worldview in which God created the world and then created "man" in His own image. Early modern scientists thus took it on faith that the world was intelligible and that they could "think God's thoughts after Him"—or reverse engineer the creation, as we would say today. But science eventually led to skepticism concerning the existence both of a biblical God and human privilege, as the immensity of the universe became clear and, with that realization, another: the relative temporal and spatial marginality of humanity in comparison with the whole. Aldo Leopold, as Baird Callicott exposes, deliberately set out to reshape the prevailing worldview in the light of evolutionary biology and ecology, the unifying theme of his classic *A Sand County Almanac*, and to explore the axiological and normative implications of the evolutionary-ecological worldview that he promulgated.

Axiology is the field of philosophy that studies values and that field is divided into two main subdivisions, ethics and aesthetics. More conservation decisions have been based on aesthetical than on ethical values, as Sheila Lintott and Allen Carlson point out. Candidate areas for preservation as US National Parks had to meet explicit aesthetic criteria, which were largely visual and ultimately derived from landscape painting. To qualify as a National Park, an area needed to be "pretty as a picture"—reversing Aristotle's dictum that art imitates nature; rather, nature must imitate art if it was to be worthy of preserving. The Big Thicket National Preserve in Texas is administered by the US National Park Service, but is not designated a "park," but rather a “preserve,” because it fails to meet conventional criteria of scenic beauty. We need a more sophisticated environmental aesthetic, one informed by the evolutionary-ecological worldview.

The myth of science as a “value-free” and “objective” pursuit of knowledge is just that: a myth. Inescapable and cognitively indispensible are metaphors in science, as Brendon Larson persuasively argues. Physicists persist in speaking of subatomic “particles,” even though there is nothing particle-like about an electron or a photon. Metaphors can, thus, guide scientific thought in perverse ways and portray nature to laymen in wildly misleading terms. Metaphors are especially rife in evolutionary biology and ecology. Take “competition,” for example, a metaphor derived from the playing field and the free market, that when attributed to say plants living in close proximity to one another—“competing” for sunlight—agency is implicitly attributed to unconscious organisms. For most of the history of evolutionary biology, an emphasis on “competition” masked the equally fundamental and indeed more venerable evolutionary process of endosymbiosis. Scientific metaphors also carry baked-in values. Consider “alien,” “exotic,” “invasive” species. These terms all bring with them negative connotations, not unlike characterizing undocumented immigrants to the US as “illegal aliens.”

While Aldo Leopold is widely credited as a seminal figure in environmental philosophy and ethics, Rachel Carson has been largely ignored by scholars in the field, even by self-styled ecofeminists, and treated more as a polemicist against dichlorodiphenyltrichloroethane and other organochlorine insecticides. That should change. Carson, no less than Leopold, as Phil Cafaro documents, developed a sophisticated environmental ethic that was conceptually unified, if not explicitly built on “theoretical foundations” that philosophers would recognize as such. Carson was Leopold’s junior by 20 years, but Leopold may have read her book *Under the Sea Wind*, which was published in 1941, about the time he began working on *Sand County*. Carson was certainly familiar with Leopold’s land ethic, but is on record as having been disappointed by *Round River: From the Journals of Aldo Leopold*, edited by Luna B. Leopold and published in 1953, because of Leopold’s seeming disregard of the lives and suffering of the animals he records himself and his brother, Carl, hunting in those journals.

Rachel Carson certainly deserves to take her rightful place beside Henry David Thoreau, John Muir, and Aldo Leopold, in the pantheon of giants on whose shoulders contemporary environmental philosophers stand. But Aldo Leopold remains the tallest of these giants because he was on the cutting-edge of ecology as it matured in the twentieth century. While Baird Callicott provides an account of the Leopold’s philosophical *bona fides* (Leopold’s bold project of worldview remediation and the theoretical foundations of his land ethic), Curt Meine provides an account of the more practical side of Leopold’s work as a scientist, not only conscious of the philosophical and ethical implications of evolutionary biology and ecology, but a scientist engaged in shaping conservation policy and in boots-on-the-ground conservation practice.

Chapter 9
The Worldview Concept and Aldo Leopold's Project of "World View" Remediation

J. Baird Callicott

Abstract According to Kant, physical reality reaches human consciousness through three *a priori* filters: sensory receptors, spatial and temporal frameworks, basic cognitive architecture. It is also filtered by a classificatory and integrative network of concepts that are acquired *a posteriori* via enculturation and education generating a worldview. Worldviews are subject to change via further education. In *A Sand County Almanac*, Aldo Leopold is engaged in worldview remediation, replacing the culturally prevailing biblical worldview with an evolutionary-ecological worldview. In the time that has elapsed since the publication of that book, ecology has undergone many small and one major paradigm shift. What is the current ecological worldview?

Keywords Kant • Worldview • Ecology • Evolution • Community • Ecosystem • Organicism • Axiology

9.1 The Worldview Concept

In the eighteenth century, Immanuel Kant proclaimed a new "Copernican revolution"—*in philosophy* (Kant 2007).[1] According to Kant, reality, as we experience it, is thrice filtered: first through our sensory receptors (eyes, ears, nose, tongue, tactile nerves); then through the "forms of intuition" (our inbuilt spatial and temporal matrices); and

[1]See the Preface to the Second Edition of the First Critique for Kant's comparison of himself to Copernicus.

J.B. Callicott (✉)
Department of Philosophy, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-0920, USA
e-mail: callicott@unt.edu

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finally through the "categories of the understanding" (Kant 2007). These categories are very basic—such as unity, substance, and causality—identifiable, as such, in part because they are "*a priori*." That is, they exist in us as features of our minds, prior to all experience; and they are universal and necessary. To take but one of his "categories," by way of illustration, we are all, Kant thought, compelled by the very structure of our human thinking to believe that every event has a cause. Often we may not know what the cause of a given event is, and we may be aware of our ignorance thereof, but we persist in believing that it must have some cause, however much it eludes us. Indeed, in our ignorance, the causality category is so *a priori* that phantasmagoric causes for otherwise mysterious events—among them unseen spirits and gods—are often imagined. Things as they are in themselves—"noumena," Kant called them—lie beyond the pale of these subjective filters, forever inaccessible and unknowable. Rather, we experience "phenomena"—things as they present themselves to human consciousness filtered through our sensory receptors, spatial and temporal matrices, and cognitive architecture.

After Kant, the "correspondence theory of truth" is untenable. Our mental models of reality cannot be *true* to the extent that the elements of those models and connections between them exactly correspond—detail for detail, process for process—with the physical reality that they purportedly mirror. Why? Because the physical reality beyond our minds is inaccessible; we are imprisoned, so to speak, inside our windowless mental models with no possibility of escape. Certainly, from a biological point of view, the experienced world we inhabit is phenomenal. The human central nervous system translates various frequencies of radiation into color, various vibrations of the atmosphere into sound, various molecular aerosols into smells; and from these purely subjective conscious elements—colors, sounds, smells—our brains, in ways that still defy scientific understanding, construct the integrated phenomenal "world" that we experience. The actual unfiltered things that, in science, we posit to exist—photons; sound waves; and molecular, atomic, and subatomic particles—are themselves artifacts of the scientific imagination. Their existence is hypothesized in scientific theory and tested by scientific experiment. Contemporary science, no less than contemporary philosophy, has abandoned the notion of truth as correspondence. If phenomenal experience bears out the predictions of our scientific models, we can only claim that they are *confirmed*—not finally and absolutely true.

Kant believed that the sensory, spatio-temporal, and cognitive filters through which the objective "noumena" are manifest to consciousness as "phenomena" are the same for all humans; they are universal. Thus all humans share, he thought, a common "reality." Kant, notoriously, never left his native Königsberg, Germany (Kuehn 2001). One may well doubt that the categories of the understanding are universal, in light of the immense cultural diversity of which we are all now so keenly aware in the age of globality. That diversity has revealed a fourth filter screening noumenal objects from phenomenal consciousness: the myriad mental pigeonholes by means of which we classify and arrange the "things" we experience. More worldly nineteenth century moral philosophers and social scientists soon discovered that, however universal—that is, species-specific—may be our human sensory receptors, spatial and temporal matrices, and basic categories of the understanding, human classificatory and organizing gridworks vary from individual to individual and even more dramatically from culture to culture. Imagine an American Indian, a Puritan pilgrim, and a Swedish naturalist standing shoulder to shoulder in eighteenth-century New England and all encountering one and the same black bear. They might all agree that it was "one" and the "same" bear (unity and identity being universal Kantian categories of the understanding), but the Indian might think himself to perceive a manitou with a message from the spirit world, the pilgrim might think himself to perceive a minion of Satan, and the naturalist might think himself to perceive a species of the genus *Ursus*—*Ursus americanus* (and he might be glad that he does not perceive *Ursus arctos horribilis*). Each organizes the same sensory stimuli located in the same spatio-temporal coordinates by way of a very different set of classifying and organizing ideas—his personal and cultural conceptual framework.

Although the sensory inputs, spatial and temporal orientations, and perhaps even the Kantian categories of the understanding of the American Indian, the Puritan Pilgrim, and the Swedish naturalist, in this imagined scene, differ little, their *worldviews* differ profoundly—shaped by their profoundly differing conceptual matrices. Human sensory receptors may be artificially enhanced (by, for example, microscopes and telescopes) and expanded (by, for example, Geiger counters and sonar). Our spatial and temporal matrices may be slightly altered by reflections on non-Euclidean geometries and quantum physics. And perhaps not all peoples have exactly the same *a priori* commitment to causality or identity. But our conceptual frameworks—and therefore our worldviews—may be thoroughly transformed, even revolutionized, by education. Our sensory capacities, spatio-temporal matrices, and perhaps some very basic structures of thought are legacies of our biology and thus they vary little from specimen to specimen because we are all members of a single species and change biologically only by genetic drift, Darwinian natural (and sexual) selection, and the vagaries of fortune. Our highly detailed systems of concepts that classify and organize our phenomenal experience vary greatly because they are legacies of culture.

Culture evolves by Lamarckian processes—the transmission of *acquired* characteristics from one generation to the next (Dobzhansky 1963). In comparison with slow *genetic* Darwinian evolution, *memetic* Lamarckian evolution is lightening fast. For all people the daytime sky is blue, the stars shine in the black night sky, day follows night and night day in the same regular order of time, and the moon we see today we believe to be the same moon we saw yesterday. But how, conceptually, to organize and arrange these common phenomena? In the classical Greek and Roman cultures the sun, moon, planets, and stars were personified as gods and goddesses, and their relationships and movements were accounted for in elaborate cosmic soap operas. The ancient astronomers depersonalized the heavenly bodies and explained their movements mathematically in reference to a fixed and central Earth. Educated people today share a neo-Copernican worldview. We conceive of Earth as one among several planets orbiting the sun; we conceive of the sun as a star and of Earth's star as one among billions of stars in the Milky Way galaxy; and we conceive of the

Milky Way as one among billions of galaxies in a finite but unimaginably large and expanding universe. This tremendous worldview transformation occurred over just a few centuries and the speed of memetic evolution has been increasing exponentially every century from the sixteenth, when Copernicus's *De Revolutionibus* was published, to the twenty-first when Brian Greene's *The Fabric of the Cosmos* (to take but one of hundreds of examples) was published (Kuhn 1957).

9.2 Aldo Leopold's Project of Worldview Remediation

Aldo Leopold was many things—forester, game manager, wildlifer, ecologist (Meine 1988). But as a writer he was mostly in the business of worldview transformation; indeed worldview revolution. He announces his intentions in the Foreword to his masterpiece, *A Sand County Almanac*: "Conservation is getting nowhere because it is incompatible with our Abrahamic *concept* of land" (Leopold 1949, viii). One of Leopold's favorite rhetorical devices is synecdoche, letting the part stand for the whole (Tallmadge 1987). Our Abrahamic concept of land is, more forthrightly put, our inherited biblical worldview. In accordance with that worldview, Leopold (1949, viii) claims, "We abuse land because we regard it as a commodity belonging to us." Toward the end of the book, in "The Land Ethic," Leopold (1949, 204–205) once more evokes the same synecdoche for the biblical worldview: "Abraham knew what the land was for: it was to drip milk and honey into Abraham's mouth. At the present moment, the assurance with which we regard this assumption is inverse to our education."

Whether Leopold fairly interprets the environmental implications of the biblical worldview or not is beside my present point, which is that Leopold *thought* that the biblical worldview is incompatible with conservation and, rather than accommodate conservation to that worldview, he instead proposed to replace it with a more coherent and comprehensive alternative: "I suppose it may be said that these essays tell the company how it may get back in step" (Leopold 1949, viii). Thoreau (1854), as everyone knows, claimed to step to the beat of a "different drummer" and was proud to be out of step with the company—nineteenth-century American cultural attitudes and values. Leopold boldly insists that the company—twentieth-century American culture—get in step with the better beat of the drummer to which he had learned to march.

"When we see land as a community to which we belong," Leopold (1949, viii–ix) continues, "we may begin to use it with love and respect.... That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics." In my opinion, *A Sand County Almanac*, at first blush a mere hodgepodge of charming but disparate vignettes, has a single overarching and unifying theme and purpose—the exposition and promulgation of an evolutionary-ecological worldview, consilient with a neo-Copernican cosmological worldview, and its axiological (moral and aesthetical) and normative (practical ethical) implications.

As noted, after Kant, to determine the *truth* of a worldview by comparing it—point for point, process for process—to some objective reality is epistemologically impossible. We have no unfiltered access to any such objective reality. But we can determine the *tenability* of a worldview by two basic epistemological criteria. A tenable worldview must be at a minimum (1) self-consistent and (2) consistent with and comprehensive of all phenomenal experience. Science deliberately tests its hypotheses for self-consistency first and—through data collection and/or experimentation—deliberately seeks to expand phenomenal experience in an effort to falsify or confirm those hypotheses that pass the self-consistency test. For that reason, Leopold regarded the scientific worldview—of which evolutionary biology and ecology are consilient parts—to be a more tenable and a more viable worldview than are its historical antecedents. I think that Leopold would also add a third criterion for the tenability of a worldview: (3) it should be aesthetically and spiritually satisfying as well.

Sand County's Part I, "the shack sketches" tackles the task of worldview remediation indirectly by portraying the world as seen through the cognitive lens of a seasoned naturalist and professional ecologist—not just as seen with the bodily eye, but seen also with the "eye" of the ecologist's mind. As Leopold (1949, 173–174, emphasis added) notes in *Sand County*'s "The Conservation Esthetic," there was no greater American woodsman than Daniel Boone, but

> Daniel Boone's reaction depended not only on the quality of what he saw, but on the quality of the mental eye with which he saw it. Ecological science has wrought a change in the mental eye. It has disclosed origins and functions for what to Boone were only facts. It has disclosed mechanisms for what to Boone were only attributes. The incredible intricacies of the plant and animal community—*the intrinsic beauty* of the organism called America, then in full bloom of her maidenhood—were as invisible and incomprehensible to Daniel Boone as they are today to Babbitt [the title character—a militantly ignorant real estate salesman, booster, and social climber—of a novel by Sinclair Lewis, satirizing the middle-class American beliefs, attitudes, and values of the 1920s].

9.3 The Evolutionary Aspect

Part II of the *Almanac*, "Sketches Here and There," tackles the task of worldview remediation more frontally. Of sandhill cranes, in "Marshland Elegy," Leopold (1949, 96, emphasis added) writes, "His tribe we now know stems out of the remote Eocene. The other members of the fauna in which he originated are long since entombed within the hills. When we hear his call, we hear no mere bird. *We hear the trumpet in the orchestra of evolution.* He is the symbol of our untamable past, of that incredible sweep of millennia which underlies and conditions the daily affairs of birds and men."

Meditating on the extinct passenger pigeon, Leopold (1949, 109–110, emphasis added) writes, "It is a century now since Darwin gave us the first glimpse of the origin of species. We *know* now what was unknown to all the preceding caravan of generations: that men are only fellow-voyagers with other creatures in *the odyssey of evolution*. This *new knowledge* should have given us, by this time, a sense of kinship with fellow-creatures; a wish to live and let live; a sense of wonder over the magnitude and duration of the biotic enterprise. Above all, we should, in the century since Darwin, have come to *know* that man, while now captain of the adventuring ship, is hardly the sole object of its quest." Then, he takes a pointed dig at the worldview that he is trying to supplant: "and his prior assumptions to this effect"—in effect, biblical anthropocentrism—"arose from the simple necessity of whistling in the dark" (Leopold 1949, 110). Leopold (1949, 110) concludes these reflections on a note of frustration. "These things, I say, should have come to us. I fear they have not come to many." Compared with Darwinian evolutionary change, Lamarckian worldview change is lightning fast; compared with the needs of our times it is still painfully slow.

The *theory* of evolution can be characterized as "knowledge" because it is a highly confirmed, self-consistent worldview that is also consistent with and comprehensive of all known relevant facts—such as the geological age of the Earth, the existence of fossils, the family-like resemblances among both extinct and extant species, genomic data, and so on. It is also spiritually gratifying, inspiring in its adherents "a sense of wonder over the magnitude and duration of the biotic enterprise" and humbling, disabusing us humans of our arrogant cosmic self-importance. As well, it has non-anthropocentric ethical implications: "a sense of kinship with fellow creatures: a wish to live and let live."

So much for the evolutionary dimension of the evolutionary-ecological worldview that Leopold promulgates in *A Sand County Almanac*, what about the ecological dimension?

9.4 The Ecological Aspect

"Odyssey" is all about nutrients, first as they cycle repeatedly through biodiverse prairie ecosystems and then as they quickly wash away to the sea in the monocultures that replaced those ecosystems. At the centennial celebration of Leopold's graduation from the Yale Forest School, Gene Likens (2009, personal communication) commented that "Odyssey" perfectly captured the nutrient-flux side of ecosystem studies and that he had spent his whole career just measuring and quantifying X and Y, the atomic players in Leopold's allegory.

"Thinking Like a Mountain," is all about predator–prey dynamics and the relationship of those dynamics to vegetation cover and soil conservation. It is also, perhaps more importantly, about a moment of epiphany in the course of Leopold's evolutionary-ecological autodidactation. The "green fire" in the dying eyes of the old she-wolf mutely ask her killer, just as the voice of Jesus asked Saul of Tarsus on the road to Damascus, "Why persecutest thou me?" (Acts 22:7). We too can live and learn, just as did Leopold himself. We too can change our worldview, just as he did. Saul of Tarsus became Paul the Apostle. Leo (as his fellow foresters called him), the zealous predator exterminator, became one of the twentieth century's most eloquent advocates and protectors of predators. Both transformations—Paul's and

Aldo's—required a profound worldview change (marked by a name change). Maybe, Aldo hoped, he was but a harbinger of the worldview transformation that society as a whole was poised to undergo. *A Sand County Almanac* is crafted to nudge that process along. The confessional "Thinking Like a Mountain" demonstrates that worldview remediation is possible. It also demonstrates how a worldview remediator like Leopold can draw on the imagery and power of the very same traditional worldview that he is hoping to scuttle with the scientific worldview that he is striving to promulgate.

In "Song of the Gavilan," Leopold (1949, 149 emphasis added) rifs on the harmony-of-nature trope:

> Then on a still night, when the campfire is low and the Pleiades have climbed over rimrocks, sit quietly and listen for a wolf to howl, and *think hard* of everything you have seen and tried to understand. Then you may hear it—a vast pulsing harmony—its score inscribed on a thousand hills, its notes the lives and deaths of plants and animals, its rhythms spanning the seconds and the centuries.

Leopold (1949, 153) ends that vignette by drolly as well as dolefully lamenting the divorce between the sciences and the humanities, ecology and philosophy:

> There are men charged with the duty of examining the construction of the plants, animals, and soils which are the instruments of the great orchestra. These men are called professors. Each selects one instrument and spends his life taking it apart and describing its strings and sounding boards. This process of dismemberment is called research. The place for dismemberment is called a university.
>
> A professor may pluck the strings of his own instrument, but never that of another, and if he listens for music he must never admit it to his fellows or to his students. For all are restrained by an iron-bound taboo which decrees that the construction of instruments is the domain of science, while the detection of harmony is the domain of poets.

9.5 Axiological and Normative Implications

Part III of the *Almanac*, "The Upshot," concerns the axiological and normative implications of the evolutionary-ecological worldview. Here we stumble upon one of the most disastrous shibboleths of twentieth-century philosophy, the so-called "naturalistic fallacy": the dogma that science and ethics belong to separate universes of discourse, nor ever the twain should have permissible intercourse and legitimate issue. Facts and values, ethics and science, *is*es and *ought*s belong to hermetically sealed compartments of thought and speech (Black 1964). Thus, the very idea that the evolutionary-ecological worldview has ethical and aesthetic implications is anathema. The derivation of *ought*s from *is*es, values from facts, ethics from science is alleged to be a fallacy of formal logic. In the 1933 "The Conservation Ethic"—from which Leopold borrowed heavily in composing "The Land Ethic"—he notes that "Some scientists may dismiss this matter forthwith, on the ground that ecology has no relation to right and wrong. To such I reply that science, *if not philosophy*, should by now have made us cautious about dismissals"

(Leopold 1991a, 182, emphasis added). The sciences and the facts they disclose do inform our values and transform our ethics—and well they should. The scientific fact that *Homo sapiens* is a single species, originating in Africa and, from there, spreading all across the planet, makes belief in the superiority of a single human "race" untenable. Indeed racism is based on the false belief that race is a biological taxon analogous to species, but we know now—thanks to the human genome project, thanks to science—that it is not. We properly correct false values—racism, misogyny, homophobia, xenophobia—by appeal to the facts disclosed by science all the time. And there is nothing in the least fallacious about it.

The normative implications of the evolutionary-ecological worldview that Leopold derives in "The Land Ethic" are straightforward and direct. From Darwin himself in *The Descent of Man*, Leopold took the idea that human ethics evolved by natural selection as a means to social integration. As Darwin (1874, 120) colorfully put it, "No tribe could hold together if murder, robbery, treachery, &c., were common; consequently such crimes within the limits of the same tribe 'are branded with everlasting infamy'; but excite no such sentiments beyond these limits." If a tribe could not hold together, then, as solitaries, its erstwhile members could hardly survive and reproduce. Their murderous, larcenous, and treacherous genes would be winnowed from the gene pool, while those of the compassionate, sympathetic, and sociable members of well-integrated cooperative communities would be conserved. As Leopold (1949, 203–204, emphasis added) puts into a nutshell Darwin's evolutionary account of the origin of ethics: "All ethics so far *evolved* rest upon a single premise: that the individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in that community, but his ethics prompt him also to co-operate (perhaps in order that there may be a place to compete for)." Darwin (1874, 126–127) then imagined how the "these limits"—the tribal boundaries—might have been expanded and with them human ethics:

> As man advances in civilization, and small tribes are united into larger communities, the simplest reason would tell each individual that he ought to extend his social instincts and sympathies to all the members of the same nation, though personally unknown to him. This point being once reached, there is only an artificial barrier to prevent his sympathies extending to the men of all nations and races.

During the same year that Leopold put the finishing touches on his masterpiece (also the year of his death), 1948, the United Nations issued its Universal Declaration of Human Rights, fulfilling—at least in principle—Darwin's vision of mankind's social instincts and sympathies extending to the men (and women) of all nations and races. But Leopold's vision went further still. To the evolutionary foundations provided by Darwin, Leopold (1949, 204) added those of ecology: Ecology "simply enlarges the boundary of the community to include soils, waters, plants, and animals, or collectively the land"; and an evolutionary-ecological land ethic, according to Leopold (1949, 204), "changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it." From these evolutionary and ecological conceptual foundations, Leopold (1949, 224–225) famously distilled a summary moral maxim: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

9.6 What Is the Twenty-First Century Ecological Worldview?

That was written more than half a century ago and between then and now, both evolutionary biology and certainly ecology have undergone a series of paradigm shifts. The land ethic obviously seems to assume as definitive the biotic-community paradigm most clearly and elegantly expressed by Charles Elton (1927) in his classic, *Animal Ecology*, in which plants and animals occupied "niches," played "roles," and pursued "professions" in the "economy of nature." After their deconstruction by the likes of R. H. Whittaker (1951), J. T. Curtis (1959), and R. P. McIntosh (1967), do ecologists still believe that biotic communities exist as robust entities? And if they do, do they have any integrity and stability to be preserved?

Philosophers call questions about the existence of this or that, *ontological* questions. Does God exist? Do Platonic forms exist? Do ghosts exist? Do electrons exist? Do quarks exist? Do biotic communities exist? Existence may come in degrees. As A. G. Tansley (1935, 300, emphasis added) noted, "the systems we isolate mentally are not only included as parts of larger ones, but they also overlap, interlock, and interact with one another. The *isolation is partly artificial*, but it is the only possible way in which we can proceed." Do ecosystems exist?—say the Greater Yellowstone Ecosystem or a prairie soil ecosystem? Yes, but when we come to isolate them, to bound them, for purposes of ecological study, we partly create them. Perhaps we might best say that ecosystems exist potentially, like electrons, and their existence is fully actualized when ecologists isolate them for purposes of study, just as electrons emerge fully into existence when quantum physicists measure them.

Leopold's project of worldview remediation in *A Sand County Almanac* is far more artful and beguiling than it was a decade earlier. In a piece titled "The Arboretum and the University," published in 1934, Leopold (1991b, 209, emphasis added) more harshly perp-walks the prevailing cultural worldview and boldly looks to ecology for a replacement:

> For twenty centuries or longer, all civilized *thought* has rested on one basic premise: that it is the destiny of man to exploit and enslave the earth.
>
> The biblical injunction to "go forth and multiply" is merely one of many dogmas which imply this attitude of *philosophical* imperialism.
>
> During the past few decades, however, a new science called ecology has been unobtrusively spreading a film of doubt over this heretofore unchallenged "world view." Ecology tells us that no animal—not even man—can be regarded as independent of his environment. Plants, animals, men, and soil are a community of interdependent parts, *an organism*. No organism can survive the decadence of a member. Mr. Babbitt is no more a separate entity than is his left arm or a single cell of his biceps.… It may flatter our ego to be called the sons of man, but it would be nearer the truth to call ourselves the brothers of our fields and forests.

The ecological worldview to which Leopold here alludes is the superorganism paradigm championed by F. E. Clements (1905), the dean of American ecology during its first quarter century of existence as a distinct scientific discipline. The next year, A. G. Tansley (1935), introduced a new paradigm in ecology—the ecosystem paradigm—which is often characterized as a radical departure from Clementsian organicism (Worster 1977). While denying that "mature, well-integrated plant communities" were well-enough integrated to qualify as organisms, Tansley repeatedly declares that they are "quasi-organisms," existing in a state of "dynamic equilibrium," evolved to persist in that happy state by "natural selection" (Tansley 1935). By mid-century, E. P. Odum (1969) had virtually returned the dominant paradigm in ecology to its Clementsian roots, characterizing ecosystems in organismic terms. *A Sand County Almanac* reflects the state of ambiguity in ecology about the ecological worldview at mid-century. The dominant image of land that Leopold promulgates there is the Eltonian "biotic community." But, with his "fountain-of-energy" trope, first published a decade before he pasted it into "The Land Ethic", Leopold (1949, 216) also anticipates the way that R. L. Lindeman (1942) integrated Tansley's ecosystem concept with Elton's pyramid of numbers and rendered Elton's qualitative idea of food chains quantitatively as conduits of measurable energy (Leopold 1939). Leopold (1949, 221) also invokes the idea of "land health." But health is a state of an organism; and indeed, in the same passage Leopold (1949, 223) uses the phrase "land the collective *organism*." On the other hand, he expresses reservations about the "balance-of-nature" and evokes "the mental image of land as a biotic *mechanism*" (Leopold 1949, 214). So, is land an organism, a biotic community, an energy-flow and nutrient-cycling ecosystem, or a mechanism? Does late-twentieth-century hierarchy theory provide a satisfactory integration of these once disparate paradigms in ecology (O'Neill et al. 1986)?

In the decades following the publication of *Sand County*, the truly radical contemporary critique of Clementsian organicism by H. A. Gleason (1926)—making Tansley's seem tame by comparison—was revived as the "individualistic paradigm" in ecology, according to which each species is "law unto itself" and biotic communities are coincidental aggregates of species adapted to similar environmental gradients (Whittaker 1967; McIntosh 1975). Natural disturbance was emphasized and "disturbance regimes" identified (Pickett and White 1985). Anthropogenic disturbance, moreover, was recognized to be long-standing and ubiquitous, requiring humans to be factored in to ecological studies on a par with other ecologically significant agents (Pickett and Ostfeld 1995). Urban ecology thus emerged as no less worthy or oxymoronic a field of study in ecology than tropical ecology or grassland ecology (Douglas et al. 2011).

So, now in the midst of the second decade of the twenty-first century, we might well ask, Is there anything that can be characterized as an ecological worldview? And, if so, in what does it consist? Does ecology, that is, provide us with a conceptual framework that functions as a lens through which our sensory experience is classified and organized to form a coherent whole, an ecological worldview?

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Chapter 10
The Link Between Aesthetic Appreciation and the Preservation Imperative

Sheila Lintott and Allen Carlson

Abstract Aldo Leopold famously observed that a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. In this chapter, we pursue Leopold's insight by investigating the relationship between aesthetic appreciation and nature preservation. We note that in general there is a strong link between our aesthetic appreciation of an object and its preservation, but that in the case of nature it is important to understand the role of ecological concepts, such as integrity and stability, in this link. Examining the place of such ecological knowledge in the relationship between aesthetic appreciation and nature preservation requires pursuing the question of the nature of aesthetic appreciation itself. We first consider traditional answers to this question, grouping them into what we call the *formalist/picturesque approach* and the *relativist/postmodern approach*. We argue that these approaches not only exclude or belittle ecological knowledge, but also give somewhat inadequate accounts of the true nature and scope of our actual aesthetic experience of nature, specifically concerning the link between appreciation and preservation. We then introduce a *cognitive approach* to aesthetic appreciation, arguing that, in granting a significant role to ecological knowledge in the appreciation of nature, this approach not only gives a more adequate account of our actual aesthetic experience of nature, but also strongly supports the link between aesthetic appreciation and nature preservation. Moreover, it provides an elaboration of Leopold's insight.

S. Lintott (✉)
Department of Philosophy, Bucknell University,
67 Coleman Hall, Lewisburg, PA 17837, USA
e-mail: sheila.lintott@bucknell.edu

A. Carlson
Department of Philosophy, University of Alberta,
4936 Dalham Cr. NW, Calgary, T3A 1L7, AB, Canada
e-mail: allen.carlson@ualberta.ca

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10.1 Introduction

As is well known, in *A Sand County Almanac* Aldo Leopold wrote: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1966).

Some have wondered about the use of the word "beauty" here because it does not seem to fit with "integrity" and "stability." From the perspective of ecological science, beauty seems subjective and relatively trivial, whereas integrity and stability seem objective and relatively important. Leopold, however, saw beauty as occupying an important place in the interrelations between key ecological features of the biotic community, such as integrity and stability, and our obligations concerning preservation. Consequently, it is important to ask about the role of beauty in an ecological context. What are the links between ecology and beauty, and between beauty and preservation? How might ecological science be involved in the relationship between the aesthetic appreciation of the beauty of nature and nature preservation?

10.2 Aesthetic Appreciation and Preservation

Initially it is important to recognize that there is an obvious link between our aesthetic appreciation of things and our attitudes and actions regarding them. This may be most evident in our treatment of works of art. When such works are judged to be of exceptional aesthetic value they are preserved with great care and at great cost. And, other than in exceptional cases, there is agreement that it would be wrong to do otherwise. In other words, we believe we are obligated to preserve them and prohibited from destroying them. Although this link may be most evident concerning art, it is also clear in other areas of aesthetic appreciation. For example, in her study of the aesthetics of everyday life, environmental aesthetician Yuriko Saito concludes that contrary to the idea that our aesthetic appreciation of everyday matters is "trivial, insignificant, and innocuous," it has "serious implications and exert[s] a surprising degree of power over the state of the world and our life" (Saito 2007a). She notes that the "power of the aesthetic to influence, and sometimes determine, our attitudes and actions has actually been recognized and utilized throughout history and among different cultural traditions."[1] She surveys ways in which "aesthetics serves political, social, or commercial purposes," discussing examples such as how fascist governments such as Nazi Germany and imperialist Japan used aesthetics to promote nationalism and how modern consumer practices employ aesthetic considerations to "influence our purchasing decisions."[2]

[1] Saito, *Everyday Aesthetics*, p. 55.

[2] Saito, *Everyday Aesthetics*, pp. 56–57.

Saito further observes that the "power of the aesthetic" likewise extends to nature. Aesthetic appreciation influences our attitudes and actions toward nature in that the natural environments, landscapes, objects, and creatures we judge to be aesthetically exceptional are thought to be, as are great works of art, worthy of preservation.[3] And we are seriously offended if they are destroyed. In his classic discussion of what he calls Leopold's "Land Aesthetic," J. Baird Callicott puts the point clearly:

> Natural aesthetic evaluation has made a terrific difference to American conservation policy and management. One of the main reasons that we have set aside certain natural areas as national, state, and county parks is because they are considered beautiful.…What kinds of country we consider to be exceptionally beautiful makes a huge difference when we come to decide which places to save, which to restore or enhance, and which to allocate to other uses. Therefore, a sound natural aesthetics is crucial to sound conservation policy and land management.[4]

We take this link between what Callicott calls "natural aesthetic evaluation" and our judgments that certain parts of nature are worthy of preservation to be beyond serious dispute. The link here is between two judgments of value, the judgment that something has aesthetic value and the judgment that it should be preserved, in other words, the judgment that we have certain obligations regarding it. We move from aesthetic value to another evaluation of worth.[5]

There are two questions that we might consider regarding this link. First, although there is no doubt that the second judgment is a judgment about value, we might yet ask if it is a moral evaluation. The answer to this question is dependent upon what kinds of things we hold to be proper objects of moral value. If, for example, we take other sentient creatures to have moral value, then our judgment that they should be preserved is a moral evaluation. If we do not, it may not be a moral judgment, but instead, for example, only a prudential judgment. This issue is of great importance but beyond the scope of our topic. What is important here is that there is a clear and indisputable link between that which we aesthetically appreciate and that which we judge worthy of preservation, whether or not the latter is a moral judgment. Second, although this link is clear and beyond dispute, we might yet ask if the link is only to the fact that people feel and act as if they have an obligation to preserve that which

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[3] As will be evident later in this chapter, aesthetic experience does not always lead to preservation of nature in an unproblematic manner. Much depends on the particular account of aesthetic appreciation. For discussion of how the aesthetic can count both for and against preservation, see Saito, *Everyday Aesthetics*, pp. 58–65, and Yuriko Saito (2007b), as well as Sheila Lintott (2006). For a general discussion of the relationship between the aesthetics of nature and environmentalism, see Allen Carlson (2010).

[4] J. Baird Callicott, "Leopold's Land Aesthetic," in *Nature, Aesthetics, and Environmentalism*, ed., Carlson and Lintott, pp. 105–118, p. 106, previously published with the title "The Land Aesthetic" (Callicott 1994).

[5] If this is indeed a case of moving from aesthetic value to another evaluation of worth, then there may be no problem here concerning bridging the traditional fact/value distinction.

they aesthetically appreciate or to the stronger claim that they do in fact have such an obligation. Again, this question is beyond the scope of our topic, but two points are worth noting. First, some current discussions of what is called an "aesthetic imperative" support the link to the latter.[6] Second, however, even if the link is only to the former, that is sufficient for our purposes. What is important here is not the status of the obligation, but rather that we do in fact respect an obligation to preserve that which we aesthetically appreciate.

We can now address the question of the role of ecological science in this link between aesthetic appreciation and the obligation to preserve. Leopold's insight is that beauty occupies an important place in the interrelations between key ecological features of the biotic community, such as integrity and stability, and our obligations concerning preservation. So, what is the place of beauty in an ecological context? What role does ecological science play in the relationship between aesthetic appreciation and preservation? To address these questions, we must turn from the consideration of the power of the aesthetic to the nature of aesthetic appreciation itself.

10.3 The Question of Aesthetic Relevance and Two Traditional Answers

What is aesthetic appreciation? Moreover, how is an answer to this question relevant to our concerns here? In other words, how can we address this question such that we can determine whether or not ecological science plays any significant role in the relationship between aesthetic appreciation and preservation? Since ecological science provides a certain kind of knowledge about nature, it is useful to address the question of the nature of aesthetic appreciation in terms of what is called, within traditional aesthetics, the "Question of Aesthetic Relevance." The classic formulation of the question was presented by American aesthetician Jerome Stolnitz in the middle of the last century: "Is it ever relevant to aesthetic experience to have thoughts or images or bits of knowledge which are not present within the object itself? If these are ever relevant, under what conditions are they so?" (Stolnitz 1960).

Given Stolnitz's way of putting the question of aesthetic relevance, our question here is whether ecological knowledge is a "bit of knowledge" that, although "not present within the object itself," is nonetheless "relevant to aesthetic experience." It is useful to begin by considering the traditional answers to the question of aesthetic relevance. These answers can be gathered into two groups, what we will call the *formalist/picturesque approach* and the *relativist/postmodern approach*. These two points of view are diametrically opposed to one another; the former tends to be conservative, purist, absolutist, universalist, and objectivist, the latter

[6] Rolston employs the notion of an "aesthetic imperative" in Holmes Rolston III (2002). For a discussion of this and other aspects of Rolston's aesthetics, see Allen Carlson (2006).

liberal, permissive, relative, personal, and subjectivist. And, as we shall see, neither approach has very much of a role for ecological science.

The formalist/picturesque approach can be illustrated by the classical position of British art critic Clive Bell and by that of late eighteenth century picturesque theoreticians, most notably William Gilpin. The aesthetic formalist claims that nothing other than that which is "present within the object itself," that is, lines, shapes, and colors, is relevant to aesthetic appreciation. Bell is notorious for saying that "to appreciate a work of art we need bring with us nothing but a sense of form and colour…we need nothing from life, no knowledge of its ideas and affairs" and that in appreciating nature all that is relevant is a "vision of landscape as pure form" by which, "instead of seeing it as fields and cottages," an appreciator must contrive "to see it as a pure formal combination of lines and colours" (Bell 1958). The answer given to the question of aesthetic relevance by the picturesque tradition is almost as narrow, in that, in addition to lines, shapes, and colors, this tradition grants aesthetic relevance only to landscapes that are classically scenic. The focus is primarily on minimal compositional features, such as having a background, a middle ground, and a foreground, and nominal subject matter, such as some high land, some water, and perhaps a few peasants and cows.[7] Although these particular sources for the formalist/picturesque point of view are historical, it should also be noted that these kinds of positions are not without contemporary supporters.[8] For example, British philosopher Nick Zangwill holds a moderate version of aesthetic formalism for works of art, but an extreme version for inorganic nature, in which only properties such as lines, shapes, and colors are relevant. He contends:

> Extreme formalism about inorganic nature seems obvious to me. Surely, where a natural thing has no purpose, we need only consider what we can immediately perceive…. The beauty of an inorganic natural thing at a time is surely determined just by its narrow nonaesthetic [i.e., perceptual] properties at that time. Anything else may be interesting, but it does not (or should not) affect aesthetic appreciation.[9]

The other approach to the issue of aesthetic relevance, what we call the relativist/postmodern approach, is primarily defended by contemporary aestheticians. In general, the point of view is that almost any "thoughts or images or bits of knowledge which are not present within the object itself" can be relevant to aesthetic appreciation. At the postmodern extreme, the aesthetically relevant "thoughts or images or bits of knowledge" can apparently include almost anything that happens to occur to an appreciator, while the less radical relativist position limits the relevant "thoughts, images and bits of knowledge" to those that play a significant role within

[7]The main theoreticians of the picturesque and their classic works are William Gilpin, *Three Essays: On Picturesque Beauty, On Picturesque Travel, and On Sketching Landscape* [1792]; Uvedale Price, *An Essay on the Picturesque* [1794]; and Richard Payne Knight, *The Landscape* [1794], *Analytical Inquiry into the Principles of Taste* [1805].

[8]Contemporary supporters of various aspects of the picturesque tradition include, for example, Robert Stecker (1997), Donald W. Crawford (2004), Thomas Leddy (2005), and Isis Brook (2008).

[9]Nick Zangwill (2001). For criticisms of aesthetic formalism, see Allen Carlson (2000) as well as Glenn Parsons and Allen Carlson (2004).

some larger cultural context. Thus, while the former is almost completely subjective, the latter is a species of cultural relativism. The postmodern alternative is seemingly endorsed by contemporary aesthetician Thomas Heyd, who proposes that "there are good reasons for believing that aesthetic appreciation does and should benefit from a great many diverse stories," arguing that such "stories, verbal and non-verbal, artistic and non-artistic, may in various ways stimulate the play of the imagination… which may in turn lead to enhanced aesthetic appreciation of the natural world" (Heyd 2001). A position more along relativist lines is defended by Yuriko Saito, who holds that the different ways in which cultures attempt to understand nature can be aesthetically relevant, adding that:

> I believe that…the effort to "make sense of" nature's various phenomena and objects… [can] include some indigenous traditions, folklore, and myths…tales that attempt to explain or make sense of observable features of specific natural objects….the interests that motivate these narratives are the shape of a mountain, the particular climate of a region, the spawning behavior of a fish, and the color, shape, and habitat of a flower (Saito 1998a).

10.4 Problems with the Traditional Approaches

As should be evident, neither the formalist/picturesque nor the relativist/postmodern response to the question of aesthetic relevance have any special place for ecological science. In the former, no knowledge of any kind has a role in aesthetic appreciation, while in the latter, even if some ecological knowledge has a role to play, it can easily be trumped by personal and cultural associations. However, these alternatives are inadequate, not because they exclude or belittle ecological knowledge, but rather because they give inadequate accounts of the true nature and scope of our actual aesthetic appreciation.

First, consider the formalist/picturesque point of view, which seems to limit the scope of aesthetic appreciation. Saito emphasizes this in her defense of the cultural relativist view:

> This approach to nature [the formalist/picturesque position] has…encouraged us to look for and appreciate primarily the *scenically* interesting and beautiful parts of our natural environment. As a result, those environments devoid of effective pictorial composition, excitement, or amusement (that is, those not worthy of being represented in a picture) are considered lacking in aesthetic values (Saito 1998b).

As Saito says, given this approach, there are environments, indeed, there are entire kinds of environments, that are relegated to the status of "lacking in aesthetic values." However, such environments in fact may only be lacking in one particular kind of aesthetic value—the scenic or picturesque. Historically this has been the case with environments such as flat lands, badlands, and wetlands. For example, traditionally wetlands such as bogs, swamps, mires, fens, and marshes have been considered unworthy of aesthetic appreciation.[10] However, along with Saito, we

[10]For discussions of the ways in which wetlands have been "considered lacking in aesthetic value," see Allen Carlson (1999), Holmes Rolston III (2000), and J. Baird Callicott (2003).

reject this point of view. There seem to us to be no kinds of natural environments that, simply because of the kinds of environments they are, lack aesthetic value and are thus beneath or beyond our aesthetic appreciation.[11] In short, the answer given to the question of aesthetic relevance by the formalist/picturesque tradition greatly limits and thereby distorts the scope of our actual aesthetic appreciation of the natural world.

What then is wrong with the answer to the question of aesthetic relevance that is provided by the relativist/postmodern point of view? The problem here is that by holding that almost any "thoughts, images, or bits of knowledge" can be aesthetically relevant, this approach complicates the line of thought that, at the outset of this chapter, we claimed to be clearly beyond reasonable doubt. This is the assertion that there is a strong link between the judgment that a thing has aesthetic value and the judgment that it should be preserved. By accepting as aesthetically relevant almost any associations that an individual or a culture may have, the relativist/postmodern approach weakens this link. There can be no secure, reliable movement from aesthetic appreciation to preservation if the aesthetic appreciation is very subjective or relative. This is more evident with the postmodern version of this approach because on this view aesthetic appreciation is strictly personal and consequently completely subjective, which clearly undercuts any meaningful connection to preservation, since preservation is obviously a public matter. The point is forcefully put by Australian philosopher Janna Thompson: "If beauty in nature…is merely in the eyes of the beholder, than no general moral obligation arises out of aesthetic judgments." She concludes that a "judgment of value that is merely personal and subjective gives us no way of arguing that everyone ought to learn to appreciate something, or at least to regard it as worthy of preservation" (Thompson 1995).

This criticism is more serious for the postmodern version of the relativist/postmodern approach, since it emphasizes the associations of individual appreciators. By contrast, the relativist version of the approach stresses "thoughts, images, or bits of knowledge" that are held at a cultural or societal level. Consequently, with the relativist view there is more possibility of consensus concerning aesthetic judgment and thus more possibility of avoiding Thompson's criticism. Moreover, some versions of the relativist position hold that in addition to, as Saito puts it, "indigenous traditions, folklore, and myths," in some cases ecological information is also relevant.[12]

[11] Within the tradition of Western aesthetics, it has frequently been held that anything that can be perceived can be aesthetically appreciated. For example, see Paul Ziff (1979).

[12] Saito defends the relevance of both "folk narratives" and scientific information in "Appreciating Nature on Its Own Terms." She writes: "Both scientific explanation and folk narratives are our attempts at helping nature tell its story to us concerning its own history and function through its sensuous surface" (p. 147). In this article, Saito also attempts to distance her own position from what she calls "associationist appreciation," which is similar to what we call the postmodern approach. However, in *Everyday Aesthetics* she somewhat retreats from this position for some "natural objects and environments" such as the Gettysburg battlefield. See *Everyday Aesthetics*, p. 80, note 80. It is worth noting that her example is not a clear case of a simple natural environment, but rather a landscape of great historical and cultural significance, for which cultural information is certainly relevant to its appropriate aesthetic appreciation.

However, even if ecological science is given some role in the relativist account, the link between aesthetic appreciation and preservation can be obfuscated by this position. This becomes clear when different sources of information come into conflict, such as, for example, cultural stories and ecological information. An interesting case is provided by aesthetician Marcia Eaton, who notes that the 1923 book by Felix Salten called *Bambi*, and especially the subsequent Disney film version, made it "incredibly difficult to look at a deer in terms that are true to it…and even more difficult to respond to it in terms appropriate to the role it…plays in…ecological systems" (Eaton 1998). The deer mythology generated by the book and the film produced very positive appreciation of deer and resultant pressure for their preservation, which proved to be out of step with ecological science and, in some instances, caused extreme ecological damage to other species. Without the Bambi myth, we imagine deer appreciation and preservation could have taken a different, perhaps more ecologically informed, direction. In short, when the diverse sources of information that are acknowledged by the relativist position come into conflict, the upshot can be conflicting aesthetic appreciation, which can problematize any move from appreciation to preservation.

Consequently, the relativist/postmodern point of view ultimately provides little ground for consensus when, as Callicott puts it, "we come to decide which places to save, which to restore or enhance, and which to allocate to other uses." Thus, the relativist/postmodern approach seems not to constitute what he terms "a sound natural aesthetics," which he insists "is crucial to sound conservation policy and land management." However useful the relativist/postmodern position may be in encouraging individuals to interact with and learn to aesthetically appreciate nature on their own terms, without requiring guidance from other sources, this approach cannot guide us from appreciation to preservation without encountering difficulties.

10.5 A Cognitive Approach

In light of the problems facing the formalist/picturesque and the relativist/postmodern responses to the question of aesthetic relevance, let us consider another alternative. On this approach, aesthetic appreciation is characterized as cognitive. In answer to the question of aesthetic relevance, this position holds that there is at least one "bit of knowledge" that is "not present within the object itself" and is yet centrally relevant to the aesthetic appreciation of that object. This key aesthetically relevant knowledge is knowledge of what can be called the object's "history of production," that is, knowledge about how the object came to be and thus came to be as it is. In short, it is the knowledge of why the object of our aesthetic appreciation, which is directly presented to our senses, is presented to our senses as it is. As with the important link between our aesthetic appreciation of things and our preservation of them, this position is perhaps most evident in respect to our appreciation of works of art. With almost any work of art, some knowledge of its history of production, that is, knowledge of how it came to be what it is, is vital to its appropriate aesthetic appreciation. Because we possess such knowledge, we know, for example, that a particular object is a painting and thus must be appropriately appreciated by looking, while another is a musical composition that consequently can be appropriately appreciated only by listening. It is also how we know to aesthetically appreciate a haiku differently from a novel, a Caravaggio differently from a Pollock, and Handel's *Messiah* differently from the Beatles' *Rubber Soul*.

Returning to the aesthetic appreciation of nature, an important part of the "history of production" of any natural environment, landscape, object, or creature is revealed by science. Thus in respect to the aesthetic appreciation of nature, the *cognitive approach* is known as *scientific cognitivism*.[13] What is especially significant here is that a central component of the science that scientific cognitivism deems relevant to aesthetic appreciation of nature is ecological science, and thus ecological knowledge is centrally relevant to nature's appropriate aesthetic appreciation. This is the important ramification of scientific cognitivism for the question of how ecological science might be involved in the relationship between our aesthetic appreciation of nature and its preservation. Given the scientific cognitivist account, ecological knowledge and aesthetic appreciation of nature, and thus nature preservation, are importantly linked. However, when aesthetic appreciation is the basis for preservation, the link is not directly between ecology and preservation. Rather it is between ecological science and preservation by way of aesthetic appreciation in that the former, ecological science, is vital to appropriate aesthetic appreciation of nature, which appreciation is in turn a basis for preservation. Given its account of the aesthetic appreciation of nature, scientific cognitivism embeds, as it were, ecological knowledge within appropriate aesthetic appreciation, resulting in a judgment of aesthetic value from which there is, as we noted earlier in this chapter, a clear link to a judgment concerning the imperative of preservation.[14]

Moreover, not only does scientific cognitivism connect aesthetic appreciation, ecological science, and preservation, it also helps to illuminate Leopold's famous insight quoted at the outset of this chapter, in which he relates beauty, ecological features like integrity and stability, and preservation. This is not surprising, for, although Leopold's thoughts on the appreciation of nature predate the scientific cognitivist account of aesthetic appreciation of nature by over 30 years, the two positions are quite similar. Callicott describes Leopold's land aesthetic as follows:

> The land aesthetic is sophisticated and cognitive, not naïve and hedonic, it delineates a refined taste in natural environments and a cultivated natural sensibility. The basis of such refinement or cultivation is natural history, and more especially evolutionary and ecological biology.[15]

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[13]The initial presentation of scientific cognitivism is Allen Carlson (1979). For elaboration of the position, see Allen Carlson, *Aesthetics and the Environment*. For a comparative analysis of several of the contemporary position concerning the aesthetic appreciation of nature, see Glenn Parsons (2008).

[14]Here again the traditional fact/value problem is perhaps avoided, since when ecological facts are embedded within aesthetic appreciation, there is no direct movement from facts to values. The movement is from aesthetic value, not directly from ecological facts.

[15]Callicott, "Leopold's Land Aesthetic," p. 116.

10.6 Conclusion

In conclusion, we offer an illustration to help clarify the lines of thought in this chapter. Consider the aesthetic appreciation of two stands of trees. Imagine that they are almost identical in appearance, each a large swath of forest glowing golden in the setting sun. Each may stir an initial aesthetic response. However, further imagine that one is a stand of tamarack, the needles of which are golden due to the coming of autumn, while the other is a stand of pine, the needles of which are golden because of an infestation of pine beetles. If we know the "history of production," as it were, of these two stands of trees, that is, if we possess the relevant ecological knowledge about tamaracks, seasonal change, pines, and the deadly pine beetle, this knowledge will inform our appropriate aesthetic appreciation of the two stands of trees. The stand of tamarack glowing in the setting sun will most likely be experienced as a thing of beauty, while the stand of dead and dying pine, although also glowing in the sun, may rather be aesthetically experienced as ugly or at least not as a straightforward source of aesthetic pleasure.[16] And when we come, to return to Callicott's words, "to decide which places to save, which to restore or enhance, and which to allocate to other uses," it may well be that, if we must choose between the two stands, then, at least in part on the basis of our aesthetic appreciation of each, we will decide to preserve the stand of tamarack and to allocate the stand of pine to other uses.

In light of this example, it is also evident how the formalist/picturesque and the relativist/postmodern points of view each fails to constitute, again in Callicott's words, "a sound natural aesthetics" on which to base "sound conservation policy and land management." The former, limited as it is to lines, shapes, and colors or at best to simple compositional features and stock subject matter, has no grounds for differing aesthetic appreciation of the two stands of trees, since they are, in this case, almost identical in appearance. Thus, in such a situation aesthetic appreciation can provide no basis for different policy or management decisions. By contrast, the relativist/postmodern point of view could provide such a basis. However, the problem here, as noted above, is that the approach can accept as aesthetically relevant, in addition to ecological information, conflicting associations, mythologies, and cultural narratives. For example, in this case there could be peculiar, unusual, or even weird associations or cultural traditions, such as, for instance, an extreme personal or cultural fondness for beetles or an acute aversion to any signs of the coming of winter. This could yield eccentric aesthetic appreciation on the part of some appreciators, thereby preventing the kind of consensus important for sound conservation policy and land management. Moreover, even if agreement were to be achieved on the basis of some such eccentric aesthetic appreciation, perhaps, for

[16]The issues here are not as simple as this would suggest. First, the stand of dying pine might be aesthetically stirring even if not in a straightforwardly positive way, perhaps, for example, as a tragic or a sublime landscape. Second, our aesthetic reaction may well be influenced by whether the beetle infestation is a naturally occurring phenomenon or the product (or byproduct) of human action. It seems that a negative aesthetic response would be more appropriate in the latter case than in the former. Concerning the second point, see Allen Carlson (1984).

instance, within a particular beetle-worshiping culture, it may not be a consensus on which one would want to base conservation policy and land management.

This illustration of two almost identical stands of trees not only makes clear the weaknesses of the formalist/picturesque and the relativist/postmodern points of view, it also more fully supports the cognitive approach. Returning briefly to the above-noted comparison with the aesthetic appreciation of works of art, imagine two almost identical paintings, one representing the stand of tamarack and the other the stand of pine. Without any cognitive input, there would be little or no grounds for any significant difference in the aesthetic appreciation of the two painting. However, even a minor bit of knowledge, such as that the former work is titled, for example, *The Coming of Autumn* while the latter is *The Death of a Forest*, can make the appropriate aesthetic experiences of the two works dramatically different. This, of course, is not to say that awareness of the cognitive dimension is all that is involved in such experiences; they also require capabilities such as attentiveness, sensitivity, and taste. However, it does demonstrate that the cognitive component, even when fairly minor, is yet a vital aspect of appropriate aesthetic appreciation. And, as noted above, this is no less true of aesthetic appreciation of nature than it is of art. Without the knowledge of natural science emphasized by scientific cognitivism, the aesthetic appreciation of nature is not simply an inadequate basis for sound conservation policy and land management, it also risks being, as some environmental philosophers have claimed, superficial, trivial, and shallow. For example, Callicott charges that when not "well informed by the ecological and evolutionary revolutions in natural history," aesthetic appreciation of nature "is not directly oriented to nature on nature's own terms;…[and] is superficial and…trivial."[17] Holmes Rolston agrees, suggesting that concerning the appreciation of nature "most aestheticians begin… rather shallowly," although he adds that if instead "aesthetics itself comes to find and to be founded on natural history," then it has important environmental ramifications. In such a case, his answer to the question "Does environmental ethics need such aesthetics to be adequately founded?" is "Yes, indeed."[18]

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[17] Callicott, "Leopold's Land Aesthetic," p. 109.

[18] Rolston, "From Beauty to Duty," p. 141. An earlier version of this chapter, with the title "The Aesthetic Dimension of the Interrelations between Ecological Science and Ethics: The Other Leopoldian Bridge," was presented at the 2011 Cary Conference, Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action. We thank those present at the conference for valuable feedback concerning the issues here addressed.

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Chapter 11
The Metaphorical Links Between Ecology, Ethics, and Society

Brendon M.H. Larson

Abstract It is now widely understood that metaphors are not simply rhetorical embellishment in science, but serve a critical epistemic role for the creation and exploration of theories. Three prevalent ecological metaphors—competition, invasion, and resilience—serve as examples and touchstones of the role of metaphors in ecology, and how their origin and operation as "feedback metaphors" interweaves ecology with its social context. In each case, the social origin of these metaphors implies that they are value-laden at the level of interpretation (i.e., due to their resonance with everyday language) and/or at the level of worldview (i.e., due to the way they highlight some aspects of a comparison while hiding others). Thus, metaphoric choices in ecology should be subject to ethical scrutiny. In effect, this necessitates paying attention to the "evolutionary ecology" of metaphors in ecology itself—that is, attention to factors such as their context, diversity, history, and scale. These normative elements in metaphors bear directly on perennial discussions about objectivity and advocacy in ecology, and how ecologists should use metaphors in science while being cognizant of and sensitive to their social context.

Keywords Advocacy • Science • Society • Values • Worldview

Over the past several decades, the role of metaphors in scientific inquiry has become much more widely appreciated. A metaphor is a figure of speech by which we understand one thing in terms of another, and most of us learned about them in the context of English courses in high school—or perhaps during our undergraduate education. We learned that "the slings and arrows of outrageous fortune" in Hamlet's

B.M.H. Larson (✉)
Department of Environment and Resource Studies, University of Waterloo,
200 University Avenue West, Waterloo, ON N2L 3G1, Canada
e-mail: blarson@uwaterloo.ca

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famous "to-be-or-not-to-be" soliloquy were not actual slings and arrows, but unpleasant things in his life (which he considered ending, by suicide). Hamlet could have just referred to them as the "problems of life." Instead, Shakespeare employed a poetic metaphor as rhetorical embellishment to 'dress up' his narrative. If this is all metaphors do—put the bare facts poetically—then it is not surprising that metaphors were widely disparaged in scientific writing until quite recently (Ortony 1993), despite their continual use. However, it is now increasingly recognized that metaphors are not simply embellishments, but cognitive instruments in science that have an "epistemic"[1] function in helping us to understand complex relationships and/or what was formerly unknown (e.g., Keller 1995; Brown 2003).

Here, I don't have space to discuss the origin and function of scientific metaphors in detail. Instead, I focus on how metaphors operate as links between ecology and its social context, demonstrating that (i) ecological metaphors originate from the everyday social world; (ii) they are thus value-laden; and (iii) their use in ecology thus requires ethical reflection, particularly in the context of advocacy for conservation outcomes. (For further discussion of these ideas, see Larson 2011a.)

Metaphors permeate ecology (Worster 1985; Larson 2011a), so a few concrete examples—competition, invasion, and resilience—will help to indicate their epistemic function. Each of these terms was adopted as a central metaphor in ecology at a particular point in time: competition a little after the time of Charles Darwin, invasion with Charles Elton in the mid-twentieth century, and resilience with C. S. Holling a few decades ago (see, respectively, McIntosh 1992; Elton 1958; Holling 1973). They were not simply embellishment, but central concepts adopted by ecologists to better understand natural phenomena by reference to everyday phenomena that were already known. In this sense, then, they were "constitutive" metaphors that directed ensuing empirical inquiry down particular paths rather than others. As time passed, one might say that they were increasingly interpreted as part of the foundation of ecology, that is "factual," because they were (arguably) subject to empirical test, and more or less empirically supported.

Ecologists chose these metaphors because they helped to understand phenomena; and they did so because of an apt comparison with something everyday and better known. Returning to our examples, ecologists inhabited a world where humans themselves competed and invaded territories, and where the meaning of "resilient" was clear in the context of everyday experiences with things that recover their shape after stress or expansion (e.g., an elastic band). By applying this everyday understanding to something new (that is, by using it metaphorically), ecologists obtained an ability to better conceptualize and therefore to investigate phenomena in nature.

But the choice of these metaphors was also an interpretive and definitive act. The choice of these metaphors was not inevitable because ecologists could have adopted other ways of understanding by choosing other metaphors. Other metaphors, however, may not have resonated as well with the cultural contexts in which

[1]Epistemic means "of or pertaining to knowledge." In this sentence, notice several instrumental metaphors ("instrument" and "function") for metaphors.

ecologists introduced them. The chosen metaphors reflected prominent aspects of the prevailing zeitgeist. The role that symbiosis plays in contemporary evolutionary biology demonstrates that early ecologists might have chosen some other metaphor than competition (Larson 2011a), and it also demonstrates that scientists are more likely to choose metaphors and follow the lines of inquiry to which such metaphors point because they resonate with the prevailing cultural assumptions about the world.

According to Keddy (1989), as another example, the competitive and masculine culture in ecology prioritized study of competitive interactions (and associated empirical exploration) over cooperative ones (also see Boucher 1986). Further, some scholars question whether competition is an appropriate metaphor for passive interactions, such as the shade of one plant preventing the growth of another, that are transformed by the metaphor into combative ones (e.g., Keller 1988). Davis et al. (2001) claim that the Nazi threat to mid-twentieth century Britain incited Elton to adopt the metaphor of "invasion" (as opposed to viewing highly mobile species as simply spreading or expanding demographically). I'm not familiar with published explanations for the recent rise of the resilience metaphor in ecological thought, though this would be an interesting topic for an historian of ecology to pursue.

Moreover, there is synergistic feedback between the metaphors adopted within ecology (and other sciences) and the cultural context in which they originate (e.g., Stepan 1986; Bono 1990; Maasen et al. 1995). Elsewhere (Larson 2011a), I have made the case for calling these "feedback metaphors."[2] The metaphors originate in everyday language; they are applied within science, where their use shapes scientific inquiry; and, their use in science in turn feeds back into culture. If this were not the case, the metaphoric referent would have been too obscure to be useful and to communicate to other scientists as well as to lay people (including funders and the broader public). If scientific metaphors did not reflect and resonate with their cultural context, they would not endure—and indeed many have not. For example, as space exploration has been given a lower and lower public policy priority, the "spaceship-Earth" metaphor, ubiquitous around the time of the spectacular Apollo moon missions, has all but dropped out of environmental discourse.

The referents of feedback metaphors occur at various scales. Often the referent is bodily experience—e.g., so-called cognitive metaphors sensu Lakoff and Johnson (1980), such as "balance," which is the referent of mathematical equilibrium according to Cuddington (2001). In other cases, the referent of a metaphor is cultural. The cultural context of some metaphors may be somewhat obscure (e.g., a "keystone" species, drawn from Medieval architecture), or they may sometimes reflect the discourse of the day—called discourse metaphors by Zinken et al. (2008)—e.g., "meltdown," drawn from nuclear-power-plant accidents, which, in turn, is drawn from metallurgy. Sometimes a metaphor may be much more deeply embedded in the cognitive structure of the society—called root metaphors by Pepper (1942)—e.g., "mechanistic" explanations.

[2] Note that this choice of a metaphor is steeped in a cybernetic view of the world (see Larson 2011a).

Given that these core metaphors in ecology reflect the society in which they occur, they are implicitly (or sometimes explicitly) value-laden. This occurs not least because metaphors can have different meanings ("polysemy"), which occurs at various levels as well. At an interpretive and psychological level, many of these metaphors have a popular "resonance" that is quite strongly value-laden, for example "invasive" species are, by that token, bad things. The value resonance of metaphors (and their alternatives) is extremely context-dependent. Partisans of free-market economics might view competition as a good thing, while partisans of Keynesian economics might view cooperation more favorably. Sometimes even invasion can be a good thing (e.g., when we want to introduce a species to control another that's deemed a "pest"). At their worst, ecological metaphors can have racist, sexist, or misogynistic overtones (e.g., Haraway 1989; Zuk 1993; Herbers 2007).

At the level of worldview, scientific metaphors are also implicitly and subtly value-laden. This largely originates from the manner in which all metaphors both highlight and hide. As I said, a metaphor is chosen because it is apt. If new species did not colonize (also a metaphor) in a manner that we could compare with "invasion," then we would not utilize the metaphor at all—we might say "colonize" rather than "invade." So by using that metaphor, we *highlight* the ways in which widely spreading species are like invaders conquering a country. But there is also an "is not" with every metaphor; that is, there are ways in which the phenomenon is not like the metaphorical referent and the metaphor hides this "is not" from view. Further, in contrast to a stated simile—X is like Y—the very act of comparison is itself obscured. The "invasion" metaphor, for example, implicitly vilifies a species that shows up in a new place. But species do not have agency or intent to harm (even if they often do cause harm) and they are not crossing borders bounding countries that are geopolitically demarcated (Larson 2005, 2011b). The value-laden element of this metaphor leads to a strong bias towards interpreting the phenomenon of spreading species in terms of what is highlighted by the metaphor, while ignoring what is hidden. This can lead to epistemic limitations and to inappropriate social responses—for example, a response to these species as if they are "bad" and "vicious" rather than just species doing what species do.

From a philosophical point of view, these feedback metaphors implicitly blur the bright line scientists typically would like to draw between fact and value. Such melding of fact and value occurs in science all the time. Many ecologists and conservation biologists, for example, naturally interpret "invasive species" as something against which we should, without question, defend the homeland (Larson 2008). While this interpretation may be appropriate if "invasive species" are defined in terms of their harmfulness, the metaphor is misleading in ecology, where they are defined simply in terms of their tendency to spread (Lodge et al. 2006). To shift metaphors, as it were, most laypersons would wish to cultivate ecological "stability" and to restrict ecological "disturbance," even though contemporary ecology now recognizes the importance of disturbance for ecological renewal and the maintenance of biological diversity (Worster 1990; Lodge and Hamlin 2006).

Not only in science itself do metaphors meld fact and value (as "invasion" so obviously demonstrates), but also when a metaphor from science, interpreted as an "is," is used to justify how things "ought" to be in the cultural context from which it is drawn (see Fleming 2006; Elliott 2009; Larson 2011a). The classic example is the "survival-of-the-fittest" metaphor drawn from Darwinian evolutionary biology and then used as a justification for competitiveness within society, as in Social Darwinism, and even as justification for eugenics and for genocide (Keller 1992; Taylor 1998; and see Larson 2011a for further nuance).

Accordingly, the choice of which metaphor to use is an ethical and value-laden one, not just epistemological, even though scientists have often restricted discussion to a metaphor's epistemic dimensions—as if science were indeed "objective" and occurring in a social vacuum. Although the *attempt* to be objective is a laudable ideal, it is ultimately not possible to actually achieve (Putnam 2002; Kincaid et al. 2007; Douglas 2009), despite the determination by the early twentieth-century Logical Positivists to draw a sharp distinction between objective facts and subjective values. This is not to suggest that the selection of a metaphor can be deliberately managed because no scientist can operate as a perfect "social engineer." Metaphoric choices are often quite unconscious, even though one goal of this chapter is to make their choice more conscious or at least more transparent. On the other hand, there are now some very good examples of biologists who have consciously used metaphors, such as "invasional meltdown" and "DNA barcoding" (Larson 2009, 2011a), to promote a particular worldview and its associated values.

Not only is the choice of metaphor an ethical choice, it is also performative, which enlarges its significance even more. By performative, I mean that the metaphors we choose are not merely cognitive: they lead to actions in the world that have consequences. The naturalistic fallacy—inferring an "ought" from an "is"—provides one example of such consequences (see Wilson et al. 2003; Fleming 2006). That is, while a metaphor may seem like a scientifically validated "is," it in fact implies "oughts" that contribute to social decisions, actions, and outcomes that may sometimes be undesirable. Even if we do not consciously transpose a metaphor from one domain to another (e.g., "competition occurs in nature, so it ought to occur in human society"), in the case of some metaphors the "is" is strongly tied to an "ought" and associated actions (e.g., "those species are invading a forest", so we are led inexorably to think, "therefore, we ought to stop them").

Over time, metaphors have their greatest power in the performativity of an entire worldview, as evidenced by some subfields and schools of thought in ecology. In the history of ecology, as already pointed out, there has been a decided emphasis on studies of competition as opposed to cooperation. The "invasive species" metaphor has been so powerfully performative as to give rise to an entire field of "invasion biology." Resilience is a fairly new metaphor in ecological science, but one that has become an increasingly common metric of the state of an ecosystem and its ability to tolerate anthropogenic change. Interestingly, though, one might say that the increasing prevalence of this metaphor in ecological discourse actually reflects a narrowing of options, thus in effect reducing our cognitive resilience for understanding ecological change in diverse ways. As ecologists, we should always be sensitive to whether our metaphoric lenses have become too narrow or whether a greater plurality of metaphors would be helpful for maintaining diverse options for responding to change.

As a consequence of the way they operate, ecological metaphors create a significant tension between neutrality and advocacy. Some would argue that we can dispense with the problem of metaphors by simply abandoning them, but that is hopeless because of their cognitive function—and even the attempt to be neutral is value-laden (Weber and Word 2001). More to the point, many ecologists, philosophers, and social scientists argue that ecology would be more effective in terms of conservation outcomes if it became more explicitly and consciously value-laden (e.g., Westoby 1997; Norton 1998; Bradshaw and Bekoff 2001; Robertson and Hull 2003; Foote et al. 2009). Conservation is, after all, motivated by values. That the contemporary zeitgeist is broadly inconsistent with sustainability values poses a significant problem for conservation because the metaphoric referents available for use by conservationists may not be consistent with desired sustainability outcomes (see Larson 2011a). There is an ongoing challenge here to find metaphors that speak positively to people about conservation and sustainability and that do not simply reinforce the largely incompatible, contemporary worldview (which puts a premium on consumption and economic growth).

11.1 Concluding Thoughts and Recommendations

Bringing to light the operation of metaphors in ecology exposes several tensions that lie at the heart of claims of scientific objectivity and the role of science in conservation and sustainability initiatives. Conservation problems are not simple ones, where facts lead to clear decisions (Sarewitz 2004), but instead they are complex, uncertain, and contested (Funtowicz and Ravetz 1993). As a result, diverse values come into play that drive the direction society will take. Therefore ethical decisions are inescapable because the choice among diverse values is by definition an ethical choice. Science must respond by moving in a more democratic direction (Kitcher 2001), despite fears that this will devalue science to the lowest common denominator of public opinion, subject to extra-scientific manipulation, such as we see with the success of climate-change denial (which is a particular sort of manipulation that must be acknowledged and prevented where possible). Gone is the previous, implicit model of the relationship between science and society/citizens (top-down, science-first), to be replaced by a more bottom-up model where society is more involved in decisions formerly thought to be determined by science alone (Dietz and Stern 1998; Pielke 2007). This is uncomfortable for some ecologists, but many increasingly recognize advocacy and public engagement as a necessary path for ecology (Lubchenco 1998; Balmford and Bond 2005; Palmer et al. 2005; Foote et al. 2009; Nelson and Vucetich 2009).

Finally, it is important to reflect on one of the overarching metaphors in this book, that of "worldview." A worldview emphasizes the sense of vision, the view of something. In that sense, it is coincident with the attempt by science to be objective, to take a "disembodied" gaze at the world. As Heidegger (1977, pp. 133–134) put it, "As soon as the world becomes picture, the position of man is conceived as a world view … The fundamental event of the modern age is the conquest of the world as picture." The problem here is that vision is one of the more "distancing" senses insofar as it separates the viewer and the observed (Ingold 2000). This may be inconsistent with the more embodied linking of ecology, ethics and praxis that we here seek. But sometimes it seems that the harder we try, the more enmired we become in language, the very metaphor of a "link" further suggesting two reified entities that must be reconciled. Awareness of feedback metaphors in ecology demonstrates the extent to which facts and values, science and society, are less linked (or in need of linking) than intertwined (a weaving metaphor, I suppose). We can no longer pretend that science exists in splendid isolation because attention to ecological metaphors demonstrates that ecology and ethics are already inextricably integrated.

To facilitate a better understanding of the metaphorical integration of ecology, ethics, and society, and to operate in this context with greater awareness:

1. Ecologists (as well as scientists and citizens more generally) should reflect on the prevalent metaphors that shape their lives. Awareness is the first step to understanding their influence.
2. When utilizing a metaphor, ecologists should reflect on the broader connections of the metaphor and whether it is consistent with their values and intentions.
3. When creating a new metaphor, ecologists should seek input from experienced science communicators and diverse stakeholders to better understand its broader ethical and social implications.

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Chapter 12
Science as Sacred Myth? Ecospirituality in the Anthropocene Age

Lisa H. Sideris

Abstract This chapter focuses on Universe Story/Epic of Evolution/Big History movements, forms of science-based ecospirituality that have emerged in recent decades. One of my central claims is that these narratives tend to encourage awe and wonder at scientific information and expert knowledge as that which is most 'real', over and above direct encounters with the natural world. As such, I question whether these new myths are likely to engender the environmental values they seek to cultivate. Everyday experiences and encounters with the natural world—encounters not filtered through scientific analysis and explanation—are likely to be devalued in this worldview. This tendency is particularly pronounced in iterations that are inspired by the work of E.O. Wilson and Richard Dawkins, both of whom promote a mythopoeic rendering of scientific information as a robust and superior rival to religion. Espousing a religion based on scientific reality, some proponents of these narratives express attitudes of intolerance toward religious and cultural traditions that do not derive meaning and value directly from science, even though these traditions may embrace green values on their own terms. As a whole these movements discourage sensory, experience-infused forms of engagement with nature that are less dependent upon and mediated by expert knowledge.

Keywords New genesis • New story • Evolutionary epic • Universe story • Myth • Science

L.H. Sideris (✉)
Department of Religious Studies, Indiana University,
Sycamore Hall 230, Bloomington, IN 47405-7005, USA
e-mail: lsideris@indiana.edu

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If we are not able to ask skeptical questions, to be skeptical of those in authority, then we are up for grabs.

– Carl Sagan

Scholarship in my home discipline of religious environmental ethics has long been shaped by a discourse of disenchantment and reenchantment. The perception of a disenchanted natural world—nature devoid of mystery, wonder, meaning, and value—has contributed to environmental degradation and disregard for the subjectivity of nonhuman life forms, many scholars believe. Some locate the roots of nature's disenchantment in the ascendency of mechanistic, scientific and technological worldviews that render nature as dead, inert matter to be valued primarily as a resource.[1] Consequently, many scholars who seek to restore nature's subjecthood, inherent value, or sacredness have developed an alternative organismic or "ecological" model of human-nature relationships. Unfortunately (and despite its name), that model of nature is usually insufficiently informed by knowledge of science and natural processes. The lack of coherence between religious ethicists' vision for nature and the realities of Darwinian science was the subject of a book-length project of mine a decade ago (Sideris 2003). There I argued that ecological theologians, and many secular environmental ethicists, tend to ignore, or make selective use of, scientific information about the natural world. Taking biological science seriously, I argued, would temper the impulse to construct a blueprint of environmental ethics drawn from human-centered (or biblically-centered) visions of a harmonious, cooperative community of subjects.

But there is also a growing movement within religious environmentalism that, in some of its present manifestations, cedes far too much authority to science and its alleged mythic potential. This movement, which I shall generically refer to as the New Genesis,[2] seeks to ground environmental behaviors in a science-based form of spirituality, positing science as the new sacred myth for our times. Proponents of the New Genesis, which goes by such names as The Epic of Evolution, The Universe Story, Big History, The New Story, or The Great Story, understand scientific worldviews not as a leading *cause* of nature's disenchantment but as the primary vehicle for restoring enchantment, wonder, meaning, and value to the natural world. The New Genesis presents a grand narrative of cosmogenesis—the story of the unfolding of the universe, from the moment of the Big Bang to the present—as the best myth on offer. In its various iterations, it defines humans as the part of the universe that has become conscious of itself. Humans' dawning geological awareness, inspired by up-to-date scientific knowledge, will enable us to guide the future unfolding of the cosmic process, ushering in an "Ecozoic" era in which humans will live in greater intimacy and harmony with the Earth (Swimme and Berry 1992). In contrast to the more descriptive term Anthropocene, the term Ecozoic is explicitly prescriptive,

[1] See, for example, Merchant 1980 and Griffin 2004.

[2] I think "New Genesis" appropriate for various reasons but primarily because all of these movements proffer a new, common creation story based upon our understanding of cosmogenesis. All are engaged in a process of religiopoeisis, of crafting a new religion, grounded in a myth that explains our origins and destiny. I thank J. Baird Callicott for suggesting this phrase.

presenting a *positive* vision of a new anthropogenic stage in cosmic history in which humans shape the next phase of cosmic unfolding for the better.

Prominent advocates of the New Genesis include the cultural historian and "geologian" Thomas Berry and his protégé, the mathematical cosmologist Brian Swimme (Swimme and Berry 1992); religion scholars Mary Evelyn Tucker (Swimme and Tucker 2011), John Grim, and Loyal Rue (2000); historian David Christian (2004); astrophysicist and science educator Eric Chaisson (2005); biologist Ursula Goodenough (1998); science writer Connie Barlow (1997); and Christian pastor and popular author, Michael Dowd (2009). These individuals frequently reference one another's work and involvement in the movement, and they understand themselves and each other as part of a more or less cohesive group.[3] The impetus for new story-telling arose in part from conversations within the academic field of "religion and ecology" regarding the need for a profound spiritual transformation (as with Tucker, Grim, and Swimme who are strongly influenced by Berry's call for a "New Story"); some versions of it display elements of therapeutic or self-help spirituality (as with Dowd and Barlow who offer webinars on how to "evolutionize" your life).[4] Still others in the movement, such as Goodenough and Rue, represent a trend toward an atheistic brand of religious naturalism, a form of what Taylor (2010) identifies as "dark green religion," i.e., nature- and science-oriented spirituality that eschews and often critiques the supernatural worldviews and values of traditional faiths, notably the Abrahamic traditions.[5] The movement also has traction outside of the academy. *Journey of the Universe*, a documentary film written by Brian Swimme and Mary Evelyn Tucker, is widely featured on public television stations, and Tucker, Grim, and Swimme hold screenings and discussions of the film worldwide. For their own part, Dowd and Barlow introduce the Epic of Evolution to children in (liberal) religious education classes or summer camps, often in song and storybook form, or in the form of ritual enactments of "evolutionary parables" (Barlow n.d.).

[3]Those most influenced by biology tend to use the phrase "Epic of Evolution"—notably Rue and Goodenough; however, Swimme and Tucker also deploy this phrase, and Dowd and Barlow use a variety of terms interchangeably. In 1996, Goodenough and Rue co-chaired a conference sponsored by the Institute on Religion in an Age of Science on The Epic of Evolution, which featured Swimme, Tucker, and Grim as speakers. In 1997, Barlow published *Green Space, Green Time*, a book that charts the genesis and development of the Epic of Evolution and features formal interviews and spontaneous conversations with E.O. Wilson, Loyal Rue, Ursula Goodenough, Mary Evelyn Tucker, John Grim, and Brian Swimme. Barlow later met and married Michael Dowd. Goodenough credits Rue as the inspiration for her book *The Sacred Depths of Nature*. Tucker, Grim, and Swimme have recently collaborated on *Journey of the Universe*, a documentary film devoted to the universe story and its potential to spark a new environmental sensibility. Goodenough served as science advisor to the book and film.

[4]The online seminar educates participants about their biological and social instincts and explores "the science of how to decode human behavior, eliminate self-judgment, and create a big-hearted life of purpose and joyful meaning." See Dowd and Barlow (n.d.).

[5]Taylor (2010) develops a typology of dark green religions that casts Goodenough's worldview as a form of Gaian Naturalism "whose proponents express awe and wonder when facing the complexity and mysteries of life and the universe, relying on religious language and metaphors of the sacred (sometimes only implicitly and not self-consciously) when confessing their feelings of belonging and connection to the energy and life systems that they inhabit and study" (16).

A new story is so urgently needed, the argument goes, because our culture is suffering from what Loyal Rue (2004) calls *amythia*—the condition of being without a serviceable myth.[6] More precisely, the stories we have, such as the narratives provided by the traditional faiths, are no longer relevant and plausible. On this view, the environmental crisis is, at root, a crisis of meaninglessness, of *storylessness*: we lack an orienting myth that will apprise us of how things *really* are and which things *really* matter. This emphasis on what is really real and really true is of central importance, and I will return to it shortly. For now, it is worth noting that this account of myths and their truth value typically assumes that religion and science are oriented to essentially the same end—namely, to give an accurate rendering of the physical world. Truth, in this context, often signals correspondence or conformity to facts. For example, sociobiologist E.O. Wilson, often credited with founding the Epic movement insists that "we must have a story to tell about where we came from, and why we are here." Science, Wilson (1998: 6–7) suggests, is "a continuation on new and better-tested ground to attain the same end [as religion]. … in that sense science is religion liberated and writ large." On this account of truth, a scientific story will, by definition, have the decisive edge.

An express goal of these movements, which have inspired numerous books, films, YouTube videos, Web sites, podcasts, and even university course offerings, is to deploy modern science in order to instill in readers and audiences a profound sense of connection with the universe, and thereby foster environmentally responsible behaviors. Our "human destiny," Swimme and Tucker (2011: 115) argue "is to become the heart of the universe that embraces the whole of the Earth community." Science, in Barlow's view, can be utilized "for greening one's deepest worldviews—that is, for nurturing ecoreligious sentiments" (Barlow 1997: 20). For Rue (2000: xiii) the Epic gives us an account of how things are *and* which things matter. Its evolutionary cosmology engenders an "ecocentric morality" that can "inspire grateful service to the enduring promise of life on the planet." "Scientific understanding" of nature, such as these stories provide, can "call forth appealing and abiding religious responses," argues Goodenough (1998: xvii). Despite the bold claims and growing influence of the New Genesis movement across a number of disciplines, there has been virtually no critical response to this movement from scholars in religious studies, environmental ethics, or other cognate disciplines.[7]

Some proponents of the new mythology—notably, Goodenough, Rue, Dowd, and Barlow—regard insights from sociobiology, evolutionary psychology, and what Wilson terms consilience as particularly relevant to the creation of a new mythology. This turn to sociobiology and evolutionary psychology distinguishes these strands

[6] It is not always clear whether this diagnosis extends only or primarily to Western cultures or to global industrial society generally, irrespective of particular religious or cultural commitments. Thomas Berry, who first called for a "New Story" in an issue of *Teilhard Studies* (1978) often diagnosed storylessness as a Eurowestern problem.

[7] Stephen Bede Scharper is a rare exception, though his critique is now somewhat dated and takes the form of a series of astute questions rather than assertions (Scharper 1997).

of the movement from the Universe Story of Tucker and Swimme who see Big Bang cosmology—not the terrestrial evolutionary paradigm—as the scientific development that lends the universe an implicit, coherent narrative structure. For those such as Rue who see mythic potential in reductive biology, evolutionary science both explains our need for religious myth *and* provides the raw materials from which a new and superior mythology can be crafted. This idea too can be traced to Wilson, who calls for a way to "divert the power of religion into the services of the great new enterprise that lays bare the sources of that power"—i.e., the scientific enterprise (Wilson 1978: 193). Some New Genesis advocates have taken up this challenge with great relish, producing a narrative that is constructed to meet our need for religion while adhering to the reality disclosed by contemporary science, whether the realities of our universe at large or particular discoveries about our hominid brains. Evolutionary psychology, for example, posits a human brain hardwired with dedicated modules for language and storytelling; the new myth can be specifically tailored to meet the story-telling needs of a human brain forged in the Pleistocene and now confronted with unprecedented challenges to continued survival (Rue 2000: 91–94). Epic of Evolution proponents also take their bearings from biologist Richard Dawkins (1998, 2011) who promotes the uniquely poetic and magical quality of scientific reality. Each in his own way, Wilson and Dawkins call for mythopoeticization of scientific knowledge—recasting scientific information as a consecrated narrative and poetic vision. Heeding this call, some proponents of the New Genesis present their narrative as superior to existing myths owing to its close adherence to reality as defined by science, as well as its alleged universality. While the existing religions tell the story of particular peoples, the all-encompassing new narrative presents "everybody's story" (Rue 2000). Longstanding myths—ranging from the traditional world religions to the sacred narratives of particular indigenous cultures—are judged to be insufficiently grounded in what science reveals to be real and true. Existing traditions thus fail to command universal assent and cannot galvanize global action. As Goodenough puts it, "this is the story, the one story, that has the potential to unite us, because it happens to be true" (1998: xvi). Religion scholar Robert Bellah, who is otherwise sympathetic to these projects—particularly as articulated by Eric Chaisson—points out the pitfalls of calling these stories "true," where doing so implies "that all the other religions are false." Myths can be true, but their truth is of a different sort than scientific truth and "must be judged by different criteria" (Bellah 2011: 47). Promotion of these new narratives as uniquely *true* myths entails a kind of slippage between the way that physicists use the term cosmology (a theory of the universe) and cosmology in an anthropological sense of a culture's shared understanding or all-encompassing vision. For some New Genesis proponents, the two become conflated in such a way that science is portrayed as containing within it all that humans need to orient themselves meaningfully to the world around them.

Claims that the New Genesis presents us with "truth" and "reality" align these stories more closely with grand, hegemonic narratives of the past than with narratives that might be derived from postmodern conceptions of science. J. Baird Callicott (2002: 167) argues that "to advertise your story as a story, to call it a 'myth,' an 'epic,' or a 'grand narrative' is to disavow any intention to make a claim of truth or to deny the possibility of cogently organizing experience some other way, of telling some other meaningful story." He denounces the "epistemic arrogance" of devotees of materialist, reductive modern science (distinct from post-modern science) who are convinced that they have "exclusive access to the Truth (with a capital 'T') about Reality (with a capital 'R')," and who thus dismiss all other knowledge systems and cultures as mere myth and superstition (Callicott 2002: 162). Callicott has defended a middle ground between the arrogant positivism of modern science and the nihilistic hand-wringing of deconstructive postmodernism. His more modest project[8] of worldview "remediation" and "reconstructive post-Modernism" invokes not the absolute and singular Truth of science, vis-à-vis other myths, but modulated criteria of "tenability." A reconstructive approach, he believes, must "expressly eschew any totalizing tendencies and hegemonic ambitions" (Callicott 2011: 169). My contention is that, despite routinely invoking the language of myth, epic, and story, the New Genesis does not always eschew these tendencies, nor does it consistently adhere to the modest epistemological claims characteristic of post-modern, science-based mythmaking. In fact, it comes perilously close to asserting itself as the one true story for all inhabitants of our planet. This should come as no surprise when we consider that Wilson's project of consilience—for some, the very cornerstone of scientific mythmaking—is an explicit effort to resume the aborted Enlightenment project and its overarching comprehensive narratives.[9]

With their claim to have accessed truth and reality firmly in hand, these new mythmakers call on us to respond with awe and wonder to what is "most real." This entails, in some cases, redirecting our sense of awe and wonder toward the scientific enterprise and its quest for totalizing knowledge—and, potentially, away from the natural world itself. The New Genesis is made possible, proponents argue, by

[8] "Although I have become a charter member of the board of directors of the newly formed Epic of Evolution Society, let me hasten to add that this is not exactly my project," Callicott writes. His project is indeed more modest, more terrestrially-focused and narrowly drawn than the grander project of Berry, Swimme, Chaisson, Tucker, Grim, Rue and others; however, while Callicott tempers the truth claims of post-modern science, his project, and the comparisons between different myths that the project entails, still suggests that science and religion are oriented to the same end, that they occupy a similar explanatory slot, or that literalist/creationist views stand in for religion generally (to wit, "a grand narrative that is contradicted by the fossil record or evidence of an expanding universe" is not sufficiently "credible," says Callicott [2002: 167]). The impulse to present science as a worldview that can function much like religion would seem itself to be a holdover of positivistic modern science. The "remediation" concept figures in a more recent essay (Callicott 2011) in which, aside from a brief reference to Berry, Callicott claims no connection to the New Genesis movement, though he makes an even more forceful argument for replacing the Abrahamic with the evolutionary-ecological worldview (while acknowledging that no worldview is, strictly speaking, true).

[9] See Wilson's chapter in *Consilience* titled "The Enlightenment." Wilson's defense of Enlightenment positivism leads him to an extended critique of post-modernism's claim that there is no "real" reality (44). Wilson's and Dawkins' works both contain diatribes against postmodern and deconstructive responses to science (as well as Romanticism generally). Wilson also expresses profound admiration for the logical positivists (67–71).

developments in science that lend a narrative quality to our knowledge. These range from the discovery of the Big Bang, to a deeply held belief in the unity of the sciences (what E.O. Wilson terms "consilience"). The Big Bang, it is argued, makes it possible to conceive of the cosmos as having a beginning point (and thus a narrative structure), while belief in consilience suggests that the disciplines will unite to tell a single, comprehensive story of the unfolding of evolutionary and human history. Wilson, for example, in his Pulitzer Prize-winning book *On Human Nature* famously offers the evolutionary epic as the best candidate myth:

> What I am suggesting, in the end, is that the evolutionary epic is probably the best myth we will ever have. It can be adjusted until it comes as close to truth as the human mind is constructed to judge the truth. And if that is the case, the mythopoeic requirements of the mind must somehow be met by scientific materialism so as to reinvest our superb energies (Wilson 1978: 201).

This sentiment is cited regularly in New Genesis Web sites and published material. According to Rue, the Epic of Evolution "has been inspired by the remarkable theoretical unification of scientific disciplines taking place during the course of the twentieth century. … These advances have gradually revealed what Edward O. Wilson has called 'consilience,' that is, a fundamental continuity and theoretical coherence among the physical sciences, the life sciences, and the behavioral sciences." Disciplinary consilience "now makes it possible to construct a coherent narrative of the emergent properties of matter, life, and consciousness. … the Epic of Evolution is a product of imaginative mythmaking under the critical and watchful eye of contemporary science" (Rue 2005: 612–614).

But on this view, who can be counted on to keep a critical and watchful eye on science? Certainly not religionists, for as Wilson's claims about scientific materialism make clear, the objective is to replace traditional religion—and the traditional study of religion—with science fleshed out in mythopoeic form. "Make no mistake about the power of scientific materialism," Wilson (1978: 192) warns. "It presents the human mind with an alternative mythology that until now has always, point for point in zones of conflict, defeated traditional religion." Wilson goes on to predict that science will enjoy its "final decisive edge" over religion when it succeeds in explaining religion as a material phenomenon. "Theology is not likely to survive as an independent intellectual discipline," but the religious *impulse* will endure as an awe-filled response to the scientific enterprise itself (Wilson 1978: 192). Once this "transfer of spiritual assets" is complete,[10] a true sense of wonder will once again infuse the broader culture, Wilson believes (Wilson 1978: 204). Building upon this vision of a society united in its awe of science, Wilson presents a fully-fledged "unification metaphysics" in *Consilience* (1998: 6) where he offers the enchanting quest for comprehensive, unified knowledge as our species' greatest adventure.

In a similar vein, Dawkins has long argued for the superiority of scientifically clarified forms of wonder and awe vis-à-vis "fake" wonder at perceived mysteries, puzzles, or miracles (whether emanating from the realm of religious belief or from

[10] The phrase is from Mary Midgley (1985, 2002: 131).

incomplete natural knowledge). For example, in *Unweaving the Rainbow* (1998) a book that purports to be about the human appetite for wonder, Dawkins argues that explanations of natural phenomena such as the rainbow are always more interesting, more wonder-evoking, than the phenomena themselves. There Dawkins chides the Romantic poets who resented Newton for destroying the mystery and poetry of the rainbow by dissecting it into light of different wavelengths. They ought instead to have rejoiced because the scientific explanation is always more interesting and beautiful than the mystery it explains away. Dawkins sees wonder as persisting—not at the original phenomenon that prompted the inquiry—but by means of making scientific explanations, and human *powers* of explanation the object of wonder. As Dawkins (1998: 42) puts it: "If you think the rainbow has poetic mystery you should try relativity [theory]." Thus Dawkins (1998: x) concludes that "science is, or ought to be, the inspiration for great poetry. Science banishes mystery and the miraculous, but the knowledge it returns is itself a thing of wonder.

In a more recent work, titled *The Magic of Reality* (2011), Dawkins endeavors to bring the same form of enlightenment to young audiences. Tentatively titled *What is a Rainbow Really?* in initial press releases for the book, *The Magic of Reality* is an elaborately illustrated volume that addresses many of children's big questions, such as those they are likely to encounter in Sunday school: "Why is there night and day?", "Who were the first man and woman?"; "When did everything begin?" and even "Why do bad things happen?" Dawkins juxtaposes beloved myths and fairytales with "lucid scientific explanation" in order to "explode myths and legends about the natural world with science" (Anon 2009). By "myths" he means everything from fairytales about the rainbow's origin to Judeo-Christian stories such as Noah's ark. The book's message is essentially the same as *Unweaving the Rainbow*: what is real in the scientific sense is most deserving of wonder. In contrast to the "fake magic" that suffuses fairy tales, children's books, or mythological and biblical stories, scientific magic is proffered as real magic. "I want to show you that the real world, as understood scientifically, has a magic of its own," Dawkins (2011: 31) explains to his young readers, "an inspiring beauty which is all the more magical because it is real and because we can understand how it works … The magic of reality is—quite simply—wonderful. Wonderful, and real. Wonderful *because* real." By contrast, religious myths "can never offer us a true explanation of what we see in the world" (Dawkins 2011: 21). These efforts receive enthusiastic support from some proponents of the Epic of Evolution. Self-styled "evolutionary evangelists" Dowd and Barlow, for example, endorse the Epic of Evolution as a new "religion of reality" and hail the so-called new atheists as courageous "prophets of reality" (Dowd 2010).

As I have suggested, these ideas are gaining currency in the broader culture. Dawkins' conviction that science, as the poetry of reality, presents us with a superior form of magic, is the theme of a musical composition created by John Boswell, a professional composer and science buff. This music video, one in a series called "The Symphony of Science," sets to music the actual words of prominent scientists (many of them professed atheists), such as Dawkins, Carl Sagan, Stephen Hawking, and blogger and biologist P.Z. Myers. The song's refrain "There is real poetry in the real world/science is the poetry of reality" is "sung" by Dawkins, through the miracle of Auto-Tune technology. The lyrics credit science with satisfying our hunger for religion and meaning. Another Boswell composition titled "A Wave of Reason," whose refrain is also sung by Dawkins, includes the following lyrical advice from Sam Harris: "You do not have to delude yourself/with Iron Age Fairy Tales." Planetary scientist Carolyn Porco adds that "the same spiritual fulfillment that people find in religion/can be found in science/ by coming to know, if you will, the mind of God" (Boswell 2010). In their own YouTube video in which they promote and recite passages from Dawkins' book, Dowd and Barlow include a lengthy clip from Boswell's composition "The Poetry of Reality" (Dowd and Barlow 2011). Barlow, who teaches a scientifically enlightened version of "Twinkle, Twinkle Little Star" to child audiences—"*Now I know just what you are*"—sees Dawkins as a kindred spirit in the science education of youthful minds (Dowd 2009: 91). Dawkins' mission to convert the world—children and adults alike—to the bracing tonic of the really real has "broad implications for society along the lines that we've been promoting for ten years," Dowd and Barlow note (Dowd and Barlow 2011). *The Magic of Reality* provides "a way of valuing science, the scientific method, and the entire scientific worldwide endeavor, as providing our best map of what's real and what's important" (Dowd and Barlow, ibid).

Clearly, valuing science is a priority. But what has all this to do with valuing nature and inculcating environmental ethics? Rather little, I would argue, and therein lies the problem. New Genesis advocates steadfastly maintain that their narratives provides a much-needed cosmological context in which environmental values can take root and flourish. A shared belief of many within the movement is that knowing the scientific story is virtually sufficient to generate the desired values and sense of connection. In other words, scientific information—if presented in sufficiently rich poetic and mythological language—can fulfill many of the functions of a religious cosmology, while also orienting us toward deeper intimacy with and concern for the natural world. Proponents routinely disavow any intention to *displace* the particular religions with universal, sacralized science. Rather, they strive to present their narrative as a "metamyth" that can incorporate diverse religious perspectives without dissolving or debunking them. Considerable lip service is paid to respecting, cherishing, and celebrating diversity—"not only geodiversity and biodiversity but also mythic diversity" even as they argue that the diversity and particularity of the existing faiths will be their downfall (Goodenough 1994: 328). Goodenough, to give just one example, portrays the traditional faiths as essentially closed systems that provide answers to questions about our origins and destiny on their own stubbornly unscientific terms. Because science can gain no point of entry, no foothold, these traditions cannot evolve sufficiently to respond to modern, global problems. Moreover, the stories they tell are too particular to be expanded into a global myth, such as the new science-based stories offer; they cannot tell *everybody's* story. What they offer are competing accounts of what is true, and in doing so, they propagate conflict and strife, rather than solidarity. If we want a religion that hits all the right notes, "we're going to have to invent one," Goodenough (1994: 325) concludes.

In this way, some proponents portray religious and cultural diversity as sheer divisiveness. Enthusiasm for the Epic story may readily engender intolerance, as when Rue (2000: 38) disparages the world religions as an uncontrolled “hemorrhage of diversity.” The inherited traditions encourage us to live at odds with reality. “Many of the cosmological claims of traditional stories have been rendered either untrue or unlikely by developments in modern science,” Rue maintains. “And further, the failure of traditional stories to transcend cultural barriers, and their palpable lack of resources for addressing the underlying forces of the global problematique make them appear out of touch with reality Rue (2000: 39).” Rather than blending science with existing religious insights, or gathering the spectrum of faiths under the umbrella of a generic metamyth, this approach simply retools scientific worldviews to serve as a universal religion. The claim that existing traditions can be situated within the epic narrative appears disingenuous once it is understood that these religions are competing for the same slot as the new myths. This is what we might expect from storytellers who look to Wilson and Dawkins, both of whom explicitly endorse science as religion’s superior rival. Wilson and Dawkins insist that feelings of awe and reverence inspired by the consilient scientific worldview constitute the purest and most noble expression of the human impulse for wonder and spiritual awe. Science and religion are seen as competitors in a contest that will determine where we direct these impulses and how we define our ultimate values.

As it is typically portrayed, this competition can have only one winner—science, of course, being the projected winner—but it can have more than one loser. Nature itself may be the ultimate casualty of the worldview variously espoused by those within this movement. By that I mean that the conflation of all that is real with whatever is scientifically known or knowable encourages a disparagement of human-level, lived experience of the natural world as *unreal*. It asks us to look behind the scenes, beyond the senses, to what is assumed to be a more fundamental domain of reality. The result is a displacement of primary experience—encounters with a more directly sensed world—with secondary and, for the most part, abstract and vicarious experience in the form of information dictated by experts. I accept that it is problematic to assert that our sensory experiences constitute an unmediated encounter with nature; nevertheless, *science* is not the same thing as *nature*, and to study the former is not to experience the latter. Nor is the study of the former necessarily conducive to seeking out experiences of the latter. Recall that, for Dawkins, the *real* beauty and majesty of the rainbow lies in its scientific genesis, not in the more immediate experience of beholding one. The rainbow, after all, is not a “proper object,” not a “definite thing,” but an “illusion” (Dawkins 2011: 147). The New Genesis in its myriad forms, offers a paean to the scientific knowledge that lies behind and clarifies what we experience in our everyday worlds. This radical privileging of scientific reality puts environmental values on shaky ground. It estranges us from what we experience as real, meaningful, and beautiful. Why attach ourselves to this world of illusion?

Commenting on the disparagement of sensuous reality that our modern discoveries and inventions have encouraged, David Abram notes that relegating our ordinary experience of the world to a secondary, derivative realm increases our reliance on experts to inform us of what is real and true about the world, what is worthy of our wondering response.[11] It seems to me that this is where the New Genesis is headed, if it isn't already there. Abram (2010: 5) writes: "Since we have no ordinary experience of these realms [e.g. the cosmological big bang or the nuclei of our cells], the essential truths to be found there must be mediated for us by experts, by those who have access to the high-powered instruments and the inordinately expensive technologies (the electron microscopes, functional MRI scanners, radio telescopes, and supercolliders) that might offer a momentary glimpse into these dimensions." Environmentalism built upon such privileging of scientific information over everyday experience of and felt connection with the natural world is unlikely to ignite the passionate concern for the environment that these new myths aim to promote.

Moreover, the almost unfathomably broad sweep of cosmic events narrated in these stories seems ill-suited to elicit or encourage positive responses to particular, local *places*. An assumption embedded within Tucker, Grim, and Swimme's Universe Story project, for example, is that humans—all of us—grapple with a sense of alienation, that we do not feel sufficiently "at home" in nature. Granting for the sake of argument that this diagnosis is correct, it is not altogether clear how exposure to the grand narrative of the universe will rectify the situation. Ultimately, this story situates us not so much in *place* as in *space*. There is something distinctly *dis*locating about the story's all-encompassing scope. The sheer scale and remoteness of the universe vis-à-vis everyday life and lived experience may interfere with rather than foster a sense of being meaningfully connected and *emplaced* in our natural environments. In educational materials that accompany the *Journey* film, Tucker and Swimme shift the focus to local environmental efforts (design of ecological cities, environmental justice movements, etc.), by way of illustrating the practical application of the story, or merely to offset the potentially disorienting impact of the story's broad sweep. But it remains unclear why the story of the universe is necessary in order to ground the environmental concerns and forms of activism highlighted in these local vignettes. (Are we to infer that these efforts are somehow insufficient without the Universe Story as their cosmological grounding? Or is the implication that these efforts are directly inspired by knowledge of the universe? If environmental activism is grounded in, say, biblical imperatives, are its motivations suspect?) Tucker and Swimme are vague on these points, and thus it is difficult to see how the normative project of *Journey* is justified by knowledge of the universe. To be clear: my contention is not that scientific information is irrelevant or unimportant to the project of valuing and preserving nature, or in the effort to cultivate wonder generally. On the contrary, I believe science to be indispensable for guiding and informing our ethical interventions in the natural world. Seen in its proper perspective,

[11] Callicott recognizes this point as well, noting that the stories science tells may be "accessible only to initiates" or "intellectual elites," though he appears confident that science can be mediated in ways that transform it into a popular mythology (2002: 171). The story-telling talents of New Genesis advocates vary considerably. Rue's flat-footed and reductionist narrative is particularly, and consistently, uninspiring.

science may help to underwrite a sense of humility and wonder at vast and ancient processes of which human beings are a small part. Nor do I wish to discount the importance of scientific discoveries in realms inaccessible to our unaided senses. I do, however, reject the claim—a claim that finds support in some iterations of the new story—that science enables alignment with Reality (with a capital R), and an ultimate encounter with Truth (with a capital T). Scientific data is critical to environmental ethical decision-making. But the elevation of science to the role of a sacred new mythology, or virtually self-sufficient normative guide, is problematic in itself and—especially—as a starting point for affective, and effective, environmental engagement. Moreover, scientistic religiosity of the sort found in some of these narratives encourages an apotheosis of scientists and the scientific endeavor. Reverence for science—a seamless transfer of spiritual assets—is precisely what Wilson hopes to cultivate. In casting the Evolutionary Epic as the best myth for our times, Wilson recognizes that "every epic needs a hero." What candidates does science offer? Wilson (1978: 203) proposes the human mind to play the starring role in the epic drama: "the mind will do." Barlow (1997: 292) similarly depicts the Epic as a story that is "basically an equal celebration of the universe and celebration of the human mind discovering how to know about the universe." There is a certain irony here. Our exhaustive journey through the vast and numinous universe, through the whole riveting drama of our planet's evolution, finally leads us back to profound admiration of … ourselves.

This privileging of scientific information has practical implications for university education as well. It suggests a hierarchy of the academic disciplines—a consilient "vertical integration"—wherein disciplines that do not grant access to ultimate reality (thus conceived) are rightly subordinate to the sciences. In *Consilience*, Wilson argues that unity of knowledge offers the best way to "renew the crumbling structure of the liberal arts" (Wilson 1998: 13). Berry too forecasts that the humanities will experience a "grand renewal" within the comprehensive, unifying paradigm of the New Story, because the "amazing new discovery by science of the story of the universe would be recognized as a supreme humanistic achievement" (1988, 108). Wilson goes a bit further, predicting that disciplines oriented to the study of human culture will eventually fall out into science, Wilson (1998: 12). "The humanities, ranging from philosophy and history to moral reasoning, comparative religion, and interpretation of the arts, will draw closer to the sciences and partly fuse with them." In the consilient vision of education, the humanities might yet earn their keep as disciplines that serve science by embellishing its narrative with poetry, art, or other forms of creative expression.[12] As Wilson explains in an interview conducted by a rapt and admiring Connie Barlow, science provides the (superior) content and the humanities obligingly give it form:

> So what we must have is poetry within the scientific, physical worldview. That means we need the humanities, too. The humanities could in effect continue to do their thing, but they

[12] Berry too laments the lack of a "unifying paradigm" in American universities and argues that while traditional or local stories are "also needed" in the education of youth, "none of them can provide the encompassing context for education such as is available in this new story" (1988: 98–99).

> would have vastly richer material to work with—grander themes—because the real world, the universe—from black holes to the origin of consciousness—offers far more complex and grander themes than does traditional theology.[13]

The heady promise of Wilson's consilient, reality-based agenda has inspired a new wave of scholars eager to see evolutionary biology, evolutionary psychology, or neuroscience confer order and coherence to humanities disciplines in presumed disarray. These critics typically portray the humanities as vacuous, obscurantist, and irrelevant—and humanities scholars as consumed by envy and resentment of scientists, their big grants, their indisputable real-world impact.[14] Representatives of the New Genesis are at the forefront of efforts to reform education along lines suggested by consilience. Goodenough and Rue, for example, argue for a consilient curriculum that introduces students to the Epic as the integrating theme of their entire college experience.[15] "Any story of human nature not firmly grounded in the sciences does not merit the attention of youthful minds," they maintain. "One world calls for one story" (Rue and Goodenough 2009: 181). A number of universities around the country, including Harvard University and Washington University in Saint Louis, now offer courses on "The Epic of Evolution" or "The Universe Story." These courses introduce students to a grand narrative whose meanings are already given, whose options for student self-understanding are, to a large extent, already scripted: "Inherent in this story is a rich and satisfying account of who we are, where we have come from, and how we might become fulfilled," Goodenough and Rue confidently assert. (Rue and Goodenough 2009: 181)

What, if anything, finally commends the New Genesis as a global myth and new creation story for our times? Might the stories it generates be amended so as to lessen their seemingly pernicious implications and hegemonic ambitions? A movement away from the abstract scale of cosmic evolution to particular, local places as the *primary* focus of story-telling, along with a de-emphasis on the Epic myth as embodying truth or reality would certainly help. Doing so would lessen concerns about these stories as metanarratives that displace or pronounce false all rival stories, and that deride other ways of knowing and experiencing our world. Many of the more hubristic implications of the New Genesis might be mitigated by jettisoning the claim that a comprehensive, unified body of scientific knowledge—consilient integration—undergirds the story. This hubris is especially discernible in versions of the Epic that uncritically embrace Wilson's agenda; however, even on Swimme's more humble reading, human's discovery of the "comprehensive

[13] Wilson offers this observation in an interview conducted by Barlow (1997: 27). Oddly, his assumption appears to be that the humanities are currently getting their material from "traditional theology"—an indication, perhaps, of Wilson's inadequate knowledge of how either the humanities or theology *do their thing*.

[14] See for example, Slingerland and Collard (2011); Slingerland (2008) and Gottshall and Wilson (2005).

[15] Goodenough co-teaches such a course at Washington University, alongside a physicist and geoscientist; no humanities faculty are required, despite the claim that the course explores the "implications of the epic for philosophy, religion, global polity, and environmental ethics." Detailed course information is available at http://epsc.wustl.edu/courses/epsc210a/

narrative" stands as "one of the monumental accomplishments of the human species, a crowning intellectual achievement" akin to our ancestors' discovery of fire (Swimme 2004: 38). However much the downsides and potential pitfalls of these new myths might be mitigated by recasting them along the lines I have just suggested, to my mind there remains no compelling reason why science's story ought to be adopted *qua* sacred myth. These myths might be augmented, revised, or interpreted in various ways that make them more meaningful and relevant to our present or local circumstances and crises; they may be interpreted in ways that render them less hubristic, less anthropocentric, or more tolerant and inclusive of values of diversity or multiculturalism, less overtly hierarchical and authoritarian. But of course, precisely the same can be said of existing religions, major and minor, all over the globe. Are there compelling enough reasons to trade in our existing (flawed) worldviews—whatever they may be—for the new (flawed) worldview that science has to offer?[16]

I remain skeptical. It seems to me that much of the good work that is done by existing faiths and local green movements—say, permaculture activists in Bloomington, Indiana; environmental justice workers in Los Angeles; Hindus protecting sacred forests in India; or Christians battling mountaintop removal in Appalachia—can be accomplished just as well (and perhaps better) without invoking the imprimatur of the New Genesis as metareligion and overarching rationale.[17] Of course, anyone who finds the story compelling, fulfilling, and satisfying as a new myth should be free to adopt it. My point is that I see no reason that anyone—much less everyone—*ought* to adopt it.

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[16]The entire New Genesis project appears at times to rest on an assumption that our present environmental crisis is actually being *caused* by the traditional faiths; sometimes this claim is made explicit, as in some of Rue's work, and sometimes the charge of guilt is restricted to the Abrahamic faiths, as Callicott seems to indicate. But this assignation of guilt is far from obvious.

[17]Tucker and Swimme have recently stressed that the New Story and the Universe Story are simply "a" story of the universe, not "the" story, and they deny that the story must be universally adopted. Such disclaimers keep certain criticisms at bay but also distance them from their project's animating rationale. Berry underscored the singular nature of *the* story and the imperative for all to embrace it: "Only through this story are we able in any integral manner to overcome our alienation from the natural world," Berry argues (1999: 83). "Both education and religion need to ground themselves within the story of the universe as we now know it through our empirical ways of knowing" (ibid.: 71). Of course, much hinges on what it means to "ground" one thing in another, but insofar as Berry and his followers offer their story as a sacred cosmology, the legacy religions appear as competing (and less functional) cosmologies.

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Chapter 13
Rachel Carson's Environmental Ethics

Philip Cafaro

Abstract Rachel Carson is well known as a founder of the modern American environmental movement, which some date to the publication of *Silent Spring* in 1962. This essay argues that Carson was not just a successful polemicist, but a deep and insightful environmental thinker, whose life and writings have much to offer contemporary environmental philosophy. It focuses on explicating the environmental ethics articulated in *Silent Spring*, which rest on the triple foundation of human health considerations, the moral considerability of non-human beings, and the value to humans of preserving wild nature and a diverse and varied landscape. Carson generally emphasizes the complementarity in the great majority of cases of the three basic goals of protecting human health, preserving non-human life, and promoting human flourishing. In trying to move her society toward greater recognition of non-human interests and higher human interests, she develops an environmental ethics with both non-anthropocentric and enlightened anthropocentric elements. While *Silent Spring* shows how these two aspects may 'converge' regarding an important public policy issue, Carson's own life, dedicated to knowing and appreciating nature, shows how they converge at the personal level. Three further themes round out the ethical argument of *Silent Spring*. First, Carson's disapproval of economism – the overvaluation or exclusive focus on economic goals and pursuits. Second, her criticisms of a human 'war on nature'. Third, her warnings concerning the increased artificiality and simplification of the landscape.

Keywords Rachel Carson • Anthropocentrism • Biocentrism • Flourishing • Wild nature

P. Cafaro (✉)
Department of Philosophy, Colorado State University,
243 Eddy Hall, Fort Collins, CO 80523-1781, USA
e-mail: philip.cafaro@colostate.edu

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Rachel Carson has been called the founder of the U.S. environmental movement, which some date, plausibly, to the publication of *Silent Spring* in 1962. That best-selling book focused public attention on the problem of pesticide and other chemical pollution, and led to such landmark legislation as the U.S. Clean Water Act and the banning of DDT in many countries throughout the world. Whatever Carson's arguments were in *Silent Spring*, they succeeded. Yet she has received relatively little attention from environmental ethicists.

I believe Rachel Carson was not just a successful polemicist, but an important environmental thinker. With the publication of a definitive biography, Linda Lear's *Rachel Carson: Witness for Nature*, we can better understand her environmental philosophy, for Carson lived that philosophy as well as wrote about it.[1] Meeting Carson the scientist and naturalist clarifies her understanding of the role knowledge can play in a larger relationship to nature. Studying her 15-year career as a U.S. Fish and Wildlife Service biologist gives valuable insight into her views on practical conservation issues. Carson's personal story teaches us much about humility and courage, as she triumphed over various setbacks and achieved great literary success, while faithfully discharging her many responsibilities to family, friends, and nature. Still, in order to best understand Carson's environmental ethics, the place to start is with her final work, *Silent Spring*.

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Silent Spring constitutes an extended argument for strictly limiting the use of pesticides, herbicides, and other dangerous agricultural and industrial chemicals, and for their careful application and safe disposal when such use is necessary. This argument rests on both factual and evaluative premises. Factually, *Silent Spring's* case rests on numerous scientific and anecdotal accounts of the abuse of these chemicals. It also rests on such easy-to-establish facts as companies' common failure to test products' effects on humans and non-humans, users' frequent negligence in following instructions for applying agricultural chemicals, and the weakness and lack of enforcement of government regulations. Carson's clear presentation of such facts, and of the basic science needed to understand the issues, gave her book its authority. Carson's scientific credentials had already been firmly established in earlier works that had popularized recent developments in oceanography and marine biology. Without Carson's scientific credibility and impressive presentation of "the facts", *Silent Spring* would not have won such a large hearing.[2]

Nevertheless, evaluative or ethical premises were equally important to Carson's overall position. She avoided complicated ethical argument in *Silent Spring*, perhaps believing that the ethical issues really were quite simple. More likely, Carson reasoned that simple appeals to widely held values would be more convincing. In any case, *Silent Spring* is filled with short, emphatic ethical statements and arguments. Evaluatively (and somewhat schematically) its plea for restraint rests on a triple foundation of

[1] Lear (1997).

[2] Ibid., pp. 396–456.

human health considerations, the moral considerability of non-human beings, and the value to humans of preserving wild nature and a diverse and varied landscape.

Doubtless most important for many readers were Carson's chapters on acute pesticide poisoning, and these chemicals' potential to cause cancer and human birth defects. For these readers Carson states the moral clearly: 'Man, however much he may like to pretend the contrary, is part of nature. [He cannot] escape a pollution that is now so thoroughly distributed throughout the world'.[3] Examples of human sicknesses and fatalities caused by inappropriate use of chemicals recur throughout the book.

Carson was acutely aware of the importance of good health, having suffered a variety of serious illnesses over the years. In fact, she was dying of cancer as she finished *Silent Spring*. Yet in writing the book, she seems to have been more concerned with the destruction of wild nature and its resultant human loss. In her acknowledgments, she writes that it was a letter from a birdwatcher, who 'told me of her own bitter experience of a small world made lifeless' by pesticide poisoning, which 'brought my attention sharply back to a problem with which I had long been concerned. I then realized I must write this book'.[4] Carson told *Life* magazine: 'I wrote [*Silent Spring*] because I think there is a great danger that the next generation will have no chance to know nature as we do'. In a letter to her best friend she wrote: 'I told you once that if I kept silent I could never again listen to a veery's song without overwhelming self-reproach'.[5]

Silent Spring clearly shows Rachel Carson's concern for all living beings, human and non-human. Many of its arguments explicitly assert or implicitly rely on the moral considerability of non-human beings. For example, she recounts a massive dieldrin spraying program to eradicate Japanese beetles in and around Sheldon, Illinois. Robins, meadowlarks, pheasants and other birds were virtually wiped out; so were squirrels. Amazingly, 90 % of area farm cats were killed during the first season of spraying. 'Incidents like the eastern Illinois spraying', Carson reflected:

> raise a question that is not only scientific but moral. The question is whether any civilization can wage relentless war on life without destroying itself, and without losing the right to be called civilized…. These creatures [wild and domestic] are innocent of any harm to man. Indeed, by their very existence they and their fellows make his life more pleasant. Yet he rewards them with a death that is not only sudden but horrible.

Carson goes on to describe the ghastly convulsions observed in poisoned birds at Sheldon, and concludes:

> By acquiescing in an act that can cause such suffering to a living creature, who among us is not diminished as a human being?[6]

This passage clearly implies moral considerability on the animals' part and moral responsibility on our part. Both inflicting unnecessary suffering and causing

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[3] Carson (1962)

[4] Ibid., p. ix.

[5] Quoted in Lear (1997), pp. 424, 409.

[6] Carson (1962), pp. 93–96.

unnecessary loss of non-human life are morally wrong. A fully human being is a humane being, feeling compassion for the suffering of others. A true civilization does not dominate or destroy the non-human world; it protects and seeks to understand it.

In another section, Carson fights the common prejudice against insects by explaining to her readers the important role of honeybees, wild bees and other pollinators in natural and human economies. ‘These insects’, she concludes:

> so essential to our agriculture and indeed to our landscape as we know it, *deserve something better from us* than the senseless destruction of their habitat.[7]

Here again, the notion of desert clearly implies moral considerability. Similar examples could be multiplied many times. They are not usually found pure – that is, Carson does not assert non-human moral considerability regardless of, or in contrast to, human self-interest. Instead, as in the examples above, she asserts non-human moral considerability *and* asserts that our selfish human interests practically harmonize with its recognition.

Our interests and their interests largely coincide – for two reasons. First, we inhabit the same environment. Hence we cannot poison other animals without poisoning ourselves. Second, preserving wild nature helps promote human happiness and flourishing. Carson approvingly quotes ecologist Paul Shepard and U.S. Supreme Court Justice William O. Douglas on the aesthetic value and intellectual stimulation provided by wildlife, wild places, and a diverse and varied landscape.[8] She also adds her own arguments:

> To the bird watcher, the suburbanite who derives joy from birds in his garden, the hunter, the fisherman or the explorer of wild regions, anything that destroys the wildlife of an area for even a single year has deprived him of pleasure to which he has a legitimate right.
>
> Over increasingly large areas of the United States, spring now comes unheralded by the return of the birds, and the early mornings are strangely silent where once they were filled with the beauty of bird song…. Can anyone imagine anything so cheerless and dreary as a springtime without a robin’s song?
>
> Who has decided – who has the *right* to decide – for the countless legions of people who were not consulted that the supreme value is a world without insects, even though it be also a sterile world ungraced by the curving wing of a bird in flight. The decision is that of the authoritarian temporarily entrusted with power; he has made it during a moment of inattention by millions to whom beauty and the ordered world of nature still have a meaning that is deep and imperative.[9]

For Rachel Carson, pleasure, adventure, beauty, grace, even meaning – all these may be driven from our world along with the “target organisms,” impoverishing our own lives. A silent spring is a season of loss to us and to them, the losses inseparably linked. As she finished *Silent Spring*, Rachel Carson was planning her next book: a guide to help parents explore nature with their children, tentatively titled *Help Your Child to Wonder*.[10]

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[7] Ibid., p. 73, emphasis added.

[8] Ibid., pp. 22, 77.

[9] Ibid., pp. 84, 97, 107, 118–119.

[10] Freeman (1995), Lear (1997), pp. 461, 466.

What is the relative importance of these three main evaluative premises – preserve human health! respect the moral considerability of non-human beings! promote human happiness and flourishing! – in *Silent Spring*? I see no evidence that one was any more important than another to Carson's main argument. The book's title suggests, perhaps, that Carson herself was motivated more by the latter two premises, with human health concerns secondary. This impression is strengthened when we recall that her previous books were works of natural history which did not deal with human health issues. Nevertheless, health is necessary for happiness and flourishing, and human health considerations play a prominent part in *Silent Spring*. Given their ubiquity and interrelatedness, it seems best to say that all three premises are crucial to Rachel Carson's environmental ethics. They are the three strong legs of an environmental ethics in which a healthy, diverse environment provides the wherewithal for human and non-human flourishing.

In general, Carson (and legions of environmentalists to come) emphasized the complementarity in the great majority of cases of the three basic goals of protecting human health, preserving non-human life, and promoting human flourishing. She shone a spotlight on the selfishness and short-sightedness which so often undermined all three goals. Meanwhile, in trying to move her society toward greater recognition of non-human interests and higher human interests, Carson developed an environmental ethics with both non-anthropocentric and enlightened anthropocentric elements. While *Silent Spring* shows how these two aspects may 'converge' regarding an important public policy issue, Carson's own life, dedicated to knowing and appreciating nature, shows how they converge at the personal level. Recognition of the intrinsic value of non-human beings provides benefits that outweigh the restrictions such recognition places upon us. So too, a nobler view of human life – one focused on friendship, the pursuit of knowledge and a rich experience, rather than on getting and spending – should lead to less environmentally destructive lifestyles. The lives of the great naturalists – including Rachel Carson's – suggest that we really will live better lives when we do right by nature.[11]

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Three further themes round out the ethical argument of *Silent Spring*. First, Carson's disapproval of economism – the overvaluation or exclusive focus on economic goals and pursuits. Second, her criticisms of a human 'war on nature'. Third, her warnings concerning the increased artificiality and simplification of the landscape.

Carson criticized the age as one 'in which the right to make a dollar at whatever cost is seldom challenged'. Corporations and individuals make 'insatiable demands' on the land, while commercial advertising lulls the users of dangerous chemicals into a false sense of security. Non-economic values and interests are routinely sacrificed to economic ones, while the 'true costs' of chemical spraying, including costs that cannot be measured in dollars, are left uncounted.[12] Worst of all, people lose the

[11] I discuss this 'convergence' and develop the idea of an environmental virtue ethics grounded in our enlightened self-interest in Cafaro (2001).

[12] Carson (1962), pp. 23, 66, 38, 69.

ability to see the land and its natural communities for what they are, to learn their stories and appreciate their beauty and complexity. Instead nature is reduced to natural resources – both in our minds and on the ground – which humans may fully engross or utterly change, without compunction. Carson believed that conservation had to take economic reality into account, including the need to feed and protect growing numbers of human beings; hence her many suggestions for alternatives to chemical control and safer means of applying chemicals, when necessary. But she also saw the failure to recognize non-economic realities as a denial of our full humanity. Like the failure to prevent unnecessary suffering, the failure to understand and appreciate nature lessened our stature as human beings.

Carson was equally uncompromising in her criticism of what she saw as a 'needless war' on nature. Again and again, she decries the desire for domination in back of much of the use of agricultural chemicals.[13] She saw a reveling in power for its own sake and a will to simplify the landscape in order to control it. But 'the "control of nature"', she concluded *Silent Spring*:

> is a phrase conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man…. [The] extraordinary capacities of life have been ignored by the practitioners of chemical control who have brought to their task … no humility before the vast forces with which they tamper.[14]

Speaking directly to millions of Americans on the television show 'CBS Reports' a few months before her death, she repeated the message: "We still talk in terms of conquest … I think we're challenged, as mankind has never been challenged before, to prove our maturity and our mastery, not of nature but of ourselves."[15] Carson doubted that human beings would find peace among themselves without first making peace with nature.[16]

Finally, Carson spoke out against artificiality and simplification: on farms, forests and rangelands, as well as towns, suburbs and highway margins. Anticipating our own contemporary concern for the preservation of biodiversity, Carson quotes ecologist Charles Elton, that 'the key to a healthy plant or animal community lies in … the conservation of variety'.[17] Such conservation of variety, particularly at the local level, is also the key to preserving human opportunities to know and enjoy nature. Carson insists that all native species have a right to persist in their environments – not just the ones human beings find attractive or useful. And while we must manage and change much of the landscape to suit our needs, some areas

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[13] Ibid., pp 118, 64, 83.

[14] Ibid., p 261. Note the close connection between *is* and *ought* implied in the pairing of 'biology and philosophy'. Post-Darwinian biology has shown us that life on earth was not created for our benefit, that we are evolutionary latecomers, and that we are kin to all life. Philosophical ethics should accommodate this new-found knowledge.

[15] Quoted in Lear (1997), p. 450.

[16] See Carson (1998) and Lear (1997), p. 407.

[17] Carson (1962), p. 110.

should be left wild, free from human artifice and control.[18] Like Aldo Leopold before her, Carson's love of nature encompassed a love of *wild* nature and a powerful determination to preserve it into the future.

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I'd like to end by noting several respects in which Rachel Carson's life and work might point the way forward for environmental ethics. First, Carson's frequent criticisms of human attempts to dominate nature suggest important parallels with contemporary ecofeminism. Consider also the roles compassion and caring seem to have played in her environmental ethics; also, her emphasis on the importance of direct experience. Finally, there were her pioneering efforts in the primarily male worlds of science, government service and conservation – and the misogynistic tone of many of her critics. All this suggests that Carson may be an important resource for ecofeminist reflection.

Second, Carson's philosophy of 'reverence for life' seems to support the whole spectrum of environmental activism. During her careers in government conservation work and private advocacy, she tackled many environmental issues, from pollution prevention to natural areas restoration to ending ocean dumping of atomic wastes. A collection of Carson's shorter and occasional pieces, titled *Lost Woods*, perhaps gives us a fuller picture of her conservation interests than we have had previously. Several pieces highlight her advocacy for wilderness, including 'The Real World Around Us' and 'Our Ever Changing Shore'. The latter includes a moving plea for the preservation of wild beachlands:

> Somewhere we should know what was nature's way; we should know what the earth would have been had not man interfered. And so, besides public parks for recreation, we should set aside some wilderness areas of sea-shore where the relations of sea and wind and shore – of living things and their physical world – remain as they have been over the long vistas of time in which man did not exist.[19]

Other articles show a concern for the beauty and health of more developed landscapes.

Lost Woods also contains Carson's prefaces to the U.S. Animal Welfare Institute's educational booklet 'Humane Biology Projects' and to Ruth Harrison's *Animal Machines*. These indicate her commitment to the humane treatment of animals. 'I am glad to see Ruth Harrison raises the question of how far man has a moral right to go in his domination of other life', she writes:

> Has he the right, as in these examples [of intensive farming], to reduce life to a bare existence that is scarcely life at all? Has he the further right to terminate these wretched lives by means that are wantonly cruel? My own answer is an unqualified no.[20]

In her biography, Linda Lear shows that Carson muted her animal welfare advocacy, out of concern that it would undermine her case against the misuse of

[18] Ibid., p. 78; see also Carson (1998), p. 194.

[19] Carson (1998), p. 124.

[20] Ibid., p. 196.

pesticides. Nevertheless, while writing *Silent Spring*, she wrote to a confidante that 'I wish I could find time to turn my pen against the Fish and Wildlife Service's [her own former agency's] despicable poisoning activities [of predators and "vermin" such as prairie dogs] … it is all part of the same black picture'.[21]

What are the similarities between sacrificing a wild beach for condominium development and sacrificing the happiness of a veal calf for the pleasure of a gourmand? In both cases, human interests come first, no matter how trivial. In both cases, we dominate or deny nature and create new anthropocentric realities. In both cases, profit trumps a true humanity. This is the 'black picture' that decrees misery or disappearance for so much that is "not us". Carson's example suggests that a philosophy of love and appreciation for all nature and its creatures can bridge the gaps between environmental ethics and animal welfare ethics, and between anthropocentric urban environmentalists and ecocentric wildlands advocates.

This indicates a final way in which Rachel Carson might point a route forward for environmental ethics: through her example of personal commitment and activism. Carson was a woman of great character who balanced her personal, professional and political responsibilities with utter integrity. She did not relish controversy, but she did not retreat from it, when necessary. No one else, she realized, had the combination of literary skill and scientific knowledge to write *Silent Spring*. Her struggle to synthesize a mountain of current scientific work and write one final book that was both accurate and compelling, in the face of family tragedy and failing health, provides one of the heroic stories in conservation history. One cannot read about it without being deeply moved. When Carson writes to a friend that it is 'a privilege as well as a duty to have the opportunity to speak out – to many thousands of people – on something so important', we know she means it and love her for it.[22]

Here knowledge and respect for nature, and personal humility and commitment to nature, go hand in hand. Such an ethics is certainly demanding. Yet reading of Carson's life, one learns how much she received in return for living up to it. Perhaps we too may hope that Nature will repay us for our attentiveness and efforts on her behalf. As inspiration and provocation, then, Rachel Carson's life and writings also hold great potential for environmental philosophy.[23]

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Chapter 14
Aldo Leopold: Connecting Conservation Science, Ethics, Policy, and Practice

Curt Meine

Abstract Creative interdisciplinary thinkers in the history of both ecology and ethics have ventured beyond their disciplinary boundaries and into the zone where they overlap. Prominent among these was Aldo Leopold. While serving as president of the Ecological Society of America in 1947, Leopold called for a "land ethic" that integrated insights from ecology, history, ethics, and aesthetics. Prompted especially by developments in science and technology following World War II, Leopold was part of a broader community of contemporaries concerned with these portentous changes. In retrospect, we can see Leopold's special contribution as a defining moment in the discourse connecting conservation science, ethics, policy, and practice. That discourse continues, especially in emerging interdisciplinary fields, even as our critical environmental concerns renders the need for integrated thinking ever more apparent and immediate.

Keywords Aldo Leopold • Ecological Society of America • Conservation • Policy • Ethics

14.1 Aldo Leopold, Ecology, and Ethics: 1947

At its annual meeting in December 1946, the Ecological Society of America (ESA) elected Aldo Leopold president. He was a somewhat surprising pick. Over the years Leopold had devoted a greater share of his professional energies to other scientific, professional, and conservation organizations. Although he had been

C. Meine (✉)
Center for Humans and Nature and Aldo Leopold Foundation,
P.O. Box 77, Baraboo, WI 53913-0077, USA
e-mail: curtmeine@gmail.com

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elected vice-president of the ESA the previous year, he had contributed only occasionally to its conferences and publications. Leopold himself was among those most surprised. “I am astonished by my election,” he wrote to the ESA Secretary, William Dreyer of the University of Cincinnati. “I had supposed… that any nominee failing to show up at the meeting would automatically be out of the running. I feel deeply the responsibility implied in being elected despite this failure on my part.”[1]

Although distressed at the time by a struggle with trigeminal neuralgia, Leopold stepped into the role. His term began in January 1947. As the Society’s flow of paperwork was partially diverted to Leopold’s office at the University of Wisconsin in Madison, he did his best to catch up on official matters involving the ESA’s committees, finances, and journals. He corresponded with members and editors, and made plans to attend the Society’s annual meeting the following December in Chicago. Despite having to undergo a worrisome operation at the Mayo Clinic in September, he was able to organize and chair at the meeting a round-table discussion on bird and mammal population mechanisms.

Leopold completed his term in office, but had one more official duty. He was due to deliver the past president’s address at the next ESA meeting. However, Leopold died on April 21, 1948, suffering a heart attack while fighting a grass fire on a neighbor’s property in Wisconsin (Meine 2010).

We are left to speculate on what Leopold might have offered to his fellow ecologists. He left no prepared manuscript or notes to suggest the trend of his thoughts. There are, however, tantalizing hints and clues as to where he would have taken his audience. On such occasions Leopold tended to highlight interesting work at the cutting edge of contemporary research, but then to focus on broader concerns, emphasize professional responsibilities, and encourage his listeners to push against their own disciplinary boundaries. His 1940 presidential address to The Wildlife Society, for example, was notable for the directness with which Leopold challenged his own professional progeny to become more than trained technicians. “Our job is to harmonize the increasing kit of scientific tools and the increasing recklessness in using them with the shrinking biotas to which they are applied. In the nature of things we are mediators and moderators, and unless we can help rewrite the objectives of science we are predestined to failure” (Leopold 1991b: 277–277).

He himself had taken up that “job” with increasing urgency. Even before the eruption of World War II he was alert to the accelerating impact of modern science and technology on humanistic values and natural systems. In a 1938 lecture he stated: “We end, I think, at what might be called the standard paradox of the twentieth century: our tools are better than we are, and grow better faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it” (Leopold

[1]All correspondence quoted here can be found in the Ecological Society of America files in the Aldo Leopold Papers of the University of Wisconsin Archives. The Leopold Papers are available on-line at http://digicoll.library.wisc.edu/AldoLeopold. Portions of this essay were originally presented in *Minding Nature* (2009), the on-line journal of the Center for Humans and Nature, at http://www.humansandnature.org/august-2009---vol-2--num-2-minding_nature-7.php

1991a: 254). During the war, he voiced his concerns regularly in published and unpublished texts. In a manuscript prepared at the end of 1944, he wrote:

> What will happen to wild values after the war when the fruits of military strategy and military engineering fall into the eager lap of modern man? DDT, capable of eradicating everything from mosquitoes up and down? Family airplanes, ready to eradicate solitude from the face of the map? Power machinery capable of rebuilding the earth on a scale almost comparable to the ice-age? If such tools are to fall short of achieving our ecological suicide, it is the time for us to learn caution and restraint in our power to eradicate wild things. (http://digital.library.wisc.edu/1711.dl/AldoLeopold.ALTypeCop, 1030)

The theme would only intensify in his writings in the few years he had remaining after World War II. As Leopold had feared, the technologies developed during the war were quickly turned toward the post-war marketplace. The major funding and research institutions adapted their agendas, bringing into being the modern scientific establishment. Leopold became increasingly critical of what he took to calling "power science." In a draft essay from 1946 he wrote:

> Time was when the aim of science was to understand the world, and to learn how man may live in harmony with it. If I read Darwin aright, he was more concerned with understanding than with power. But science, as now decanted for public consumption, is mainly a race for power. Science has no respect for the land as a community of organisms, no concept of man as a fellow-passenger in the odyssey of evolution. Science has developed a kind of cosmic arrogance which in turn determines the content and direction of scientific endeavor. (http://digital.library.wisc.edu/1711.dl/AldoLeopold.ALMiscManPub, 760–762)

Leopold was hardly one to harbor a romantic disdain for science or reason. Trained in the scientific method, a disciplined observer and recorder of natural phenomena, an innovative thinker in several fields of natural science, and mentor to a vanguard of young ecologists, Leopold was a staunch defender of science in the many institutions, organizations, and public fora in which he participated. "Science," he once wrote, "contributes moral as well as material blessings to the world. Its great moral contribution is objectivity, or the scientific point-of-view. This means doubting everything except facts; it means hewing to the facts, let the chips fall where they may" (Leopold 1949: 153–154). But especially in the aftermath of the war, Leopold saw fundamental changes occurring in the conduct of science, the role of scientific institutions, and the application of science's findings.

Other trends were also redirecting Leopold's field of vision. The war had, among its manifold effects, globalized conservation concerns. Leading thinkers dating back to Alexander von Humboldt and George Perkins Marsh had appreciated the global scale of human environmental impacts, but the war had grounded these considerations in new and more immediate ways, and had focused attention—for some at least—on their ethical implications. While Leopold was serving as ESA president, he was in communication with two colleagues who would produce important early statements on the global conservation dilemma. Fairfield Osborn's *Our Plundered Planet* and William Vogt's *Road to Survival* would both be published in 1948 (Robertson 2012). Meanwhile, national and international institutions and organizations were mobilizing in response in unprecedented ways.

Leopold himself was invited to serve as advisor to the United Nations' International Scientific Conference on the Conservation and Utilization of Natural Resources, scheduled to convene in 1949.

These trends and concerns were also playing out within the Ecological Society of America. In particular, the Society was experiencing the latest expression of a tension long latent in its ranks. Since its founding in 1915 the ESA had included members who wanted the Society to advocate more actively on behalf of the conservation of species, ecological communities, and natural areas. An ESA Committee for the Preservation of Natural Areas was founded and chaired by Victor Shelford, ESA's first president, in 1917. Other ESA members saw such forthright advocacy as inappropriate for a scientific organization. In March 1946 the conservation forces formed the Ecologist's Union (predecessor to The Nature Conservancy) to channel and organize their conservation activity (Gross 2001; Callicott 2008). Leopold was not directly involved at first, and was only vaguely aware of the growing movement within the ESA. As the newly installed president, he was soon brought up to speed. Although he was initially hesitant about the Ecologist's Union's strategy, he expressed support for its aims. In March 1947 he wrote to Dreyer, "We simply cannot call ourselves ecologists and be indifferent to the slaughter of the biota now becoming world wide." Later that year he joined the Ecologist's Union as a dues-paying member.

During his year of service as ESA president, Leopold returned to his work on the evolving collection of essays that would become *A Sand County Almanac*, but that he was then calling "Great Possessions" (Meine 1999). The manuscript had already been rejected three times by prospective publishers. In the summer of 1947 he drafted a foreword, reorganized the volume's contents, and compiled its capstone essay "The Land Ethic." His post-war misgivings about the course of science and industry came to the foreground as he reworked the manuscript. In "The Land Ethic" he drew a sharp distinction between "man the conqueror *versus* man the biotic citizen; science the sharpener of his sword *versus* science the search-light on his universe; land the slave and servant *versus* land the collective organism" (Leopold 1949: 223). In the draft foreword he reiterated the point: "Science is, or should be, much more than a lever for easier livings. Scientific discovery is nutriment for our sense of wonder, a much more important matter than thicker steaks or bigger bathtubs" (Leopold 1987: 281–282). And he gave memorable expression to the conscientious ecologist's dilemma—an echo, quite likely, of the contemporaneous tensions within the ESA:

> One of the penalties of an ecological education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise. (Leopold 1987: 286)

On September 13, having completed his summer's work on the book manuscript, and just before traveling to the Mayo Clinic for his surgical procedure, Leopold wrote to Dreyer, "Is anything expected of me in the way of a presidential address? If so, I have several chapters in my book which might be suitable." Clearly Leopold saw his address as an important opportunity to air his thoughts, and he made a direct connection to his literary work-in-progress. Immediately after the December meeting in Chicago he wrote again to Dreyer, "I have already started work on my presidential address because I can see very clearly from the Chicago sessions the need for emphasizing certain ideas."

What those ideas were, he did not specify. However, we may presume that he would have addressed the issues that were roiling the broader conservation community, that were rousing dissent and discussion within the ESA, and that were surfacing in his recent writing and speeches: the accelerating assaults on land health and biotic diversity; the emerging global conversation on development and conservation; the changing role, priorities, and system of scientific research; the moral and civic responsibilities of the scientist, especially ecologists; the growing estrangement of science and ethics; and the harnessing of science to heedless economic expansion.

In another key statement from this period, "The Ecological Conscience," delivered on June 27, 1947 to the Conservation Committee of the Garden Club of America, Leopold spoke to an audience outside his professional scientific circle. On this occasion he emphasized the ethical aspect of his converging concerns:

> No important change in human conduct is over accomplished without an internal change in our intellectual emphases, our loyalties, our affections, and our convictions. The proof that conservation has not yet touched these foundations of conduct lies in the fact that philosophy, ethics, and religion have not yet heard of it.
>
> I need a short name for what is lacking; I call it the ecological conscience. Ecology is the science of communities, and the ecological conscience is therefore the ethics of community life. (Leopold 1991c: 339–340)

"The Ecological Conscience" set the stage for Leopold's composition of "The Land Ethic" in the crucial weeks that followed. He incorporated significant portions of the former into the latter. For more than a quarter century Leopold had explored—recurrently, if sporadically—the connections between ethics and ecology, policy and action. In "The Land Ethic" he achieved his most complete and, as fate would have it, his final synthesis. One week before Leopold's death on April 21, 1948, Oxford University Press accepted his book manuscript. *A Sand County Almanac* was on its way to publication.

Left hanging in the air was the question of Leopold's intended ESA address. Joseph Hickey, Leopold's close colleague (and former graduate student) at the University of Wisconsin, recommended to the ESA "a superb manuscript which would lend itself wonderfully to use as the past president's address." That manuscript was "The Land Ethic." Hickey wrote: "In content this paper is a searching examination of the conservation movement both past and present. The approach is historical, the outlook ecological, the findings philosophical. It is my conviction that as an address, it will more than satisfy Professor Leopold's obligation to the Society." The new ESA secretary, William Castle, replied, "From your description I believe it will serve admirably for the occasion." Leopold's successor as ESA president, his friend Paul Sears, read the "The Land Ethic" in his stead (Burgess 2010).

14.2 Post-war Voices: "Thoughtful people are trying to understand our place in Nature…"

Aldo Leopold was not alone in seeing the need to connect science, ethics, aesthetics, economy, public policy, and conservation practice. At least some of his contemporaries saw the same need, and voiced similar sentiments. The books by Vogt and Osborn became bestsellers. Other ecologists tested the deeper ethical waters. Paul Errington (1947: 267) stated that "I probably would not want to remain in the profession… [i]f I did not feel that I might be working for something more important than my own or any other person's selfish advantage." Sears (1950: 94) suggested, "It may be that we shall presently begin to use science in a new and worthier way, to give us our bearings, to help us understand the ecology of our own species. To this end we must weave together all that we know of ourselves and of the physical world." A few years later, Olaus Murie (1954: 289) remarked, "Thoughtful people are trying to understand our place in Nature, trying to build a proper social fabric, groping for a code of ethics toward each other and toward nature. The current controversies in the diverse field of conservation are an expression of this ethical struggle." Although conservation tended to attract students fascinated by the non-human living world, those in the field found it increasingly necessary to address the reality of human social dilemmas.

Beyond ecology and the sciences, contemporary ethicists, writers, and cultural critics were circling around the same point of convergence. Out of the war experience, Hannah Arendt and Hans Jonas would examine the cultural forces of dehumanization and alienation from nature for insights into the rise of twentieth century totalitarianism (Whiteside 1998; Donnelley 1995). In the years after the war, thinkers as diverse as John Dewey, Albert Schweitzer, Jacques Ellul, Joseph Wood Krutch, Loren Eisley, and Thomas Merton wrestled with the broad ethical and theological issues involving nature, science, technology, and the human condition. The advent of nuclear weaponry and technology in particular raised ultimate questions about the fate of nature and humanity in a world where science was unmoored from ethics.

Of all the multidisciplinary voices of this period, Lewis Mumford stands out for the breadth and coherence of his integrated analysis of ethics, culture, and ecological insight. Best known for his work as a literary and architectural critic, he turned increasingly in the post-war years toward wide-ranging studies of intellectual history and human cultural development. In *The Conduct of Life* (1951: 12), he wrote, "So habitually have our minds been committed to the specialized, the fragmentary, the particular, and so uncommon is the habit of viewing life as a dynamic inter-related system, that we cannot on our own premises recognize when civilization as a whole is in danger; nor can we readily accept the notion that no part of it will be safe or sound until the whole is reorganized."

Mumford was an insightful scholar of early conservation thought, and attuned as well to the most current findings ecology and evolutionary biology. He was thus uniquely qualified to help lead the landmark 1955 international symposium, *Man's Role in Changing the Face of the Earth*—an ambitious high point in the post-war merging of disciplinary knowledge and perspectives. The symposium brought together (in Princeton, New Jersey) seventy five of the leading natural and social scientists of the day to examine the role of "Man, the ecological dominant on the planet" and "to understand what has happened and is happening to the earth under man's impress" (Thomas 1956: xxxvii).

In his summary remarks at the symposium, Mumford found himself at the same end-point that Leopold had come to in *A Sand County Almanac*: the elaboration of an ecologically informed ethic. Mumford's was a very different voice, but he was delivering much the same message:

> As the dominant biological species, man now has a special responsibility to his fellow creatures as well as to himself. Will he turn the cosmic energies at his disposal to higher ends, or will he, willfully and carelessly, exterminate life and bring his own existence to a premature end? …Not power but power directed by love into the forms of beauty and truth is what we need for our further development. Only when love takes the lead will the earth, and life on earth, be safe again. And not until then. (Thomas 1956: 1146, 1152)

In retrospect, we can see Mumford's statement, and the entire symposium (and published volume) that it concluded, as a consummate expression of the times. The post-war decade was a critical period of cross-disciplinary ferment, an almost desperate response to the disorientation and anxiety over the human prospect in the long shadow of World War II. The great irony is that, even as the moment was flowering, the ecological science that helped to nurture it was itself becoming more specialized, more theoretical and mathematical, more systems-oriented and model-driven. The apparent connections to other fields were becoming less distinct and less urgent as post-war affluence and consumerism transformed the cultural context of the interdisciplinary conversation.

14.3 Framing the Narrative of Conservation History

The stories that I have just told are pertinent in and of themselves to the themes of this volume; but they also serve to illustrate a broader approach to understanding the ever-evolving relationship between ecology and ethics. This post-World War II moment was critical in the development of that relationship. But how can we understand it in its entire historical context? How can we fully appreciate that moment as part of a larger narrative?

We could turn to our history books, but so far even the best of those can only partially orient us. We have a number of indispensible histories of ecology and environmental ethics (e.g., McIntosh 1986; Nash 1989; Worster 1994; Egerton 2012). Yet there is no single book that one can read to learn the entire, complex story of the co-evolution of ecology, conservation, and environmental thought, from ancient origins to the present, from the local to the global scale. To tell that story fully, one would need to know and integrate multiple fields of knowledge, and vast realms of detail within them. It is a large and complex task, and no single scholar has yet comprehended it.

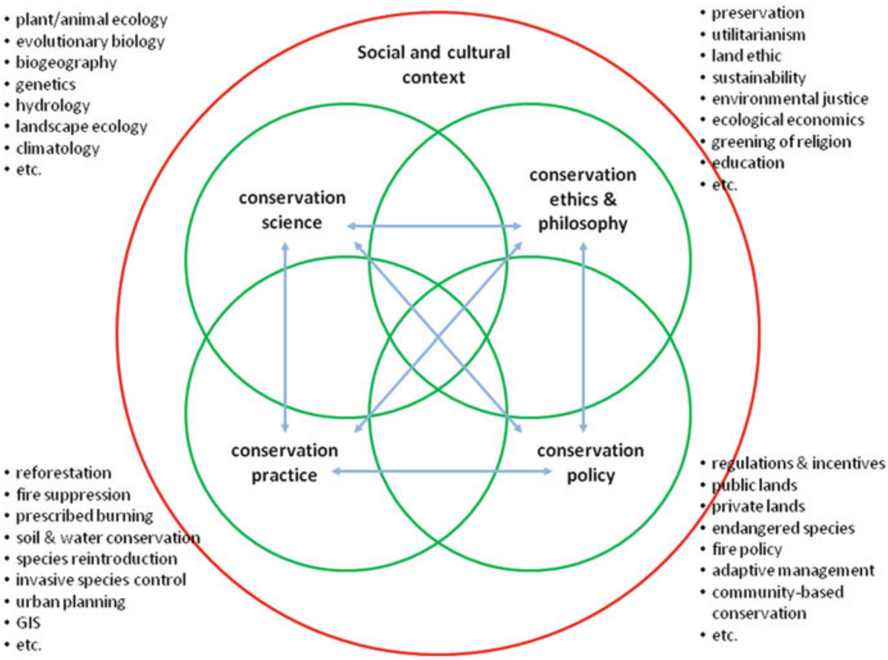

Fig. 14.1 A framework for understanding conservation history. The *green circles* represent four major and overlapping spheres of conservation "content": science, philosophy, policy, and practice (examples of concepts and topics falling within these spheres are provided in the corners). *Blue arrows* indicate the dynamic and continuing flow of interactions and influences among them. All are situated within, and influenced by, the continually changing social and cultural context. All, in turn, are embedded within a still broader context of commingled human and natural systems

Lacking such a complete account, we can at least frame the narrative in a way that suggests the challenge of the task and helps to guide us in our interdisciplinary discussions. Figure 14.1 attempts to show, in simplified form, one way of understanding the dynamism of ecology and conservation history. There is no single point of entry into that complex narrative. For present purposes, let us begin in the upper left, in the realm of conservation science. (I use the term *conservation* here. Other terms might be effectively substituted here, e.g. *environmental* science, or perhaps *sustainability* science.)

Consider the many scientific disciplines relevant to conservation, from geology and hydrology to ecology and climatology. Each of the disciplines listed here—and many others besides (including the social sciences)—obviously has its own rich intellectual history. Thanks to our colleagues in the history of science and environmental history, we have an ever-expanding bookshelf on the history of the sciences, and our understanding of their development continues to evolve.

But conservation (or sustainability, or environmental stewardship) is not a matter of science alone. Conservation *science* intersects with conservation *practice*: the application of that knowledge in ecosystems, landscapes, and communities. In the realm of conservation practice, we can identify a multitude of particular activities, techniques, and technologies—everything from historic reforestation efforts to invasive species control, from soil conservation methods to hydraulic engineering, from maps to the most recent advances in GIS technology. These tools and practices have their own rich histories, their complex pathways of origin, development, deployment, and adaptation.

But conservation is not only a matter of science and practice. It includes as well a rich narrative thread of conservation *ethics* and *philosophy*, of shifting concepts, competing schools of thought, and new areas of convergence. This humanistic dimension of conservation is also dauntingly varied, including fields ranging from literature to theology to environmental history and environmental ethics. And each of these, too, has a complex history of emergence and acceptance, innovation and experimentation, retrenchment and revolution.

But conservation is not only a matter of science, practice, and philosophy. The sphere of conservation *policy* includes all the varied ways in which we seek to govern ourselves in our interactions with one another and the natural world. Within the realm of policy we might include, for example, such endeavors as wildlife law, economics, and land use policy—all of which, again, have their own rich histories.

These spheres—what we *know* from science, what we *do* in practice, what we *value* and *believe* though our philosophies, and how we *govern* ourselves—are meant to be illustrative, not exclusive; we could and no doubt should add other circles to this schema. What is most interesting, and difficult, in grasping the large story of conservation history is the complex and dynamic interaction of these realms. The ultimate, comprehensive hypertext of conservation history would somehow need to examine all the complex connections, synergies, influences, and feedback loops at work over time. A new piece of scientific information, for example, may suggest a new ethical insight… which inspires a new management practice on the ground… which might require or suggest a change in policy… which might in turn lead to a new ethical insight… which might suggest a new research question… which might challenge an existing policy… etc…etc… *in perpetuum*. Change in conservation ricochets around and around and around as history unfolds. All of this occurs, of course, within a complex and ever-changing social and cultural context. And all of that occurs within the phenomenal world itself, the ever-changing and commingled natural and social reality that includes all of the above.

Aldo Leopold stands out in our history as one who worked effectively in all these realms, made innovations within them, made connections between them, and constantly evolved intellectually and emotionally in the process. One can track him moving fluidly among these circles, always in a critical and creative manner. Leopold thus provides a unique transect across the history of twentieth century conservation science, policy, philosophy, and practice. Within this framework, we can appreciate more fully the significance of Leopold's composition of "The Land Ethic" in 1947, and its posthumous presentation to the Ecological Society of America in 1948. Drawing upon his interdisciplinary knowledge and years of field observation and professional endeavor, he was attempting to fuse large spheres in human knowledge, in the human experience, and in the changing relationship of humans and nature.

14.4 Seeking Systemic Solutions to Systems Problems

The relationship between ecological science and environmental philosophy and ethics has developed considerably since Leopold advanced the dialogue in 1947. Certainly there are scientists who devote little time to considering the philosophical and ethical implications of their research; few are trained to do so, and it seems that few are encouraged or rewarded for doing so. And certainly there are philosophers and ethicists unaware of (and perhaps uninterested in) the fine details of the history of ecology or findings from the current cutting edge of research. However, in the environmental arena, the exclusively disciplinary scholar is becoming an ever more elusive creature. Work across the disciplinary frontiers is no longer rare, surprising, or suspect. Emerging interdisciplinary fields—conservation biology, restoration ecology, landscape ecology, agroecology, ecological economics, conservation psychology, evolutionary psychology—are aware of, if not explicit in recognizing, their inherent ethical dimensions. Conversely, over the last generation environmental historians, ethicists, and philosophers have absorbed the concepts, vocabulary, methodologies, and organizing principles of ecology, evolutionary biology, and the earth sciences. Scientists and ethicists alike regularly consider and critique the lessons from—and the implications for—environmental policy and conservation practice. The flow of influence among and between these interacting spheres of knowledge and experience is robust.

As the cross-flow of ideas and information has increased and intensified since 1947 (or, more expansively, since publication of Marsh's *Man and Nature* in 1864, or Darwin's *On the Origin of Species* in 1859, or von Humboldt's *Cosmos* in 1845), the stakes have increased socially, politically, and environmentally. In the decades since Leopold promulgated "The Land Ethic," the pace of anthropogenic environmental change has quickened, the scope broadened, the scale expanded. Biodiversity loss, pollution and overexploitation of soils and fresh waters, ocean degradation, and climate disruption are pervasive forces. It is precisely because these forces are no longer avoidable that the conversation between ecology and ethics has intensified—as has the willful discounting, denying, and opposing of its implications. Interdisciplinary discussion almost by definition challenges the status quo, and it is always easier (and generally more lucrative) to keep the conversation narrow, and to stay within the comfortable confines of one's special area of expertise. However, as Leopold and others have recognized, there is no refuge behind fortified disciplinary boundaries. "Too much safety," as Leopold wrote in another context, "seems to yield only danger in the long run" (Leopold 1949: 133).

We live, now in an Age of Consequences, when the varied social, economic, and environmental challenges we face are cumulative, convergent, and synergistic. Our local issues are invariably tied to global realities; our short-term concerns reflect long-term trends reaching back into the distant past and forward into a distant future. Our array of particular problems cannot be dealt with piecemeal; they are systemic, and thus require systemic solutions. If we are to avoid the worst-case social and environmental scenarios, solutions to one problem must simultaneously contribute to the solution of other problems. The demands of problem-solving in the Age of Consequences require that ecology and ethics be in close and constant communication—with each other, and with any and all other fields deemed relevant to the issue at hand.

Nisbet et al. (2010: 331) come to much the same conclusion when they write, "Preventing the worst effects of current environmental threats may well require the greatest exercise of the human imagination the world has ever seen. We challenge readers to put their minds together to bridge the great wellsprings of human understanding—including the natural and social sciences, philosophy, religion, and the creative arts—to, re-imagine, how we live on Earth." Leopold, Sears, Errington, Murie, Vogt, Arendt, Jonas, Mumford, and many others besides, remind us that we are not the first to take up this exercise; that we build upon the creative efforts of others who were compelled, and inspired, to bridge disciplines and forge connections.

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Part III
Environmental Philosophy: Ethics, Epistemology, Justice

Chapter 15
Introduction to Environmental Philosophy: Ethics, Epistemology, Justice

Clare Palmer

Abstract This chapter introduces the section of *Linking Ecology and Ethics for a Changing World* on Ethics, Epistemology and Justice, three of the major concerns of environmental philosophy. It provides an overview of the chapters that constitute this section by Palmer, Longino, Hayward, Northcott, Eliot, and Mallory and picks out important themes that link these chapters. In particular, this chapter focuses on questions of scientific knowledge, the role values play in science (as discussed in Longino's paper) and what kinds of things in the environment might be thought of as being valuable (discussed in Palmer's and Eliot's papers). The chapter also provides an outline of different approaches to global environmental justice as developed by Hayward, Northcott and Mallory. Hayward focuses on the idea of 'ecological space', Northcott on climate injustice, and Mallory on the importance of recognizing issues of gender and race in any discussion of environmental justice.

Keywords Ecological communities • Environmental justice • Moral considerability • Moral pluralism • Positivism

This part introduces key ideas in environmental ethics, epistemology, and justice, three of the key concerns of environmental philosophy. All three areas are contested territory, and are interpreted by scholars and practitioners in a variety of different ways, as is illustrated by the divergent approaches of the authors here.

The part begins with Clare Palmer's chapter "Contested Frameworks in Environmental Ethics" (Chap. 16). Palmer attempts to map out some of the key positions in environmental ethics as it has developed in the past 40 years. She highlights a range of different possible value commitments and approaches to ethical theory, and also considers the different ways in which environmental ethics can be

C. Palmer (✉)
Department of Philosophy, Texas A&M University,
4237 TAMU, College Station, TX 77843-4237, USA
e-mail: cpalmer@philosophy.tamu.edu

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pluralist. The chapter provides an introduction to ideas about environmental justice and the moral relevance of ecological "wholes", central to the chapters by Hayward, Northcott and Eliot later in this part.

The second chapter in this part, Helen Longino's "Legacies of Positivism in the Philosophy of Science" (Chap. 17) explores questions about the nature of knowledge in science, and whether and how scientific "objectivity" is possible – clearly an important concern for environmental philosophy. After introducing some key ideas from early twentieth century positivism, Longino explains her alternative approach of *critical contextual empiricism.* While applauding the positivists' insistence on the importance of observation and measurement, she develops an alternative, social view of scientific knowledge that is understood to be both partial and dynamic. Her chapter concludes by arguing that "Both philosophers and scientists must admit the role values play in the sciences, while preventing the empirical from being overrun by the normative and the ideological".

Longino's chapter provides a useful theoretical context for the third contribution to this part, Christopher Eliot's "Ecological Objects for Environmental Ethics" (Chap. 18). Drawing on theoretical ecology, Eliot considers whether there are "ecological objects" in the world – such as ecological communities and ecosystems – and whether (if so) these might be the kinds of objects to which we can attribute moral status. Obviously, this is a central question in environmental philosophy, in particular in traditions influenced by a Leopoldian land ethic. Eliot argues that ecological communities are properly regarded as ecological objects, because they are causally integrated in the right kinds of way. And, he maintains, recent work in ecology, in a tradition flowing from Gleason, does not reject this kind of causal integration – despite what is popularly thought. This conclusion does not settle the question whether ecological communities *should* be attributed moral status, but it does mean that they are sufficiently robust to at least *permit* consideration of their moral status.

The following two chapters shift the focus from scientific knowledge, and the ways in which scientific ecology has contributed to our understanding of the world, to the impacts of the environmental actions and attitudes of the affluent on others who are vulnerable – both human and non-human. Both Tim Hayward's chapter "Ecology, Ethics and Global Justice" (Chap. 19) and Michael Northcott's "Whose Danger, Which Climate? Mesopotamian versus Liberal Accounts of Climate Justice," (Chap. 20) develop ideas about global environmental justice, although adopting somewhat divergent (but complementary) approaches. Hayward argues that humans need to recognize their location in what he calls "ecological space", a space that is limited and on which all humans (and non-humans, too) depend for their health and well-being. All human beings, he maintains, have a right to be able to access enough ecological space to have a "minimally decent life". However, some people currently use, and hoard, much more ecological space than others; but since ecological space is limited, when some have plenty, others are being deprived of useful access. This infringes on their rights. Mainstream liberal conceptions of justice, Hayward suggests, are based on the idea that continued economic growth is possible (so they fail to recognize the constraints of ecological space). Hayward challenges this assumption, arguing instead that if both present and future people are to have sufficient ecological space to flourish, global ecological demands on the planet overall must contract, and the wealthy will need to reduce their exclusive occupation of ecological space, bringing their demands closer to convergence with those who are worse off.

Northcott's chapter also concerns global environmental injustice, and – like Hayward – he offers a critique of "liberal" accounts of justice and the refusal of such accounts to accept that there are "earth related limits to justice". Northcott's focus is, specifically, on the injustice that the impacts of climate change will cause – in particular, the injustice that would result from the widespread acceptance of a 2 °C target for maximum warming above pre-industrial levels. He points out that while this target may be one that affluent Europeans and North Americans can live with, even the amount of warming currently in the system is seriously impacting on the lives and wellbeing of many residents of North Africa and the Middle East. So, dominant concepts of global liberal justice, Northcott argues, are already leading to injustices in particular regions and communities towards those who are poor and vulnerable – for instance those in the Middle East who are losing land to drought influenced by anthropogenic climate change.

The final chapter in this part, Chaone Mallory's "Environmental Justice, Ecofeminism and Power" (Chap. 21) explores the intersection between environmental justice and ecofeminism. She argues that analyses of environmental justice that "do not incorporate an explicitly gendered and ecofeminist analysis of ecological problems will not adequately understand the ways in which systems of oppression (such as racism, gender discrimination, and environmental degradation) are interconnected and mutually reinforcing." While accepting the claims of those advocating for environmental justice, like Hayward and Northcott, that not all human beings are equally situated with respect to environmental harms, she argues that further analysis of the nature of environmental injustice is needed. The inequalities of power and wealth Northcott and Hayward discuss are also *gendered* and *raced*; women of color, for instance, are particularly hard hit by ecological degradation and climate change. Mallory's chapter, then, adds an important dimension to this part, and points forward to the chapters in the next part with their emphasis on values and action.

Chapter 16
Contested Frameworks in Environmental Ethics

Clare Palmer

Abstract This chapter provides an overview of some key, and contrasting, ideas in environmental ethics for those unfamiliar with the field. It outlines the ways in which environmental ethicists have defended different positions concerning what matters ethically, from those that focus on human beings (including issues of environmental justice and justice between generations) to those who argue that non-human animals, living organisms, ecosystems and species have some kind of moral status. The chapter also considers different theoretical approaches to environmental ethics in terms of consequentialist, broadly deontological and virtue theories. Finally, three different interpretations of moral pluralism in environmental ethics are introduced: pluralism about values, pluralism about theories, and a pragmatic, methodological pluralism.

Keywords Environmental ethics • Moral considerability • Moral pluralism • Anthropocentrism • Ethical holism

16.1 Introduction

Environmental ethics emerged as an academic field during the 1970s, and grew rapidly. Today, courses in environmental ethics are taught in universities across the world; textbooks, journals and monographs in the field have proliferated.[1] As the field has grown, it has diversified, now supporting a wide range of contrasting views concerning what should be understood as the fundamental problems of environmental ethics, how to approach and prioritize such problems and, more

[1] For a longer, though still brief history, see http://www.cep.unt.edu/novice.html

C. Palmer (✉)
Department of Philosophy, Texas A&M University,
4237 TAMU, College Station, TX 77843-4237, USA
e-mail: cpalmer@philosophy.tamu.edu

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specifically, what has value, why it has value, and in what kind of ethical theory such values should be embedded.

Attempting to give an overview of such a contested field in a short paper is difficult; so this paper is necessarily limited. I will outline three kinds of divisions in broadly "Anglo-American" approaches to environmental ethics. This means there will inevitably be important omissions. I won't discuss environmental *philosophy* more generally construed (including approaches drawn from Continental or Latin American philosophical traditions, Deep Ecology, Ecofeminism and Social Ecology[2]) and I won't focus on particular issues (such as ecological restoration[3], climate change or wilderness[4]) that have been highly significant in the development of the field. Instead, I'll concentrate on underlying theoretical frameworks, which may help to locate different approaches to such issues (while noting that some environmental ethicists argue that this theoretical approach is the wrong starting place). Some of the conflicting approaches to environmental ethics I'll discuss are derived from differences found more generally within ethics. Others relate to the specifically *environmental* concerns of the field.

The conflicts I'll explore here offer different answers to the following three questions:

1. Are human individuals the only things that matter morally? If not, what else is of moral relevance, and why?
2. What approach to ethical theory should environmental ethicists adopt?
3. Should environmental ethicists be ethical monists or pluralists?

Commitment to a particular answer to question 1 doesn't require any particular answer to question 2. So, there can be disagreements along two dimensions; approaches to environmental ethics can diverge *both* about what matters morally *and* about ethical theory. However, answers to the first two questions may lead to a particular answer to question 3.

16.2 Conflicting Approaches: Moral Status

16.2.1 Key Terminology

The first key term here is "moral status" or, alternatively, "moral considerability". Most simply, "moral status" is usually used to refer to something or being

[2]For more information about approaches drawn from Continental philosophy, see Brown and Toadvine (2003); Foltz and Frodeman (2004), and from Latin American philosophy see Rozzi (2012). For Deep Ecology see Brennan and Witoszek (1999); for Social Ecology, see Bookchin (1995), Light (1998); for ecofeminism, see Plumwood (1994), Warren (1997).

[3]But see Elliot (1997), Throop (2000) on ecological restoration.

[4]See Callicott and Nelson (1998) on wilderness.

that we should take directly into account in our decision-making; "we may not treat it just in any way we please" (Warren 2000, p. 3). Even if some thing, or being, with moral status is useful to us, it is not *just* useful; it is also something for which we should be directly concerned. On most accounts something that possesses moral status has *interests*, a good of its own. Some further distinctions are useful here:

(a) To say that something has moral status/considerability is not necessarily to say that it has *rights*. Rights possession is usually construed much more narrowly (see Goodpaster 1978). Most environmental ethicists, if they accept rights arguments at all, confine rights to a small group of beings, either just human beings, or more broadly, humans and mammals.
(b) To say that some thing or being has moral status says nothing about *comparative* value. Moral status/moral considerability should be understood as *threshold* terms. If we say a being has moral status, all we're saying is that it counts for *something*. The term "moral significance" is usually reserved for comparative judgments of value; we could say that two beings (say a bear and a beetle) are morally considerable, but that the bear has more *moral significance* than the beetle.
(c) Moral status/considerability is often closely related to the term *intrinsic value*. But the term "intrinsic value" is used in many different ways, too complex to discuss here.[5] However, two points to note: In environmental ethics, "intrinsic value" is commonly used to mean *non-instrumental* value; the "value of things as *ends in themselves* regardless of whether they are also useful as means to other ends" (Brennan and Lo 2008). Second, on some accounts, to say that some being, thing, or state has intrinsic value *just is* to say that it is morally considerable. But, alternatively, it is also possible to argue that some thing (such as a painting) can be valued intrinsically, without having to maintain that it has moral status (see Cahen (1988) for further discussion of this distinction).

16.2.2 Understandings of Moral Status

There are two independent fault lines within environmental ethics with respect to moral status. These are (a) an anthropocentric/non-anthropocentric fault line, and (b) an individualist/holistic fault line. There is also substantial disagreement over (c) what capacities or qualities give some thing or being moral status, and add to its moral significance.

[5] So, for instance, on some accounts intrinsic value is taken to mean the value some thing or state has in itself, independently of its relations; while alternatively, on other accounts, intrinsic value is the value an object, state or fact has an end, rather than as a means. See O'Neill (1992); McShane (2007) and Zimmerman (2010) for further discussion.

16.2.3 Anthropocentrism/Non-anthropocentrism

Anthropocentrism just means "human-centered," and as such can refer very broadly to worldviews and attitudes, as well as to values. Here, however, I'm concerned with a narrower sense of anthropocentrism, anthropocentrism about moral status. This can take different forms. On one view, *only humans* have moral status; the natural world matters only inasmuch as it is important or useful for human beings. An alternative form of anthropocentrism maintains that humans have higher, or much higher, moral significance than anything else in the natural world, but that at least some nonhuman beings or things have some degree of moral significance. These are sometimes called "strong" and "weak" anthropocentric views, although these terms can be used in different ways.[6] A *non-anthropocentric* view maintains that at least some nonhuman beings or things have high moral significance; perhaps as high, or even higher, than human beings. Non-anthropocentric views can also take many forms, however, as I'll explain below.

Very significant environmental ethics problems exist, *even if* one is strongly or weakly anthropocentric about moral status. For even if only humans are thought to have moral status, there are still substantial inter-human *environmental justice* issues with relation to the environment. In the case of human contemporaries, some individuals and groups (both within nations, and internationally) may bear a *disproportionate burden* of environmental harms, be *unfairly deprived* of access to key environmental resources, and be *excluded from decision-making procedures* about the environments in which they live. And justice issues *between* generations can be even more starkly drawn. Future generations are vulnerable to the actions of present generations; they can play no direct part in decision-making about actions that will affect them; and environmental costs, burdens and deprivations can be pushed forward to future people, while present people gain the benefits.

The term "anthropocentric" in environmental ethics has sometimes carried negative valence (in a similar way to the negative valence popularly carried by the term "egocentrism"). However, some environmental ethicists have strongly defended anthropocentric approaches to ethics, especially for *strategic* reasons. In public policy debates, it is maintained, anthropocentric arguments for environmental protection are much more likely to be persuasive than non-anthropocentric ones (de-Shalit 2000; Light 2002). Norton (1993, 1997) argues that if anthropocentrism is sufficiently *reflective* – that is, if it takes future people, ecosystem services, and other cultural and aesthetic interests seriously enough – there will, in practice, be convergence between anthropocentric and non-anthropocentric environmental policy. So, there is no need to argue for more contentious, non-anthropocentric ethical views. However, these views are highly contested in environmental ethics, as I'll point out later.

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[6] "Strong" and "weak" anthropocentrism can be used in different ways. For instance, these terms may describe the *origin* of values, or the *objects* of values; here I'm referring to the *objects* of values. Bryan Norton takes "strong anthropocentrism" to mean instrumentally valuing nature for consumptive uses and "weak anthropocentrism" to mean "widely" instrumentally valuing nature for nonconsumptive "higher uses" (e.g. as an aesthetic and spiritual resource).

16.2.4 Individualistic/Holistic

A second distinct fault line concerns whether *only individuals* can be thought to have moral status. Actually, putting it this way begs a key question, since one problem here concerns what *constitutes* an "individual." Traditionally, "individual" has referred to individual human beings, animals and other living organisms. Many views in environmental ethics maintain that only individuals of these kinds – some or all organisms – *can* have moral status. Why? Most simply, because (on this view) only living individuals can have a well-being, interests, can be harmed or benefited, and/or have a good of their own. And it is only beings about which we can make these kinds of claims that *could* have moral status. If something can't be harmed or benefited (it is argued) why *should* we take it directly into account morally?

However, this opens up two possible responses, both of which can be found within environmental ethics. The first is to argue that some things in the natural world generally thought of as groups, sets or collectives, have more cohesion than these terms imply. This cohesion is such that they can be thought of as "quasi-individuals" that can be in some way harmed or benefited, and thus that they can, like more traditional individuals, have moral status. The second response is to maintain that groups such as communities should be valued, or can have moral status, as a group, *even though* they lack individual-like qualities. Both these responses – I'll call them "holistic" – may conflict strongly with individualist, organism-focused views. The conflict between these approaches has underpinned some of the most enduring disputes in environmental ethics, particularly in the context of ecosystem management, hunting and culling, where the claims of particular individuals may compete with the claims of "wholes" such as systems or species.

16.2.5 Differing Grounds for Moral Status

It is generally thought that individual adult humans are "paradigm cases" of moral status. However, even in the human case, reasons for maintaining this differ. In starkly simple terms, there are two important traditions here. One – a broadly Kantian tradition – focuses on human *rationality*; the second on human *sentience* (very roughly, the human capacity to *feel* and to *experience*). Most strong ethical anthropocentrism works with the first tradition. Humans are autonomous, capable of reasoning, in particular of reasoning about ethics; they can enter into agreements with one another; they can reciprocate. Nothing else has such capacities; and these are the capacities that underpin moral status. So, only humans have moral status.

Some worries about this view immediately arise. If this is the basis of moral status, only some humans will have it. Infants, the senile, those in comas, those with severe mental disabilities and fetuses are not capable of this kind of sophisticated reasoning. So, they do not appear to have moral status. For some philosophers, this implication alone (sometimes unhappily called the Argument from Marginal Cases) is sufficient reason to reject the view. Others have attempted to extend arguments about reason to include those who are partial reasoners, potential reasoners or past reasoners; and yet others argue that it is enough for an individual to be "of the same kind" as those that *do* reason, where "kind" is interpreted as "species" (Cohen 1986). However, these arguments are problematic, as has frequently been pointed out (most comprehensively in Nobis 2004).

The second perspective grounds moral status not on individuals' reason, but on individuals' sentience. As the utilitarian philosopher Jeremy Bentham (1989) famously commented, "The question is not, Can they reason? nor, Can they talk? but, Can they suffer?" But if *suffering* is what matters, many non-human animals should also have moral status along with human beings. Although, of course, animal suffering has been a long-standing issue of popular, philosophical, and theological concern, it was the publication of Peter Singer's *Animal Liberation* in 1975 that led to the prominence of **sentience-centered** ethics. Singer argued that suffering matters morally wherever it is found, and that every being that can suffer should be taken equally into account in our moral decision-making. Although many disagreed with Singer's account of animals' moral significance, the idea that *if* a being is sentient *then* it should be understood to have moral status has been very widely accepted, both inside and outside environmental ethics. This view forms a key individualist position in environmental ethics.

Some environmental ethicists, however, argue that sentience-centered approaches do not go far enough. Moral status is still limited to those beings that have an "experiential well-being". But, such philosophers argue, we can make sense of the idea of "well-being" without requiring that it be *experienced*. Failing to water a houseplant is *bad for* the plant; it is contrary to the plant's interests. On this basis, it is argued, we should extend moral concern to plants; indeed, to all living things. On views of this kind – **biocentric** ethical views – all living organisms have moral status (though this should not be taken to mean that they all have high moral *significance*). Although biocentric ethicists have made slightly different arguments for the moral status of all living things, this approach to environmental ethics has been very significant (see Taylor 1986; Agar 2001; Varner 1988; Attfield 1987).

These moves in environmental ethics are sometimes called ethical *extensionism*. Ideas of moral status have been *extended* from humans, to individual sentient animals, to all living organisms. However, this isn't the only way in which extensionism in environmental ethics has moved. It has also extended *holistically*, outward from human communities to include, for instance, ecosystems and species.

The most prominent kind of holism – **ecocentric holism**, or **ecocentrism** – originates in the work of Aldo Leopold (1949). Leopold argues for a rather different form of ethical extensionism: "The land ethic simply enlarges the boundaries of the community to include soils, waters, plants and animals, or collectively, the land" (Leopold 1968, p. 204). The starting point of Leopold's ethical extension is not the individual, but the community; and inanimate things (such as "waters") have moral relevance, since they form part of "the land." The focus here is on whole ecological communities or ecosystems, and on emergent properties they may possess. So Leopold's land ethic famously maintains that "A thing is right as long as it tends to preserve the integrity, stability, and beauty of the land community. It is wrong as it tends otherwise" (Leopold 1968, p. 224). Integrity and stability are not properties possessed by individual community members, but by the community *as a whole*.

In the past several decades, a number of environmental ethicists have attempted to develop a systematic underpinning for ecocentric ethics (see, for example, Callicott 1989; Rolston 1988; Johnson 1991). These accounts as to why ecological communities or ecosystems should be valued as wholes or accorded moral status differ considerably. Callicott (1989) argues – drawing on Hume and Darwin – that just as we have emotional loyalties and moral responsibilities towards *human* communities in which we are located, so too we should have such loyalties and responsibilities to the ecological communities of which we are also members. The argument proposed by Rolston (1988) focuses on ecosystems as wild processes that create and nurture life; it would be peculiar, Rolston insists, to value the organisms, the products of the system, without recognizing the value of the processes that produced them. Johnson (1991) argues that ecosystems should be understood as quasi-individuals with "interests," interests that don't necessarily coincide with the interests of their members.

However, ecocentric views have run into many difficulties, including what kind of thing an ecological community, or an ecosystem, might be thought to *be*. Are ecosystems really distinct from what's around them – do they have boundaries? Do ecological communities form any kind of coherent whole, or are they aggregates of individuals (and do different communities have different degrees of cohesion)? Does it make sense to talk about "ecosystem" or "ecological community" health? Do ecological communities reach a stable equilibrium, or are they in a constant state of flux and disequilibrium? (see McShane 2004; Odenbaugh 2007; Pickett and Ostfeld 1995). The more indistinct, incoherent, and rapidly changing ecosystems or communities seem to be, the more difficult it becomes to maintain certain kinds of ecocentric ethics, especially those that depend on the idea of ecological communities or ecosystems as having a "good" or "interests" that can be "set back."

Some environmental ethicists maintain that *species* have moral status, a view that's usually grafted onto the position taken by some philosophers of biology that a species is not a *class* or *set* but rather a kind of concrete particular, an *individual*. For, it is argued, a species is connected not by relations of similarity common to the constituents of sets, but rather by causal and spatiotemporal connections (see, for instance, Hull 1978; Crane 2004). These *descriptive* arguments about how best to conceive of species are used to base claims about species' *moral* status. Johnson (2003, p. 478), for instance, argues that a species is a living entity, an ongoing process that maintains near equilibrium with its environment. This kind of life process, he argues, has interests in "whatever contributes to its coherent and effective functioning as the particular ongoing life process which it is." Such species interests, Johnson (2003, p. 479) maintains, can be distinguished from the sum of the interests of individuals of the species; something could be in the interests of a species that's not in the interests of any individuals that are part of it. For this reason, Johnson argues, species' interests are of *moral significance;* other things being equal, we *should* protect and promote species' interests. Of course, arguments of this kind are contentious; even if this *description* of a species is accepted, the claims that species have interests, and that those interests are of moral relevance, are troublesome to defend (see, for instance, Sandler and Crane 2006).

I've identified two key fault lines here: between anthropocentric views and a variety of non-anthropocentric views; and between individualistic/holistic views. Commitments with respect to one don't necessarily determine commitments with respect to the other; individualistic views can be both anthropocentric and non-anthropocentric, as can holistic views.

16.3 Conflicting Approaches: Ethical Theory

I've focused so far on competing approaches to moral *status*. However, to be action-guiding, ideas about moral status must be embedded within what's called an ethical *theory*. I'll outline three differing ethical theories that have been important in environmental ethics: consequentialism, deontology, and virtue ethics. I will show how these link back to ideas about moral status, and indicate key conflicts between them.[7]

16.3.1 Consequentialism

A consequentialist aims at bringing about best outcomes, most commonly by his or her actions or practices. Standard forms of consequentialism are *maximizing* (we should bring about the best expected outcomes possible), and require us to take the *whole outcome* into account (including the outcomes of *omitting* to do things we could have done).[8] Given this framework, what we take "best outcomes" to be in terms of what we think is good (or bad) is critical. This takes us back to moral status, because the capacities that give moral status/significance are usually closely connected to what we think is "good." Here's an example: Suppose we take a sentience-centered position on moral status, so beings that can feel pleasure and pain matter morally. Then we combine it with a consequentialist ethical theory. This gives us the basic structure of what's known as *hedonistic utilitarianism*; utilitarianism is the best-known form of consequentialism. For a sentience-centered consequentialist, "pleasure" is the good (to be maximized) and "pain" is the bad (to be

[7] I won't discuss some theories important in ethics more generally (such as ethical egoism and moral contractarianism) that have been less significant in environmental ethics.

[8] This is, of course, oversimplified; there are forms of consequentialism that don't focus on actions; and there are satisficing, not maximizing consequentialisms; but these variations have not been highly significant in environmental ethics.

minimized). The aim of actions, then, will be to bring about the greatest amount of expected pleasure, net of pain; this constitutes the "best outcome."[9] But consequentialism does not only apply where states of pleasure (pain) are the good (bad). Other forms of utilitarianism emphasize preference satisfaction, where the good is satisfied preferences, and the bad frustrated preferences; for biocentric consequentialists the good (to be maximized) is organismic flourishing, and the bad (to be minimized) is setting back organismic flourishing (see Attfield 1987). Holistic views may also be consequentialist; one might aim at maximizing ecosystemic health, or species flourishing. Consequentialists have very diverse ideas of what constitutes the good. What makes them consequentialist is the forward-looking aim at *best outcomes*.

16.3.2 Deontology

Consequentialist ethical theories contrast with what are (roughly) known as deontological theories. Consequentialists aim to bring about the best *states of affairs* in the world – states such as pleasure and flourishing. But one worry about consequentialism is that to get to the best states of affairs, particular individuals may need to be sacrificed. So, for instance, if inflicting suffering on one would relieve the suffering of many, a consequentialist may require that the one suffers. Second, the maximizing nature of consequentialism seems relentless; all our actions seem to be swept up into the moral sphere.[10]

Deontologists, therefore, argue that consequentialism is *unjust* (in requiring the sacrifice of some individuals to create best states of affairs overall) and *overdemanding* (in requiring a constant aim at best consequences). In particular, deontological theorists argue that there are some things that should never be permitted, even if doing them does bring about the best consequences; there should be *restrictions* on maximizing the good. Most deontological theorists also argue that one is *not always required* to maximize the good; for instance, it is at least sometimes permissible to pursue one's own private interests (such as reading a good book in the armchair) even though better consequences might be brought about if one did something else.

Deontological theories in environmental ethics emphasize rules, principles, duties, rights or some combination of these. The basic idea is that we should adopt certain principles or respect certain rights, rather than that we are required always to maximize the good. Although the distinction between deontological and consequentialist approaches occurs in all kinds of environmental ethics, the most prominent battle has been between utilitarian and rights theorists concerning animals. A hedonistic utilitarian, of the kind mentioned above, could support animal

[9] There are other forms of consequentialism that work with *intended* or *actual*, not expected outcomes.

[10] Some sophisticated forms of consequentialism – in particular various kinds of indirect consequentialism avoid these difficulties; I'm just sketching relatively simple forms here.

experimentation in certain (rare) circumstances, where the expected outcome of some particular painful experiments would be to reduce overall suffering. However, deontological rights theorists – such as Tom Regan (1984) – reject this view. For Regan, if a being has moral status (he has a rather sophisticated account of moral status) then it has *rights*. And one should not infringe on a being's rights, *even if* doing so would bring about best outcomes overall. On this view, practices such as eating meat and animal experimentation should be abolished, because they infringe on animals' rights. A consequentialist approach, in contrast, while finding many instances of both meat eating and animal experimentation morally objectionable (because they don't maximize pleasure/minimize pain overall) would not support absolute abolition of such practices.

Deontological approaches are not confined to sentience-centered views. Paul Taylor, a prominent *biocentric* ethicist, argues that we have certain deontological duties to respect all wild individual living organisms. Deontological views could also be holistic; for instance, we might have duties towards species, such that we should never render a species extinct, even if doing so would promote the flourishing of five other species.

16.3.3 Virtue Ethics

Rather than being concerned primarily with actions and practices (as consequentialists are) or with rights, principles or rules (as deontological theorists are), virtue theorists are primarily interested in *character*. Virtue ethics asks how we should live, what sort of people we should be, what it is to be a "good person" and how to make ourselves into such a person. Virtues (vices) are understood as dispositions or traits of character that it is desirable (undesirable) to have. In an environmental context then, what's at stake is not so much *norms of action* as *norms of character* (Sandler and Cafaro 2005, p. 1); that is, virtue ethics concerns our *attitudes* and *dispositions* with respect to the environment. Obviously, this yields a very different moral theoretical approach to one that's either outcome-oriented (as is consequentialism) or rule-following (as deontology). For this reason, environmental virtue ethics is less obviously concerned with environmental policy and legislation. But still, virtue ethicists can argue, character is the right place for our primary ethical focus. Our environmental actions flow from our characters. If we are greedy, selfish, short-sighted, complacent, ungrateful, and callous in our attitudes and dispositions towards people, animals and the non-human world, then it is not surprising that environmental crises result. As Sandler and Cafaro (2005, p. 3) argue: "How one interacts with the environment is largely determined by one's disposition towards it, and it seems to many that the enabling cause of reckless environmental exploitation is the attitude that nature is a boundless resource for satisfying human wants and needs." Virtue ethics, then, is an ethical approach that claims to get at the heart of environmental problems by examining the *kinds of people we are*.

A related theoretical approach, sometimes called the "ethics of care," has also played an important role in debates in environmental ethics, in particular in feminist approaches to animal ethics (see Donovan and Adams 2007). Care ethics, as its name suggests, maintains that caring relationships, usually with particular others, lie at the heart of ethics; we should attend to individual people (or other organisms) rather than primarily to consequences or principles. Virtue and care ethics share certain features in common; indeed, it has been argued that care ethics should be understood as a form of virtue ethics (where "being caring" is taken to be a critical virtue). Both approaches maintain that human emotions should play a significant part in ethical decisions; we are not *only* rational beings. Developing and expressing the moral emotions such as compassion, sympathy and empathy should form part of a rich and flourishing moral life. This emphasis on the place of human emotion in ethical decisions, as well as the focus on character, makes for a contrast between deontological and consequentialist approaches on the one hand, and care and virtue ethics on the other.

16.4 Conflicting Approaches: Monism and Pluralism

I have so far outlined different views on *moral status* and *ethical theory*. But suppose one finds several different accounts of moral significance plausible, though they appear to be in conflict? Or suppose one finds attractive (or repellent!) elements of different ethical theories? This raises questions about whether one should be a *monist* or a *pluralist* in environmental ethics. In fact, the terms "monist" and "pluralist" can be understood in various different ways; what I say here will inevitably simplify these debates, which can be framed rather differently (see Brennan 1992; Wenz 1993). With this caveat in mind, I will discuss three kinds of pluralism: pluralism about *values*, pluralism about *ethical theory*, and what has been called *methodological pluralism*.

16.4.1 Value Pluralism

Environmental ethicists have argued for the moral importance of many different capacities, (such as sentience), states (such as pleasure), and qualities (such as naturalness). And I have had no room to discuss other ethical considerations that are generally thought to be important – such as justice, equality, and liberty. But there may be occasions where these values might conflict; or at least, respecting one might mean denying another.

One way of thinking about this is to maintain that only one value is *fundamentally* morally important. The others are either not values at all, or are not independently valuable; they should be "cashed out" in terms of one "master" value. This is the route taken by *value monists.* Value pluralists, on the other hand, accept that there is more than one (and perhaps many) moral values and considerations. These values cannot all be translated into one "master value currency," but neither should they be silenced or ignored. Values really are plural, and potentially in conflict with each other. The central problem for value *monists,* then, is to identify this "master" fundamental value, explain why it is so significant, and how to translate other values into its terms. The central problem for value *pluralists* is to provide a way of prioritizing or balancing competing values when they come into conflict.

Hedonistic utilitarianism is a key example of value monism. The master, fundamental value/disvalue is pleasure/pain; all other values and considerations can be translated into the master value (so, justice is important inasmuch as it maximizes pleasure and minimizes pain; rationality is important inasmuch as it intensifies or lessens pains and pleasures). Sometimes this is called "strong value commensurability:" since there is a master value, all values are commensurable. However, many environmental ethicists reject strong value commensurability. They argue that values are fundamentally plural. For instance, both "being sentient" and "being rational" are morally important; rationality is not only important because it can enhance or reduce pleasure and pain. Hence there can be a genuine conflict between these values. How does one deal with such conflicts?

On the view that's sometimes called "weak value commensurability," one can consistently *rank* values. For instance, one can say that both sentience and rationality are important, but that when they conflict, one (say, rationality) always has priority over the other (sentience). That is, some kind of *lexical priority rule* can be adopted, where one value (or an amount of the value) is always given priority over another value (or amount of the value). Other value pluralists reject such regular ranking patterns, arguing for different forms of value *incommensurability*. On these views, value-rankings either vary by context (so in some cases one might prioritize one value, in other cases a different value) or on some occasions at least, values just cannot be ranked at all; rational choices can't be made between them. The philosopher Isaiah Berlin famously called these "tragic choices."

Value pluralism of one kind or another has the significant advantage, as Carter (2005, p. 76) puts it, of "recognizing that each value continually exercises its pull." This position has been widely adopted in environmental ethics. There are individualist value pluralists who maintain that, for instance, being alive, being sentient, being rationally autonomous are all different but important values, and have come up with various frameworks for decision-making in situations of conflict. Equally, there are holistic value pluralists, who maintain, for instance, both that "species protection" and "naturalness" are values, and have systems for adjudicating between them when species protection requires human intervention. And finally there are ethicists – such as Johnson (1991) – who accept both individualist and holistic values, and find ways of balancing, prioritizing or trading off these values when they conflict.[11]

[11] This kind of value pluralism is of particular significance to consequentialists, who aim at bringing about the best outcomes. There is a similar kind of pluralism of *principles*, more common among deontologists, that I do not have space to discuss here.

16.4.2 Pluralism About Ethical Theory

A second debate concerns pluralism in ethical *theory*. In environmental ethics, this debate largely arose in response to a claim by Stone (1988) that a moral pluralist might be a utilitarian in public life but adopt a non-consequentialist ethical theory in his or her private life. This form of moral pluralism seems to endorse the view that we could theory-switch in different contexts. The majority of environmental ethicists have been skeptical about this kind of moral pluralism. Attfield (2003, p. 90) argues that theory-switching is incoherent, since the same action could thereby appear to be both right and wrong simultaneously. Other worries concern the integrity of moral agents. Callicott (1990) goes so far as to maintain that theory-switching is open to (perhaps unconscious) manipulation – if a theory comes up with an answer you don't like, you appear to be permitted to switch to the theory that gives the answer you actually want. There seems to be a deeper worry about the consistency involved in attempting to be pluralist about ethical *theory* than *value*. While there could be pluralism in ethical theory that reduces worries about theory-switching, this would require rules about which theory should be consistently applied in which circumstances, or a lexical ordering rule about which theory has priority when there are conflicts. Of course, frequently ethical theories *coincide* in the actions they recommend; in these cases we could describe the action as *multi-determined*.

This isn't to say, though, that aspects of different moral theories can't be combined into one coherent theory. There are advocates of what's called "virtue consequentialism," where a commitment to virtues is adopted as an indirect way of bringing about best consequences (Jamieson 2007). Other *hybrid theories* also exist, for instance Scheffler's (1984) *hybrid consequentialism*. However, hybrid theories are not *strictly* pluralist, since they create a unified theory composed from elements of several independent theories. True pluralism in ethical theory, especially where this involves theory-switching, is not very common.

16.4.3 Methodological Pluralism

"Methodological pluralism" is particularly relevant to environmental policy and practice, and is connected to a school in environmental ethics called "environmental pragmatism" (see Light 1996, 2002). Methodological pluralism maintains that, in terms of making environmental policies and interacting with environmental professionals, we should be tolerant of a wide range of different values *and* theories. People can and do value nature in many different ways; rather than seeking to persuade people to value the "right things," we should work with the values people actually have. So, for instance, Andrew Light (2002) a prominent methodological pluralist, argues that if we look at the actual environmental values people hold, we see that people are generally very concerned about the environment their children and future people will live in, but have few non-anthropocentric concerns. Rather than trying to persuade people to become non-anthropocentric (i.e., to have the "right" values) it is better – methodologically – to work with their existing values to achieve environmental protection. This may also involve adopting strategic anthropocentrism.

Of course, this methodologically pluralistic argument is easier to maintain where diverse theories and values coincide in practice. As we've seen, Norton argues that if anthropocentrism is sufficiently "reflective," then divergent positions about anthropocentric/non-anthropocentric value *will* so converge. Yet, as critics have pointed out, there will surely be *some* cases where anthropocentric and non-anthropocentric values come apart. Norton (1993) denies this, maintaining that most such human/nature conflicts are set-ups. And, of course, if individuals' values are not sufficiently "reflective", it still looks as though there is a need to persuade people to embrace more wide-ranging *human*-centered values, which at least constrains the breadth of methodological pluralism that is under discussion. More fundamental objections to methodological pluralism have also been made. If anthropocentrism is a morally objectionable attitude (like sexism, for instance) it can be argued that there is good reason to try to change the attitude, *even if* agreement can be reached on particular actions and practices without doing so. So, although in practice most environmental policy does spring from a coalition of different value positions, there is disagreement among environmental ethicists as to whether methodological pluralism should be adopted as a governing approach in practical and policy contexts.

16.5 Conclusion

I began with three questions:

1. Are human individuals the only things that matter morally? If not, what else is of moral relevance, and why?
2. What approach to ethical theory should environmental ethicists adopt?
3. Should environmental ethicists be ethical monists or pluralists?

As we have seen, there are conflicting approaches – and answers – to all three questions. The territory of environmental ethics still is highly contested. This raises a series of further questions. Should such diversity about moral status, values, and theory be welcomed? Is more agreement about these questions possible, or desirable? What are the implications of such deep fissures in environmental ethics for environmental professionals, in particular for those engaged in environmental conservation and restoration? Is the best we can hope for, on the ground, some form of methodological pluralism?

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Chapter 17
Legacies of Positivism in the Philosophy of Science

Helen E. Longino

Abstract It has become common to use "positivist" and "positivism" as words of opprobrium. Positivists are rigid, unimaginative, committed to an unrealistic separation of fact and value. So understood, the epithet may fit some scientists, both past and present. And one might justly think of positivism's legacy as a bad philosophical hangover. But this understanding mischaracterizes the original positivists. First I sketch what the original positivists were about and indicate both strengths and shortcomings of the views they advocated. Then, I suggest an alternative approach to thinking about the nature of knowledge in science that retains some of positivism's original aspirations without the overreach that was its downfall.

Keywords Critical contextual empiricism • Theory-ladenness • Verificationism

17.1 General Background

The philosophers known as the logical positivists (and logical empiricists) were located primarily in Vienna and Berlin in the early twentieth century. Most of them emigrated to the United States in the 1930s, some barely escaping Hitler's advance through Central Europe. While some had formal philosophical training, more of them were philosophically inclined physicists or economists responding to the challenge of relativity theory's use of non-Euclidean geometry. Their overall philosophical orientation was a rejection of the metaphysical idealism that predominated in English and German philosophy of the late nineteenth and early twentieth century in favor of a rigorous empiricism. But they were also actively engaged in the social and cultural life of their respective communities.

H.E. Longino (✉)
Department of Philosophy, Stanford University, Building 90, Stanford, CA 94305-2155, USA
e-mail: hlongino@stanford.edu

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The logical positivists' primary question was: What is the relation of mathematics and logic to the empirical sciences? Until the end of the eighteenth century, mathematical, including geometrical, propositions were thought of as necessarily true. Euclid's account of spatial extent was a necessarily true description of spatial relations. The discovery of coherent geometries formed by variations on the law of parallel lines and Einstein's adoption of one of those (Reimannian geometry) for the expression of the theory of relativity, generated puzzles about the status of mathematics and its relation to the sciences. In addition to these questions, the positivists thought and taught that the sciences and a scientific attitude were keys to human and social improvement as a bulwark against racism, theocracy, and other forms of non-empirical justifications of social injustice. They thought many of the latter were supported by the unjustifiable metaphysical views of absolute idealism, and hoped to promote a scientific way of thinking about society and social issues unconstrained by speculative metaphysics. An empiricist theory of meaning and of knowledge was intended to do the philosophical work of banning metaphysics. Once in the United States, their political engagement became muted, and their strongly logic-based approach to philosophy came to dominate North American philosophy departments for several decades.[1]

17.2 Who Were the Positivists?

The first philosopher to use the concept of positivism was the Frenchman, Auguste Comte. This nineteenth-century philosopher was one of the first systematic thinkers about the empirical sciences and their interrelations. He thought all questions could be answered by empirical means. In the twentieth century positivism took a formal aspect in Logical Positivism and Logical Empiricism. One group constituted the Vienna Circle, and included Moritz Schlick (1882–1936), murdered by a student on the steps of the University of Vienna, and Rudolf Carnap (1891–1970), author of works in the philosophy of physics, logic, and probability theory and of introductory texts in philosophy of science. He ended up at the University of California, Los Angeles (UCLA), and was one of the most influential of the positivists in North America. Otto Neurath (1882–1945) was trained as an economist and statistician, and was very involved in the politics of so-called Red Vienna. He went to Oxford, in the UK. The other group, the Berliners, included Hans Reichenbach (1891–1953), author of books on Space and Time and on general philosophy of science, who preceded Carnap at UCLA, and his student, Carl Gustav Hempel (1905–1977). Hempel wrote extensively on issues of scientific method, such as explanation and confirmation, and

[1]For more on the history of twentieth century positivism, see Giere and Richardson 1996; Hardcastle and Richardson 2003. For their relation to politics after emigration, see especially Howard 2003. In North America the escapees from Nazi persecution were wary of engaging in American politics and even more so in the face of the anti-communist fervor that dominated the country in the late 1940s and early 1950s. The story of how their approach came to dominate philosophy of science in North America is a complicated and contested one. See Mirowski 2004 and replies.

also published a widely used introductory textbook. After fleeing Berlin, he landed eventually at Princeton University in New Jersey. Along with Carnap, Hempel was the most well known and widely cited of the European positivists/empiricists. Three other individuals assisted the spread of logical positivism through their publication of textbooks and anthologies of philosophy of science: Herbert Feigl (1902–1988), who emigrated from Vienna to the University of Minnesota, Ernest Nagel (1901–1985), who taught at Columbia University for many years, and May Brodbeck (1917–1983), who taught at the University of Minnesota and the University of Iowa.

17.3 Central Ideas of Twentieth Century Positivism

In the early twentieth century Bertrand Russell and Gottlob Frege developed formal systems of logic, characterized by notational systems in which all declarative sentences should in principle be expressible. Once so expressed their logical properties and interrelations could be rigorously demonstrated. These systems were the new tool with which to engage in analysis of the structure of scientific knowledge.

So *one plank of logical positivism* concerned the mode of representation:

A. Statements of scientific theories are translatable into the notation of first order logic, such that
B. Relations among scientific statements can be represented as logical ones. Such relations include implication, consistency, inconsistency or contradiction. Theories could be represented as axiomatic systems; the structure of explanation could be understood through those logical relations.

The *second plank of logical positivism* was empiricism. The positivists developed empiricist theories of meaning and meaningfulness as well as empiricist analyses of knowledge and its justification. The empiricist criterion of significance in its first form has been called *verificationism*. This view consists in the following propositions:

A. The meaning of a statement consists in the method of its verification.
B. All meaningful statements are either analytic or synthetic (either reducible to logical truths or making true or false factual claims).
C. Synthetic statements are either verifiable in sensory experience or meaningless.

Verificationism, thus, affirms both that a synthetic (factual) statement is cognitively meaningful if and only if it is directly verifiable in sensory experience and that its meaning is the sensory experiences that verify it.

Integrating the views about the logical representability of scientific claims and the grounding of factual claims in sensory experience gave rise to two more features of this philosophical orientation: one about the basis of knowledge (or justified belief or acceptance) and one about the proper sphere of philosophical investigation.

The first of these is a view about the nature of confirmation in science. Because finite data will never provide definitive proof of scientific hypotheses, philosophers (and scientists) speak instead of confirmation. Data confirm a hypothesis if they make it more likely than its negation. Analyzing and refining the phrase "make it more likely" is a preoccupation of probability theorists. For our purposes it is sufficient to note that for the logical positivists, confirmation of scientific claims consists in ascertaining the truth of the observation statements (i.e. statements directly verifiable in sensory experience) that were deducible from those claims.

The second feature is what is known as the distinction between discovery and justification. Hypotheses and theories may have their origin in any kind of psychological or social process. According to the positivists, what should matter for philosophers is not how hypotheses come to be entertained but the procedures employed in their testing. The context of confirmation/justification is all that matters from a logical point of view.

This is admittedly a potted version of philosophical positions that were developed with great depth and subtlety, but not so potted that we cannot identify some broader implications of the approach, implications drawn by the positivists themselves. Nor are we prevented from seeing the relevance of some of the objections, what I call below "disruptions," to the positivist picture.

One set of consequences is internal to the views about science, and consists in prescriptions for understanding the nature and structure of scientific knowledge. The employment of formal logic as the structural backbone of scientific understanding meant that theories, explanation, and confirmation were represented in ways susceptible to logical analysis. Theories were rationally reconstructed as axiomatic systems, consisting of some central axioms, theorems derived from those axioms, and chains of derivations from these theorems to the observation statements that provided empirical confirmation. Explanation was analyzed as having a deductive structure: a phenomenon was explained when a statement describing it could be derived from a law and statement of initial conditions. Confirmation was also analyzed in terms of deducibility. If O is understood as the collection of possible observation statements $o_i \ldots o_n$, then o_j confirms H if [H->O] and o_j while not-o_j disconfirms H if [H->O] and not-o_j. Scientific change was understood as rejection of the falsified and incorporation through reduction of what was correct in an older view into the newer theory. Reduction was a technical term for the incorporation of one theory with restricted scope into a theory of broader scope as a deductive consequence or derivable special case of the broader theory. Thus, classical physics was said to be reducible to relativistic physics if the laws of classical physics or, in a different version, the empirical regularities explained by classical physics, were deducible as a special case from relativity theory.[2] Similarly, classical genetics was deemed reducible to molecular genetics if the regularities of classical genetics could be derived from molecular genetics.[3]

[2] This usage is different from that of scientists who say that relativistic physics reduces to classical physics for objects close to the surface of the earth, but refers to the same relationship, if not to the same logical analysis of the relationship.

[3] Whether such reductions were possible became and continues to be a subject of much debate among philosophers of science. For good overviews, see the relevant entries in the Stanford Encyclopedia of Philosophy: "Intertheory Relations in Physics" http://plato.stanford.edu/entries/physics-interrelate/ and "Reductionism in Biology" http://plato.stanford.edu/entries/reduction-biology/.

The second set of consequences goes beyond science to philosophy more generally. The analysis of meaningfulness means that metaphysics, especially speculation about the nature of reality, is rendered toothless ("cognitively meaningless pseudo statements"). And not only is metaphysics meaningless, but normative or value claims, whether aesthetic or moral, are also cognitively meaningless because they cannot be cashed out in terms of sensory experience. Such claims were reanalyzed in philosophy influenced by positivism as expressive of feelings or attitudes rather than descriptive of some state of affairs.

The third set of consequences concerns the reinforcing of a popular picture of scientific inquiry and knowledge as objective, value-free, rational, and unifiable.

The positivists were able to spell out what this means in terms of the logical structure and empirical basis of scientific theories. This reinforced those popular ideas, which were also reinforced by United States Cold War science policy. It remains, in its broad outlines, a conception of scientific inquiry congenial to many scientists, as it legitimizes a view of science as a pursuit of knowledge free of political, economic, or other social influence, and thus authoritative.

17.3.1 Problems

Like all beautiful human constructions, this one did not last without serious challenges. One problem was internal. It was never possible to articulate the verificationist theory of meaning in a way that ruled in the meaningful statements of scientific theories, and ruled out the pseudo-statements of metaphysics. A number of formulations were tried and rejected before the effort was dropped entirely.[4]

Another problem was external to some extent. The assumption of the positivists was that the logical structures they developed mapped fairly straightforwardly on to actual science. Three philosophers of science working independently in the early 1960s, Thomas Kuhn, Norwood Hanson, and Paul Feyerabend were also students of history and raised devastating rebuttals to that assumption.[5] Each detailed ways in which central episodes in the history of Western science could not be represented with the apparatus of logical empiricism. While there are interesting differences among the detailed views of these three, they introduced two important notions into philosophical thinking about the sciences. One was the notion of theory-ladenness, which affected both meaning and observation. The theory-ladenness of meaning was demonstrated by arguments showing that central ideas like "mass" changed their meaning when theories changed, for example from classical mechanics to relativistic mechanics. The theory-ladenness of observation terms followed from the theory-ladenness of meaning, but both Kuhn and Hanson appealed to gestalt

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[4]For a good short history of the fate of verificationism, see Hempel 1965.

[5]Kuhn 1962, Hanson 1958, Feyerabend 1963.

type experiments to argue that our sensory experience was shaped by our expectations. So, contrary to the positivist picture, there was no neutral language that could be used to describe basic observations.

The second idea introduced by these thinkers was that of *incommensurability*. Because there was no neutral "observation language" and all scientific terms bore traces of the theory in which they were being used, theories could not be compared empirically one with another. It made no sense to think one true and a competitor false, or one better confirmed than another, at least not in the terms available for such judgments in the positivist scheme. These ideas met with considerable resistance from the philosophy of science community, as well as from those in the scientific community who followed philosophical discussions. A primary difficulty was that the holism of Kuhn's view made it difficult to retain any distinction between hypothetical statements and their evidence.[6] He did, however, convince many philosophers that they could not analyze concepts like explanation and confirmation in the abstract, but needed instead to see how these were used in the sciences, and to bring their normative concerns into contact with actual, current, scientific research and practice.

A third difficulty for the positivists' view, especially of confirmation, had been articulated well before the formation of the Vienna Circle. French physicist, Pierre Duhem, author of *Aim and Structure of Physical Theory*, published in 1906, identified a problem that has continued to exercise philosophers of science and has acquired the name of *underdetermination*. Where the positivists incorporated a hypothetical statement like (H->O) into the deductive structure of confirmation, Duhem argued that an observation statement was never implied by a hypothesis pure and simple, but only by a hypothesis conjoined with a number of assumptions (from assumptions about the experimental apparatus to methodological stipulations like preference for certain kinds of error over others to more metaphysical assumptions about the nature of the phenomenon being investigated). This being the case, if one failed to observe O when O was expected, one could not fault the hypothesis (by application of a simple *modus tollens*), as the problem might lie in one of the assumptions. In the notation used above, if O is understood as the collection of possible observation statements $o_i \ldots o_n$, then not-o_j will not disconfirm H but only $H+A_1 \ldots A_n$, and o_j confirms not the hypothesis H but the more complex formulation $H+A_1 \ldots A_n$, leaving it open that with a different set of assumptions, some quite different hypothesis, G, might be in the set of confirmed hypotheses.

Underdetermination arises because there is a semantic gap between the statements articulating theoretical relations and the statements describing the data that can serve as evidence for those statements. They are about different kinds of thing, whether particle collisions and disintegrations on the one hand and bubble-chamber

[6] By holism, philosophers of science mean a view of theories that holds or has as a consequence that the parts of a theory are dependent on the whole, such that no part has significance apart from the entire theory in which it is embedded. In particular, the meaning of data or observation statements is a function of the theory in whose context they have been generated and changes when occurring in a different theory.

tracks or detector printouts on the other, or molecular differences in gene structure and physiological or anatomical differences at the organismal level. The language we use to express claims about these different aspects of reality is different. This means that they cannot be linked by formal logical operations. Some kind of content is also required, and that is what is provided by background assumptions. The upshot of the underdetermination problem is that observational data alone cannot adjudicate among competing hypotheses/theories (such data underdetermine the hypotheses for which they are purported to be evidence) and the relation between a theoretical hypothesis and evidence is always mediated by additional background assumptions.

Underdetermination poses a number of challenges to the popular conception of science named above, and thus to the trust placed in science on the assumption the conception is correct. How can science be objective if the assumptions required are not grounded in some way? Of course, some of them may be empirically tested, but depending on the linguistic relations, an infinite regress may open up, and there may be assumptions (methodological or metaphysical) that are not susceptible to empirical testing, but require some other kind of support. The value-freedom of the sciences comes under threat given that it is not possible to guarantee that assumptions do not have some kind of normative or value context, or are not rendered plausible by background norms or values. If the rationality of science is not guaranteed by representing scientific reasoning as logical calculation, then in what does rationality consist?

17.3.2 A Social Alternative

Critical contextual empiricism (CCE) is the name of the view I have developed to address these worries.[7] CCE accepts the underdeterminationist claim that data acquire evidential relevance only in context of background assumptions. It rejects the idea that we should seek a guarantee of value freedom in formal methodology and proposes that the kind of control of background assumptions necessary to secure objectivity is not possible for individual cognitive agents, but is possible for groups or communities of such agents. What is required for objectivity is critical interaction among agents representing different points of view. Diversity is necessary because there is no guarantee that even the most self-critical of agents will be able to identify all the assumptions guiding her or his reasoning. Sometimes only an agent with a different perspective or different set of assumptions will be in a position to identify one's own assumptions. Critical interaction thus becomes a component of methodology and of scientific rationality. Since not all criticism is effective, it is necessary to propose community norms whose function is to assure as much objectivity as is possible at a given time. CCE proposes four:

[7] Longino 2002.

1. *Venues*. There must be accepted fora for the expression and response to criticism. Communicative space cannot be reserved for positive results only.
2. *Uptake*. The beliefs of the community must change over time in a way that is sensitive to the critical discourse in which it partakes.
3. *Public standards*. The standards that regulate critical discourse must be public and are themselves subject to critical examination (itself subject to these same norms).
4. *(Tempered) equality of intellectual authority*. All perspectives must at the outset be regarded as equally capable of generating relevant criticism and alternatives. This presumptive equality of authority can, however, be lost by failing to observe community norms, for example, by failing to respond to objections in an appropriate way.

Adopting this social view of knowledge leads to new characterizations of scientific knowledge. One of the most striking differences of this view from either the logical empiricist or holist views is its pluralism. It is possible that multiple non-reconcilable accounts of the same set of phenomena be equally acceptable. This is because different background assumptions or methodologies may be activated by different cognitive goals. The social view distinguishes general from local epistemology, where general epistemology encompasses very broad-stroke analyses such as that sketched above, drawn from an interpretation of the expression "knowledge." Local epistemology is more normative and refers to the particular set of methods and assumptions brought to bear in addressing a particular set of questions about some specific set of phenomena or phenomena under a particular description. For example, the methods for addressing questions about the evolutionary history of a trait are different from the methods for addressing the process of development of the trait in a specific organism. Local epistemologies are evaluable with respect to the particular cognitive goals brought to bear on a phenomenon or set of phenomena.

Knowledge in this framework must also be understood as partial and as dynamic. Partial because limited by the questions, and their associated assumptions and methodologies. Dynamic because answers to questions beget more questions; developments in measuring and other experimental technologies change the kinds of things we seek to know. What is perfectly adequate in one era is superseded in another. Truth is not understood as an absolute. Instead of truth, on this social view, what is sought is *conformation* (of representation to object represented)[8]. Conformation is always in some specified respect and to some specified degree. Both respect and degree are a function of the goals of inquiry. All three (goals, degrees, respects) are determined through community interaction. They are givens neither of inquiry nor of the material inquired about.

This perspective saves objectivity and rationality, but offers no algorithmic method of eliminating values from the sciences. Instead, the control of values' influence is a function of the degree of diversity of perspectives in the community and the

[8] This is a term introduced in Longino 2002 to cover multiple relations of semantic success (including truth, but also similarity, approximation, fit, and others).

degree of its satisfaction of the CCE norms. Because of the role assigned to cognitive goals in setting appropriate standards for any particular inquiry, this view also qualifies as a form of pragmatism.

17.3.3 Legacies

From the perspective of this socially contextualized conception of knowledge and of scientific inquiry, it is possible to discern both a negative and a positive legacy from twentieth century positivism. On the negative side positivists worked with a narrow conception of rationality that took philosophy of science away from the sciences and towards the solution of formal problems within the positivist framework.

Positivism's casual assumption that the sciences, when properly understood, were adequately represented by the logical schemata offered for explanation and confirmation facilitated complacency regarding the ability of scientific method to filter out social values. This complacency characterized both scientists and philosophers of science. While philosophers of science have grappled in different ways with the demise of the formal guarantee of value-independence, the assumption persists in other circles that method properly followed eliminates the influence of values. This impedes both scientific and popular appraisal of scientific disagreement.

On the positive side, positivism must be credited with one crucial acknowledgement of actual scientific practice, and that is its insistence on placing observation and measurement at the heart of inquiry. Their excessively narrow conception of scientific rationality can be seen as a reaction to the equally excessive obscurantism that characterized some nineteenth and early twentieth century thought. As a counter to the latter, positivism seems a breath of fresh air. But respecting the need for empirical grounding does not mean that observational consequences exhaust the meaning of theoretical claims nor that values are eliminated or eliminable from inquiry. Nor does it mean, as we have seen, that observation alone can determine which of a set of alternative hypotheses is acceptable and which not.

17.3.4 More Challenges

The alternative social account still retains some of the features of the positivist account it seeks to replace. In particular, it articulates the issues of confirmation assuming the models and hypotheses being confirmed concern fairly straightforward empirical relationships. But many sciences now are working with complex models of the phenomena they study. These models include multiple interdependent theoretical parameters and relationships, better modeled using nonlinear mathematics. Data themselves are not multiple independent observations, but collections of measurements, where what is important is statistical features of the data, such as relative frequencies of some quantity among the measurements, averages, means, and so on.

Logically, the situation is comparable to classical underdetermination. But in the case of complex models, for example those in ecology or in climate science, not only is the representation of data different than in the picture developed by positivists, but there is an even more serious question about even obtaining relevant data. For example, systems requiring measurement of multiple independent and interdependent parameters pose several challenges. One is the difficulty (if not impossibility) of obtaining comparable and stable measurements of the relevant observable quantities when their values are interdependent or require different methods of measurement. Another is to obtain simultaneous enough measurements of the relevant observable quantities when they are at a distance from one another or to record and preserve measurements over the time scales needed to ascertain patterns of change. The underdetermination problem has its version here in the consequent difficulty of empirically grounding particular models of complex systems When multiple adjustments of theoretical parameters can make different and even inconsistent models compatible with available empirical data, we have the logical situation classically described by Duhem.

These difficulties raise different challenges for philosophers and scientists. For philosophers the question becomes: How must the requirement of empirical grounding be elaborated in order that competing models of complex systems can be comparatively evaluated? This must be elaborated in relation to actual proposed models so philosophers can rise to the level of the problem and scientists can see the relevance of that logical and conceptual reflection. For scientists, the questions are focused on the substance of their models: How can one model of complexity be differentiated from another? In what empirical differences are we, as scientists, interested? In what empirical differences are we, as members of a public that will be affected by this research, interested? Which changes do we wish to enhance and which to inhibit? On the social view, these questions and their deliberation become part of the scientific process. Both philosophers and scientists must admit the role values play in the sciences while preventing the empirical from being overrun by the normative and the ideological. The key is to foster collaborative interactions and to model the interaction of the empirical and the normative rather than for one to be dominated by the other.

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Chapter 18
Ecological Objects for Environmental Ethics

Christopher H. Eliot

Abstract The emergence of theoretical ecology during the twentieth century advanced our understanding of what kinds of things exist in our world, such as ecological communities and ecosystems. Accordingly ecology offered a new set of things we might care about or care for, and that development has both stimulated and challenged environmental ethics. Here, I consider how ecological objects may serve as objects of moral concern. I argue that while questions remain about ecological objects, environmental ethics does not require objects more robust than those ecology already offers.

Keywords Metaphysics • Environmental ethics • Ecological communities • Moral considerability

18.1 Expanding Our Moral World

The emergence of theoretical ecology during the twentieth century advanced our understanding of what kinds of things might exist in our world. In particular, it suggested that objects like "ecological communities" and "ecosystems" might exist. In developing these ideas, ecology offered a new set of things we might care about or care for, and that development has both stimulated and challenged environmental ethics. Here, I consider how ecological objects like these may serve as objects of moral concern, and what questions about them deserve further investigation.

Questions about what kinds of things in the world one might be morally concerned about are relatively new. The dominant ethical traditions of the nineteenth and twentieth centuries were those broadly in the tradition of Immanuel Kant and forms

C.H. Eliot (✉)
Hofstra University, 104 Heger Hall, Hempstead, NY 11549-1000, USA
e-mail: Christopher.Eliot@hofstra.edu

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of utilitarianism, in particular as developed by Jeremy Bentham and John Stuart Mill. Kantians argued that we ought to respect and protect “rational agency” (being capable of willing rationally about what to do). So, the question of whether a thing deserved our moral concern was determined by the empirical question of whether it possessed rational agency. For utilitarians like John Stuart Mill, happiness stood out as that which is good in itself, and the question of what we ought to care for could again be settled by answering an empirical question, the question of what things are capable of experiencing happiness. While Kantians assumed that only human beings were capable of rational agency, utilitarians, most conspicuously Jeremy Bentham, accepted that some animals could suffer and feel happiness, and that we should take this into account when making moral decisions. Recent scientific work in cognitive science and ethology, in particular, has confirmed Bentham’s view that some non-human animals experience pleasure or happiness, and even that they are capable of reasoning. This has led to more widespread acceptance of the idea that individual sentient animals are objects of moral concern, whether they are human or non-human. If these beings are the focus of moral concern, however, other things such as habitats are of interest just because of their relationship to valuable animals. This can certainly ground a kind of environmental ethic: one focused around protecting the environment to benefit individual sentient organisms. However, this view differs from more traditional, anthropocentric ethics only in what living beings it understands as meeting its criteria for valuation.

Twentieth century ecology, however, offered new kinds of things, in the form of communities and ecosystems, and thus provoked the question whether any of them might warrant moral consideration. By “warranting moral consideration” I mean this: when we look around the world, we find that there are entities that we ought to take directly into account when we decide what to do. Kenneth Goodpaster (1978) described this group of things as what is “morally considerable.” Twentieth century ecology, by describing new kinds of things, raised the question whether any of them—communities, ecosystems, and anything else—belongs in that group. Let us call these “ecological objects”: non-phylogenetic things described by ecology that contain more than an individual organism and its parts. Might we have reason to value any such ecological objects in themselves? That is, might we have grounds for valuing them other than that we value the individual organisms within them? Are there reasons that any things other than individual organisms might deserve our moral consideration?

18.2 Moral Considerability

To assess this question, we need to identify criteria for moral considerability. It is useful to partition this project into moral and ecological projects, though they must interact to answer it satisfactorily. The moral project is to identify reasons we might have for valuing ecological objects of a certain kind. The ecological project is to identify what kinds of ecological objects exist. Spanning these projects and not resolvable by either, in the domain of a field recently called philosophy of ecology, is the question of whether any ecological objects exist in such a way that they can be candidates for moral consideration.

Consider an Oak-Hickory forest community in lower New York, USA. It is composed of populations of White and Northern Red Oaks, Red Maples, and some dozens of other trees, as well as Grey Squirrel, Spotted Salamander, Black-capped Chickadee, and dozens of other plants, vertebrates, and invertebrates. Is this an object that is a candidate for moral consideration?

We must first ask whether it is an object at all. There are grounds for doubt about whether this community counts as "an object." Though it is composed of things we ordinarily think of as objects, it may not count as an object itself. We normally think of objects as things located in one place, like a sculpture in a garden, and we think of things located in many places as counting as many objects. Yet, if a sculpture is dismantled in order to be moved, and its pieces are shipped separately, it is still an object, though its parts are in many places. Now consider in contrast whether there could be an object whose parts are Charles Darwin's favorite pen and the tallest tree in South America. If the parts of objects can be in many places, it is hard to think of a reason why, in principle, this pen and tree cannot be considered an object, and indeed philosophers have generally agreed that it *could* count as an object in some sense. Still, it may strike us as missing something objects usually have—something besides spatio-temporal connection.

We can think about what it is missing by recognizing that, to warrant moral considerability, it is normally maintained that an object must also have *interests*. By this I do not mean that an object must be consciously interested *in* anything. I mean rather that there are things that can be good and bad for it, ways it can be affected positively or negatively (Goodpaster 1978). If it is not possible to make something worse off, or to harm it, it would seem odd to think that it matters morally. Our arbitrary pen and tree pair does not apparently have any significant interests. Why? I suggest that it does not have interests because it is not *causally integrated.* If a group of things is not causally connected to one another such that modifying one of them cannot affect the others, those things can have no *collective* interests worth considering, apart from any individual interests they might have. They cannot therefore form an object with interests of its own. Having interests, for an object, therefore requires causal integration. The pen and tree, even if they can be considered an object in *some* sense, cannot have interests because they are not causally integrated to any significant degree. It is for that reason that the possible object consisting of them is not even a candidate for moral consideration.

So, I have just suggested that causal integration is *necessary* for having interests. But is this all that's required? What is *sufficient* for having interests? Our general question about what kinds of things are morally considerable has become more focused. We should now ask, What *kinds* of causal connections among things are sufficient to yield ecological objects with interests?

In our Oak-Hickory community, for instance, Palm Warblers—songbirds that winter far to the south and breed far to the north of the forest—visit only during a period of a few weeks on their Spring and Fall migrations, and only a fraction of the eastern population visits the community. But during these brief visits, Palm Warblers serve as significant insectivores. Their causal relationship to the forest—the degree to which they exert changes on it—is dramatically greater than that of a Snowy Owl that passes overhead once on migration without landing. Given their limited, but non-negligible influence, are they part of the community? Is the owl? Our question about each potential community member therefore becomes: Are they causally connected to others in ways that generate an object with interests? And to answer that question, we must ask: What kinds of causes can play the role of connecting them in the right way?

18.3 Communities as Ecological Objects

I have mentioned this sample forest community as an example of a possible ecological object, but the questions raised about communities apply equally to other possible ecological objects like ecosystems, associations, guilds, and even the biosphere. In so far as ecosystems consist of unified causal processes, they can be more neatly delineated than communities, which are connected by a wide variety of causal relationships. However, both communities and ecosystems face the question of how much can be added to or subtracted from them without compromising their identities (Odenbaugh 2007). Recognizing that there are other kinds of ecological objects, including ecosystems, in what follows I will focus on communities, mainly because a significant discourse has developed about them among environmental ethicists, environmental historians, and ecologists. In this continuing discussion, each group has repeatedly framed the question of the status of communities in terms of the theories of the early twentieth-century vegetation ecologists Frederic Clements and Henry Gleason, and I will argue that that has been a mistake.

The plant ecologies of Clements and Gleason will be familiar at least in outline to most readers of this chapter, in that they are widely used in textbooks and courses to introduce not only plant succession but also community ecology more generally. Briefly, then: Clements's ecological theory has been associated with a pair of related claims: (1) that vegetation develops in any given area according to a pattern which is comparable to—or literally identical with—the development of an individual organism; (2) that the development of vegetation in any given area necessarily results in a predetermined type of vegetation, called that area's "climax," which is determined by the area's climate. Gleason's ecological theory has been associated with the rejection of these two claims, and has been identified with an alternative he called the "Individualistic Concept of Ecology." This theory has been represented as the view that individual plants disperse and establish independently of others, so that plant communities are merely unstructured aggregates of independent plants. The individualism is often taken to apply to populations, such that the claim is that communities are unstructured aggregates of populations.

Ecologists, historians of ecology, and environmental historians have often presented the historical trajectory of these views as an eclipse. Ronald Tobey (1981), for instance, presents Clements's view as the dominant plant-ecology paradigm of the 1910s and 1920s, before it was replaced in the 1930s by Gleason's theory. Cementing the triumph, the latter half of the twentieth century saw the emergence in ecology of non-equilibrium theory on a nominally Gleasonian model. Though presented as theories of vegetation, Clements's and Gleason's accounts have been extended by others to describe communities more generally, incorporating animals and other taxa. Clements's view is typically presented as naïve and holistic, invoking mysterious causal connections between the components of communities, and Gleason's as sophisticated, reductionist, and causally unassuming. Thus, the standard narrative is a story of scientific progress.

Prominent environmental ethicists and environmental historians have embraced the eclipse narrative but resisted its characterization as progressive, to the point of raising alarm about its threat to environmental ethics. The putative threat arises from the presumed dependence of environmental ethics on a Clementsian understanding of communities. Baird Callicott, for instance, has argued that there are "residual traces of the early twentieth-century Clementsian super-organism paradigm" in Aldo Leopold's land ethic and in the environmental ethics tradition following him (Callicott 1996, 358). The alignment between Leopold's land ethic and Clements's ecology entails that the waning of the latter threatens the former. In this, Callicott follows environmental historian Donald Worster (1990). Callicott describes the "intellectual watershed" moment when

> "Donald Worster debuted his essay, 'The Ecology of Order and Chaos,' in which he summarized and documented, for the community of environmental humanists, the ethically untoward and disturbing shift in ecology from the mid-century 'balance of nature paradigm' to the fin-de-siècle 'flux of nature paradigm' (as the principal proponent of the latter, Steward Pickett, styles them)—the ecology of order and the ecology of chaos, respectively, of Worster's title." (Callicott 1999, 15)

Environmental historian Andrew Isenberg similarly aligns the undermining of Clementsian ecology with the embrace of "chaos" and non-equilibrium ecology:

> Although one's impression of the western plains depends largely on the breadth of one's view—the last 10,000 years or the last 200—such changes contradict the notion of self-regulating equilibrium inherent in the early twentieth-century ecologists' concepts of 'climax community' and 'ecosystem.' In recent years, particularly as 'chaos theory' has become an important part of scientific study, ecologists have shifted away from the idea of self-regulating equilibrium in nature and toward a conception of nature as prone to unpredictable change. (Isenberg 2001, 11)

And historian Paul Sutter similarly finds a threat to wilderness-preservation in ecologists' adoption of flux instead of equilibrium:

> The ecological critique of wilderness is premised on shifting scientific understandings of how nature works. Where ecologists once saw order, harmony, equilibrium, and purpose in the natural world, many now see stochasticity, competition, and pervasive disturbance. Utilizing the insights of this new ecology, one group of critics has suggested that the complexity of natural processes invariably complicates attempts to preserve wilderness. To preserve wilderness, ecologists tell us, is not to keep nature in a timeless equilibrium. Rather, it is to draw boundaries around a world in flux. (Sutter 2002)

It is strange to think of competition as a current interest opposed to order, harmony, and equilibrium, as it has been discussed and regarded as consistent with those qualities by ecologists extending back to Darwin. But more generally, in terms recalling ancient philosopher Heraclitus's view that everything in nature is in flux, Sutter offers a vision of recent ecology undermining nature-preservation by replacing the orderly, causally-integrated, equilibrial community with chaos and disorder.

One patent flaw in these and similar claims is that chaos theory does not embrace flux and disorder. These environmentalist authors are concerned about disorder, while chaos theory, in contrast, describes a kind of mathematically-describable order in seemingly-disordered systems—unstable, aperiodic behavior in deterministic, nonlinear systems. Moreover, employing chaos theory to describe systems presupposes that such systems can be isolated for description, which is the very assumption supposed to be threatened by chaos. This confusion is a relatively minor problem because it is terminological. Even so, it reflects an inattentive engagement with ecological science that is also at the heart of a second, more significant problem with these claims.

18.4 The Clements/Gleason Spectrum Revisited

The environmental ethicists and historians above argue that ecologists embracing a Gleasonian understanding of communities have undermined a Clementsian interpretation of communities on which nature-preservation conceptually depends. However, this contrast supposes that the populations that make up Clementsian communities are causally connected in a way that populations in Gleasonian communities are not.

This picture misrepresents both Clements and Gleason. I have elsewhere argued from analyses of their explanatory efforts (Eliot 2007, 2011) that while Clements and Gleason differ in the emphasis they place on certain causes, they agree that vegetation is a function of the environmental sorting of potential immigrants. I will reiterate a few of the key points here. The main one is that though Clements attaches a stronger causal role to the environmental sorting, and Gleason to the patterns of distribution of immigrants, there is no kind of cause Clements employs in his explanations of vegetation that Gleason does not also employ in his. Consequently, Clements does not suggest any special connection among plants or other members of a community that Gleason does not also assert. In both theories, potential immigrants are subject to environmental sorting, and that is the sum of the kinds of cause explaining vegetation.

Unfortunately, the best defense of this reanalysis is a detailed account of how Clements does explain vegetation while doing without other kinds of causes attributed to his theory. But I note a few points. First, Clements does not assert that communities must be composed of certain particular species. He writes: "In the case of invasion, it is obvious that the failure of the dominants of a particular stage to reach the area would produce striking disturbances in development. Likewise, the appearance of alien dominants or potential climax species would profoundly affect the usual life-history" of a community (Clements 1916, 33). It is consistent with this view that such a situation never arises, but elsewhere Clements remarks that "unlikeness and variation are universally present in vegetation" (Clements 1907, 289). Second, Clements does not understand vegetation to have even the same degree of internal functional integration that microorganisms like paramecia have, for instance, much less that of macrovertebrates. Such organisms have physiologies, while in plant communities, every interaction among plants is indirect, mediated by some intervening medium like air, soil, or environmental nutrients. Third, what determines whether a population is part of community for Clements is the degree to which it causally contributes to creating habitat for other plants or is produced by the same habitat. It is not a function of something like causal bonds such as connect our nervous and circulatory systems.[1] For his part, Gleason—often presented as embracing disorder—accepts that such indirect causes structure vegetation in exactly the same way. I offer just one indication of what structure Gleason allows. For Clements, all plant succession is produced by four kinds of causes: primary, reactive, ecesic, and stabilizing, and the strongest source of causal connection between organisms in communities consists of what he calls "reactive causes." Reactive causes are those concerning the relationships among individual plants, and in particular those influences of plants on their environments which modify those environments. Such modifications are in turn capable of affecting the fates of nearby plants and potential immigrants. That is, reaction serves, for Clements, as the one kind of causal relationship which unites communities, and which is supposed to be absent in a Gleasonian community. However, here Gleason describes it:

> Nevertheless, these plants have definitely an influence on each other. To select perfectly obvious examples, it is clear that the larger plant affects the light and, though its leaf-fall, the soil environment of the smaller, while the latter intercepts rainwater and reduces the light for seedlings of the larger one. The two plants have intersecting spheres of influence; each interferes with the environment of the other…. Intensifying the influence of either plant within its sphere has a direct effect on the life and well-being of the other. It may act either favorably or unfavorably. (Gleason 1936a, 444–445)

This exemplifies what Clements calls "reaction." Gleason moreover writes in a different paper from 1936 that "the joint reaction of the whole population is one of the most important factors in maintaining the uniformity and the equilibrium, and therefore the identity of the association" (Gleason 1936b, 44–45). In other words, the one kind of causal relationship supposed to distinguish the Clementsian community is not only accepted by Gleason, but moreover taken by him to be essential to its equilibrium.[2]

So, what does this similarity demonstrate? To recapitulate, our question about what grounds the collective interests of communities produced the question of what

[1] Significantly more detailed analysis can be found in Eliot (2007, 2011), and Hagen (1988).

[2] For further analysis of Gleason's theory see Eliot (2011) and Nicolson (1990).

kinds of causes might integrate them. This reminded us that ecologists have sometimes expressed aversion towards causal integration or causal structure for communities, and have framed that suspicion as a rejection of Clementsian ecology, adopting a Gleasonian posture. Environmental ethicists have responded with alarm framed in the same terms. However, if the causal commitments of even these two putatively opposite theories resemble one another quite closely, we should be suspicious of the durability of both the aversion and the alarm.

On a more constructive note, this result also suggests that to answer our question about the kinds of causes that can hold communities together, we need not dabble in obscure or mysterious kinds of causes besides Gleasonian ones. We should notice that some organisms do have considerably more direct interactions than the indirect relationships Clements and Gleason represented (like diminishing the sunlight available to understory plants): some organisms live on one another or consume one another. But that notwithstanding, in the effort to provide environmental ethics with an accurate account of what ecological objects exist, we do not need to contest the terrain between Clements and Gleason. What varies along the spectrum between Clements and Gleason is not kinds of causation, but degree of emphasis on habitat or on properties of organisms themselves. Clements emphasizes the former, and Gleason the latter. If even Clements did not employ other kinds of causation in his explanatory theory, we do not need to, to identify communities. All the kinds of causation needed to identify communities are present at the Gleasonian end. They are the various ways each population affects the numbers of others, both direct (as with consumption) and mediated (as with competition for an abiotic resource). And these are the causes we need to work with to determine identity conditions for communities, for environmental ethics.

18.5 Kinds of Communities

So, what causal relationships should we consider among populations, towards establishing what might be morally considerable? We should consider the ways populations directly and indirectly affect the numbers of other populations. Among these, ecologists discuss the familiar suite of mutualism, competition, predation, parasitism, and dependence. Not every community includes all of these relationships, and communities may differ in which of these relationships bind them.

First, imagine a community consisting solely of two populations competing for a limited resource, and not competing with other organisms. This pair represents a community in so far as the numbers of each population causally bear on the fate of the other. If our interest is in long-term forecasting for these taxa, we may pick out this community as a unit because our interest in forecasting focuses our attention on a particular causal relation (competition), and we have identified an object delimited by that relation.

Second, consider the different community we would have to preserve if we wanted to preserve a particular species that is a member of it. We should start by picking out a set of populations connected to the target population by dependence relationships—dependence at least in one direction, whether facultative or obligate. This second community is delimited by a different kind of causal relationship, and may differ in its membership from one determined by another kind of relationship like competition.

I suggest that each of these two communities would be a real object, in so far as its component populations are connected by a particular kind of causal connection. These communities are casually integrated, and so are not arbitrary in the way the pen-and-tree object seems to most people. Though they might overlap in a single place—e.g. within the oak-maple forest in New York—they are recognizable as distinct objects. Though each is real, they are determined by different sets of causes. In this way, what counts as a community may vary depending on what kind of interest we bring to describing it, and still be real. Its boundaries are determined by the set of causal relations relevant to some interest.[3] Among those interests may be its preservation.

18.6 Conclusion: Towards Morally Significant Objects

Ecology offers ethics a variety of candidates for moral consideration. To be a candidate for moral consideration, an object must have interests, and having interests requires some form of causal integration. But what kind of causal integration is sufficient? Some environmentalists have worried that, in the case of communities, a strong form of causal integration, of the kind they ascribe to Clementsian ecology, is required; and have worried that the rise of Gleasonian ecology undermines the moral considerability of communities. If, however, Clements and Gleason agree about the kinds of causation that structure communities, as I have suggested, we should not worry that Gleasonian communities are less suitable for moral consideration than Clementsian ones by virtue of lacking some exotic form of causal integration. So, what kind of integration will do? Many kinds are sufficient, I suggest, and each can produce communities that are adequately real objects for moral scrutiny.

That is not to assert that communities or ecosystems are morally considerable. That further conclusion requires work in ethics. I have argued just that as objects, communities are up to the task of being evaluated. They are sufficiently real in the right sort of way. A significant problem remains for communities in that the criteria I have advanced do not sufficiently answer the question Odenbaugh (2007) asks about which additions or subtractions from a community are sufficient to change its identity. A similar question applies to ecosystems. Ecosystems, though I have sidestepped them here, are causally integrated even more clearly than communities are, in that they consist of causal processes, and so are adequate objects for the same

[3] Lockwood (2011) independently arrives at a similar conclusion and provides useful analysis of insect communities.

reasons. Still, they deserve further analysis. Besides ecosystems, there may also be further kinds of ecological objects deserving moral attention, like associations, guilds, or even the biosphere. And each or all of these kinds of object might have morally-significant properties beyond those I have mentioned or beyond what we know about.

To note what is already on the table in this vein, there may indeed exist causal relationships integrating communities other than direct and mediated Gleasonian casual interactions. Gregory Mikkelson (2004) and Kim Sterelny (2006) have each recently argued that communities have collective causal properties, if, for example diversity—a property of whole communities—causally affects community stability. Sandra Mitchell (2009) has recently argued that identifying emergent properties is fundamental to understanding complex biological systems, and if either such properties, whether community-level or emergent, have causal efficacy, they may determine ecological objects with more potential for moral considerability than those defended here.

I have argued just that ecological objects familiar from twentieth century ecology are sufficient for undergoing moral scrutiny. There are open questions about ecological objects, and fruitful projects remaining for philosophy of ecology. But to do its work of figuring out what arguments can be made for the moral considerability of ecological objects, environmental ethics does not require objects more robust than those ecology already offers.

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Chapter 19
Ecology, Ethics and Global Justice

Tim Hayward

Abstract Environmental change yields problems that require our ethical attention, but a key idea developed here is that our ecological position in the world also frames and drives our ethical concerns in more fundamental, if sometimes less obvious, ways. By learning from ecology, we can develop more appropriate ethical thinking than we otherwise might, not only regarding our treatment of the natural environment, but also regarding some fundamental questions of justice, and on a global scale. The chapter sets out an "ecological" way of seeing the place of humans in the world, as they relate both to the rest of nature and to each other. This leads to a conceptualisation of "ecological space" as what answers to the most fundamental needs of human beings, such as to be appropriately regarded as the object of a human right. It allows us to conceptualize the circumstances of justice in the world today as those of a crowded planet where some people deprive others (as well as non-humans) of access to sufficient ecological space. This way of seeing has critical implications for some influential views of justice that are premised on continuing, rather than restraining, the contemporary trajectory of economic development. For those views rest on assumptions that would seem to be contradicted by what an ecological perspective tells us about the vulnerabilities and interconnections of life on this planet.

Keywords Global justice • Human rights • Ecological space • Ethics • Anthropocentrism

Environmental change can influence ethical thought in important ways, for it gives rise to new questions about our conduct and its consequences; our ethical commitments, in turn, can be expected to affect the impacts we have on the environment.

T. Hayward (✉)
School of Social and Political Science, University of Edinburgh,
Chrystal Macmillan Building, 15A George Square, Edinburgh EH8 9LD, UK
e-mail: tim.hayward@ed.ac.uk

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In this chapter, however, I suggest that some of the most significant influences – in either direction – may be rather less direct than might be expected by thinking in terms of 'environmental ethics', if this is understood to mean ethical reflection on environmental matters that is intended to guide policy and action in relation to those matters. A key idea to be developed here is that environmental matters are not simply a 'topic', or field of problems, for ethics to reflect on; rather, our ecological position in the world frames and drives our ethical concerns in more fundamental, if sometimes less overtly graspable, ways. In fact, I shall suggest, by attending to lessons of ecology, we can develop much more appropriate ethical thinking than we otherwise might – not only regarding our treatment of the natural environment, but also regarding some fundamental questions of justice, and on a global scale.

This chapter starts by taking a degree of critical distance from the framework of environmental ethics as this is often conceived. This includes explaining what is really wrong with anthropocentrism, the avoidance of which is often taken to be a hallmark of environmental concern. Subsequently, I set out what I call an 'ecological' way of seeing the place of humans in the world, as they relate both to the rest of nature and to each other. This leads to a conceptualisation of 'ecological space' as what answers to the most fundamental needs of human beings, such as to be appropriately regarded as the object of a human right. I characterize the circumstances of justice in the world today as these are constituted in a crowded planet where some people deprive others (as well as non-humans) of access to sufficient ecological space. I emphasize the significance of this way of seeing for some influential views of justice that are premised on continuing, rather than restraining, the contemporary trajectory of development. I argue that those views rest on assumptions that would seem to fly in the face of everything an ecological perspective tells us about the vulnerabilities and interconnections of life on this planet.

19.1 The Real Problem of Anthropocentrism

The relevance of ecology to ethics can be revealed through a critique of what I identify as the real problem of anthropocentrism. Anthropocentrism has been criticized, from various perspectives within environmental ethics, as the expression of arbitrary preference for the value of human ends over those of other species, individually or collectively. Yet for humans to be at the center of the ethical schemes that humans devise is not entirely arbitrary. Indeed, there are some ways in which it would be arbitrary to attempt anything different. Of course, environmental ethics – in its general purpose and content – is often thought of in terms of elucidating principles and values that would guide decision-making to protect this or that population, species, community or habitat, and ideally this would involve some detachment from human interests. Yet while a focus of concern may be on aspects of the nonhuman world, our reasons for selecting one concern rather than another will always reflect a scheme of values that we humans, or some of us, happen to subscribe to. In that sense, there is always, and inevitably, some 'anthropocentrism' at the heart of environmental ethics.[1] Furthermore, if anthropocentrism is not entirely avoidable, it is also not entirely undesirable from an ethical point of view: for it could be argued that one of the greatest ethical problems is that humans, rather than being concerned too much about humanity, are generally not concerned enough about caring for other humans. (In that sense, one might wish that in a world of selfish or possessive individuals that people would be a bit more anthropocentric!).

But if the critique of anthropocentrism in ethics is not clear cut, I believe there is nevertheless a clear cut ethical objection that can be made to anthropocentrism. I refer, here, to a set of cognitive deficiencies that could rightly be criticized as anthropocentric because they are not unavoidable and depend on a wilfully selective view of humans' place in the world.

What the ecological perspective helps us see is that to the extent that humans are the center of their world under a certain perception or description of it, what humans are the center of is not quite what they sometimes imagine it to be. 'The' environment, as we loosely refer to it in ethical and political discourse, is always *our* environment, of course, if we are interacting with it at all; but we need to understand the adjective 'our' not as denoting possession, let alone domination; rather we should think of ourselves as *belonging* to this wider set of conditions that we depend on for our existence; recognizing this dependence, we should also be alert to our vulnerability and the limitations of our 'power' over nature. The real problem that can be characterized as anthropocentrism, I suggest, is something that is not so much ethically deficient as cognitively delusional because it loses sight of the dependency and vulnerability of the human condition.

19.2 The Ecological Perspective: Ecological Space as a Way of Seeing the Human Place in the World

The ecological perspective, then, by no means endorses anthropocentrism of cognitive or ontological kinds. Here I want to highlight how it involves a distinctive **way of seeing** that involves depicting us – human beings, individuals and collectivities – as living in **ecological space**. Ecological space is defined, for humans, in terms of human species dependencies. This key concept provides the conceptual medium for relating ecological concerns to ethical ones.

The ethical implications of the concept of ecological space can be drawn out from the focus it brings to issues arising from the finitude and vulnerability of habitats. In this planet's biosphere, there has always been competition of various kinds – within, among, and between species, populations and communities of organisms – for adequate environmental resources. The complexity of life, of course, also means that many organisms are themselves environmental resources for others. These natural ecological processes in themselves are hardly

[1] For this and the next point see Hayward 1997a.

appropriate, or even possible, matters for ethical regulation by humans. Ethical questions do arise, however, when consciously directed activities of human beings cause harm to the environments or resources that other human beings depend on. Ethical questions also arise when humans cause harm to the environments or resources of members of species other than *Homo sapiens*, or indeed when they directly harm those members themselves. Questions of animal ethics, biocentrism, ecocentrism, and various aspects of human-nonhuman relations, constitute important fields of inquiry in their own right. My aim is to establish how the idea of ecological space can be used in the construction of ethical arguments, and although here I confine attention to relations among humans, it could well be used for arguments involving concern for non-humans.

The ethical significance of the concept of ecological space can be approached by considering how some basic principles of ecology can be brought to bear on the general concept of space. The concept of space, in general, involves no picturing whatever: space is, in the abstract, the pure constitutive form of appearance of extended objects in reality as we experience it. Space, in general, is a term that stands for a fundamental and constitutive condition of existence; space as we refer to the term in any determinate context, however, is always thought of under a particular sort of description. Ecology – the science and the reality studied by it – concerns the complex interrelationships between and among organisms and their environments. These interrelationships take place in extended space, to be sure, but we can distinguish ecological space from geographical and topographical descriptions. The concept of ecological space allows us to picture the world in terms that are not captured by purely physical or geographical descriptions of space. The relevant space is defined more critically by function than by physical dimension or magnitude. This point and its implications can helpfully be brought out by thinking of it as what is provided by an ecological *niche.* This is a particular kind of 'space' for organisms to live in that is defined by parameters other than of physical extension and that exists as the sum of the habitat requirements allowing a species to persist and produce offspring. As influentially formulated by G. Evelyn Hutchinson (1958) when seeking to account for how there can be so many different types of organisms in any one habitat, the niche can be conceptualized in terms of a 'hypervolume', a multi-dimensional 'space' of resources and environmental conditions (e.g., light, nutrients, structure, etc.) that are available to (and specifically used by) the organisms that require them.

We human beings can be said to have expanded the niche that we actually live in on this planet – our *realized* niche[2] – quite considerably. We can adapt ourselves to a wide variety of habitats, because – or, more exactly, in virtue of the fact that – we can adapt the habitats themselves to our needs. We do not fundamentally alter the human organism's need for nutrition, hydration, a certain air temperature and pressure range, and so on (i.e. the conditions that ecologists refer to as our *fundamental*,

[2]Ecologists distinguish between the fundamental niche of a species – the general conditions functionally required for its persistence and reproduction – and its realized niche. The point in the text is loosely based on this distinction (see Hutchinson 1958; also Pulliam 1988).

as opposed to realized, niche); we use technological devices to provide what is needed when the immediate natural environment does not. (Thus we can also send people to the bottom of the ocean or out into space.) Our relation to the rest of nature, then, is highly mediated: very complex technological and social constructions provide settings for individual human organisms, communities, populations and – ultimately – the whole species to live in, and in ever changing ways. Indeed, humans are the species in this biosphere that has a *history*, as distinct from simply a co-evolutionary record. The distinctive history of humans, their various communities and populations, is all about their changing modes of technological adaptation to, and of, their environments in conjunction with changing modes of social organization. But having become so accustomed to an expansionary vision of the world, it seems, we have failed adequately to appreciate the ecological contingency of the fine web of interrelationships on this planet upon which we depend.

The 'way of seeing' that has dominated modern Western thought includes a basic depiction of Man (advisedly gendered) as set over against the rest of nature, in a world that has a lot of empty space to be filled by his products, these being wrought through the mastering of the natural objects and processes that He discovers and invents. Man came to feel Himself 'independent' of nature in important ways. It is this attitude that is perhaps most tellingly criticized as 'anthropocentrism' (Hayward 1997b), whereby attributes of power and transcendence vis-à-vis nature that were once projected onto deities came to be arrogated to human beings. The ecological space of the human species has in modern times undergone such changes that the very fact of our critical dependence on it has been lost to view to many of us in the industrialized world. We know, though, that peoples who live in direct contact with the land and depend directly for their lives and livelihoods on the survival and flourishing of local flora and fauna are liable to see a dense, complex, and vulnerable world immediately around them. They are of necessity aware that they depend on ecological space that needs to be sustained in their geographical vicinity. In the highly industrialized and technologically developed world our relationship with the ecological space we depend on has become so complex and highly mediated that hardly any of us has much appreciation of it at all. Nevertheless, as global environmental change becomes more dramatic, and under the impact, especially, of warnings of climate change, contemporary moral and political philosophers have started to think a little more carefully about the human relationship to the rest of nature. What I suggest here, though, is that the kind of thinking required does need a clear change of framing assumptions, a different way of seeing.

The 'imaginary' that has informed Western thinking in recent centuries has consisted of impressions of geographical space with wide open spaces, endless frontiers, outer space, and so on with an abundance of resources that unbridled human ingenuity will ever find innovative ways to valorize. The truth, of course, is that none of the things treated for practical purposes as unbounded or infinite actually is; and the scale of our alterations of ecological relations has become so great that it is revealed to be mistaken to suppose they are. In fact, we are now being forced to recognize that we inhabit a contained, dense biosphere that is being put under enormous strains and as we make increasing demands on its capacities, the space becomes increasingly crowded.

19.3 Ecological Space in a Crowded Biosphere: The Circumstances of Justice in Socio-historical Perspective

The planet's biosphere is crowded in the sense that the demands placed by the world's human population on its ecological space are such that some members of the human population do not have access to ecological spaces adequate for their health and well-being. One aspect of this problem is the finitude of the earth's aggregate biophysical capacity, as it can support a finite amount of organisms in general and human organisms in particular. Another aspect of the problem is also appreciated, however, when we recognize that 'humanity in aggregate' is an abstraction and that some humans make vastly more use of the planet's ecological space than others do. The very different realities of lives lived in affluence or in poverty owe their tangibility to the differential capacities to command ecological space: the wealthy have an ecological footprint that covers much of the globe, while the poor are ecologically marginalized and deprived of access to resources on their own doorstep.[3] These circumstances clearly give rise to questions of justice, particularly in a global context. Furthermore, the idea that each human being depends on access to ecological space, in a circumstance in which actions of others can deprive her of it, suggests, too, that access to ecological space might be regarded as a human rights issue. In this way, fundamentally important ethical concerns – of global justice and human rights – can be captured by reference to the idea of ecological space.

A clear ethical concern relating to ecological space is that each person should have access to enough of it to enable them to lead at least a minimally decent life. For I presume we would find hard to recognize, as an ethical proposition, the contrary suggestion that it is acceptable for some people to be denied the legitimate expectation of being allowed access to what they need to live a minimally decent life. We can thus – with relatively little argumentative apparatus – derive the normative proposition: To deprive a person of access to needed ecological space is wrong.

Affirmation of this simple proposition leaves open, of course, a number of consequent questions. What if the deprivation is, in some cases, unavoidable? What is the definition of a *decent* life? How does one determine what, exactly, and how much of it, is (minimally) needed? Would it also necessarily be wrong to fail to give a person what is needed, and if so wrong of whom? What about space that is more than is needed? These and related questions are clearly on the agenda for ethics from an ecological perspective. But I shall pick up here on one major point. The proposition affirmed implies that we can speak here of a human right. This would be a human right of access to ecological space such as is necessary for a minimally decent life.

To secure this human right around the world today would require some redistribution of access to ecological resources. For there are millions, if not billions, of people worldwide whose very lives and livelihoods are at risk on a constant basis from inadequacies of access to the most basic elements of human life – including

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[3] Below I shall further explain why 'command' of ecological space can go even beyond measurable ecological footprints.

healthy water, air and food, and the land and water sources to supply these things. This means that support of the human right implies an imperative of global justice to address some of the most egregious inequalities.

Now there are those who would argue that the poorest can be made better off by maintaining the current trajectory of global development, with a share of the benefits that are currently being amassed by the affluent eventually trickling down to the worst off too, either through 'natural' economic processes or with a little political encouragement. On this prevalent view, continued economic development is the key to overcoming human misery, and environmental considerations are either neutral with respect to that goal or, when properly understood, even favorable to it. Thus, for instance, since the influential Brundtland Report (WCED 1987), the idea of sustainable development has widely been taken to represent the key goal for humankind. The report holds out the prospect of a win-win-win scenario in which economic development continues indefinitely, but its benefits are shared sufficiently for global injustices to be rectified, while at the same time the environment is adequately protected for both present and future generations. And yet, as the world moves ever further away from any such actualization, it remains unclear what evidence or reason supports a presumption that this win-win-win scenario is achievable.

At this point, evidence from ecologists is relevant (e.g. Millennium Ecosystem Assessment 2005). If ecosystems are being seriously undermined in many parts of the world, and at an alarming rate, and if the causes are quite clearly associated with human activity in a large proportion of the cases, then a more reasonable presumption is that our current development trajectory is a significant part of the problem, rather than its solution. Thus, I would suggest, an ecological perspective can be more strongly critical of business-as-usual than most advocates of sustainable development have tended to be.

In fact, such an ecological perspective could support a veritable paradigm shift in our thinking about the nature of global political economy and thus also the principles of justice that should guide its governance. Certainly, insofar as mainstream liberal thinking about ethics and justice is premised, tacitly or explicitly, on assumptions about continued economic growth, it can be argued that we need a paradigm shift. For insofar as 'normal' theories of justice are those premised on the idea that a central concern is how to distribute that portion of production surplus to survival requirements, and especially assumptions that economic growth can continue indefinitely, they would appear to be highly debatable, and perhaps even indefensible, from an ecological perspective. We need a conceptual framing that allows us to recognize, amongst other things, how there can be winners and losers in the context of global development. (Of course, in a worst case scenario of an eventual total global ecological collapse, all would be losers; but here and now and in any foreseeable shorter term future, harms will affect some sooner and more severely than others.)

At the heart of the problem is that no matter how severe the ecological disruptions may be, there appear to be vested and institutionalized interests in presenting these as quite separate issues from those concerning poverty and wealth or production and exchange. Against that influential line of thought that would have us accelerate our productive capacities in order to develop more wealth with which to pay for rectification of environmental harms, we should pose critical questions about what exactly that wealth would be constituted by, and what any such payment would therefore actually represent. For you cannot do anything with money if that money does not represent any real assets; and if we squander all our natural assets, what will future money represent that can restore them? (Hayward 2009)

19.4 Need for a Paradigm Shift in Assumptions, Two New Principles of Justice, and Cultivation of a New Ethos

Here I would suggest two very broad normative principles that answer to the demands of justice in the circumstances prevailing today. These can be described, adapting concepts familiar from climate change debate, as the twin principles of contraction and convergence. Concerns to protect interests of future people require global *contraction* of our demands on the planet to make these sustainable in the longer term; concerns to achieve that equitably, and in particular in a way that is compatible with protecting the worst off in the current generation, require *convergence* between the demands of the better off and worst off.

The point that the globalized economy is producing winners and losers among humanity, as well as causing ecological upheaval means that we need to attend more closely not only to how ecological space is used, but also how rights to use, occupy and control it are inequitably shared amongst humans. Such rights correspond to different kinds of property relation that humans can stand in. The norms that prevail in the world today presumptively protect property rights that have been created, when these have a minimum of legal propriety, historical precedent, or simply historical facticity. The creation and exchange of property rights follows behavioral logics that need make no particular reference to wider human interests or morality. As inequalities intensify, both globally and within states, these inequalities are held in place by means of those norms that protect the property rights of some against any possible claims by others. The material situation in the world today is that there are *radical inequalities* that severely, persistently, and imperviously affect the worst off (Nagel 1977; Pogge 2002). The worst off lack access to adequate ecological space. In the most obvious of cases, their plight can readily be described in terms of ecological marginalization (Homer-Dixon 1999); but also for reasons already noted, we can understand how the plight of people on the wrong end of radical inequalities more generally is bound up with mediated issues of access, use, occupation and control of ecological space.

To fully grasp how economic destitution is intimately bound up not only with deprivation of access to ecological space but also with the norms of property ownership globally, we need to appreciate how ecological space can not only be used endosomatically, by human organisms, or exosomatically, through productive technique; it can also be 'used' for socio-economic advantage in ways that involve no actual (biophysical) use.

For one thing, it is possible – in virtue of a system of property rights – to occupy ecological space, even if one has no need or use for it. This possibility, however, can only be described from a social perspective, not a purely ecological one. It signifies a relation between people and ecological space that depends on acceptance of particular social norms for its possibility. An analogy would be the situation in which an empty theater seat is said to be occupied: the convention of reserving seats gives sense to what would, under a purely physical description, be a self-contradictory proposition: 'the empty seat is occupied'. When one occupies a physical space like this, what one does is retain the option for oneself to use it while excluding others from exercising such an option, as long as they share a commitment to the salient normative expectations. Likewise, occupation of ecological space does not represent any facts about the *natural* world; it is understood as a purely social, *normative*, category; it can only apply when norms with the effect of *property* incidents are recognized as valid. But it is highly relevant when we think about claims of property and right that involve access for some and exclusion for others. It is a crucial part of understanding how people can acquire and control more ecological space than they could ever actually make use of. When vast numbers of people are ecologically marginalized by the activities of a relatively small number we can only understand how this could happen by examining the normative relations between the different kinds of people.

Furthermore it is possible to ***command*** ecological space by exploiting a potentiality that presupposes merely the possibility of occupying it. One commands ecological space to the extent that one has the power or capacity to make an effective decision to acquire or occupy ecological space that currently is owned or used by another. This would be the power or capacity, as typically represented by the holding of assets, (including money, bonds, promissory notes, and so on, that physically manifest no ecological space at all,) to take possession, through a transaction, either of goods or services that do embody ecological space, or of rights of occupation of ecological space. At any moment, a holder of money wealth could convert the money into holdings that embody actual ecological space. This potentiality is of considerable significance, as is glimpsed, for instance, when abstract and speculative transactions on global commodity markets have very dramatic effects on lives and livelihoods of very many people in ecologically marginalized situations in the world.[4]

Under prevailing norms, which by and large treat all property rights as presumptively justified, the practices involving what I designate as the occupation and command of ecological space are not seen as problematic: the accepted view is that accumulation of productive capacity is necessary for the efficient production that,

[4]Command of ecological space does not have to take the form of financial wealth. Ecological space, in fact, due to its inherent territorial extension, can be commanded within a regime of territorial rights too. This is something that Avery Kolers (2012) has (indirectly) highlighted when pointing out that a political regime governing a territory can make various kinds of exploitative 'use' of its ecological resources without actually consuming them.

ultimately, benefits everyone. But that reasoning presupposes that the system of global economic production does not cause overshoot with respect to the planet's ecological capacities. If we take the ecological perspective seriously, we cannot find it unproblematic that anyone have, and exercise, untrammelled rights over natural resources of any kind. If we take the finitude of the planet seriously we cannot continue with assumptions about growth – or even a stationary state – being possible. We need to recognize that the global economy has to contract. We certainly cannot simply assume that there will always be, or even is now, a 'surplus' to share out. So even if there were the will among the better off to allow some redistribution to the worse off, putting this into effect would involve more than setting aside a share of surplus. Put in other terminology, it is not possible to have convergence between the wealthy and the poor without also having contraction of the aggregate ecological space demands.

That means, finally, cultivating an ethos in the world – and especially amongst the affluent – characterized by virtues of restraint as well as resilience. This includes a willingness to accept with regard to shares of ecological space that enough is enough – in order that the worst off, and generations to come, will have at least enough. On that basis, we might hope to make the planet more habitable also for our nonhuman co-inhabitants; it is doubtful that we will have lasting success with policies for environmental or animal ethics without addressing the fundamental drivers that are leading humans to affect this planet's ecology in ways that may last for historical periods to come.

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Chapter 20
Whose Danger, Which Climate? Mesopotamian versus Liberal Accounts of Climate Justice

Michael S. Northcott

Abstract Dangerous climate change was first defined as globally averaged warming of 2° above the pre-industrial average by an economist, not a natural scientist. A global average rise of 2° equates to significantly more climatological effects in some earth regions. Food and energy price rises sparked by rising temperatures and enduring drought in the Middle East and North Africa, combined with increased pumping of ground water, are implicated in the rise of civil conflict, revolution, and war in these regions since 2009. The inability of industrial civilisation to adapt to the climatological limits of the biosphere arises from the refusal of liberal economists and others to recognize that justice is contextual to the boundaried nature of political communities, and to the limits of the earth system. In the history of Western culture, discourses about justice first appear in association with the development of agriculture and irrigation systems in Mesopotamian cultures. Agriculture in the Levant made possible more densely populated societies, and the division of labour. It also permitted the emergence of great inequality and slavery. Hebrew discourses of government and justice evolved which sustained limits on the asymmetric distribution of land and its product in a bordered political community. These discourses also suggest that just land distribution not only makes for solidarity in self-sufficient communities, but for benign climates. Modern liberal theories of justice as procedural, and grounded in political rights and freedoms, miss the antique contextualisation of standards of justice in political and economic communities, and the role of restraints on power and wealth, and territorial limits, in the construction of justice.

M.S. Northcott (✉)
School of Divinity, New College, University of Edinburgh,
Mound Place, Edinburgh EH1 2LX, UK
e-mail: M.Northcott@ed.ac.uk

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20.1 The Factish of a Target Climate

The United Nations Framework Convention on Climate Change (UNFCCC) identifies the core goal of signatory parties to the convention, which includes 194 UN member states, as 'avoiding dangerous anthropogenic interference in the climate system' (UNFCCC 1992). It is widely assumed that a judgment about dangerous climate change is a scientific judgment, because it is a 'factish' judgment about nature rather than a value judgment about culture (Latour 2010). However, dangerous climate change is first associated with a target climate of 2 °C above pre-industrial temperatures in a paper modelling the economic costs and potential benefits of climate change risks and mitigation efforts (Nordhaus 1977). Nordhaus notes that the then 0.5° of warming since 1900 was likely linked to drought in the Sahel, and that warming of 1° may provoke an arctic free of summer ice. He also notes that increased photosynthesis by plants in a warming climate will likely increase crop outputs in Northern latitudes.

Climate change for Nordhaus is a 'market externality'. But if fossil fuel producers attempt to internalize the costs of climate change out of 'altruism', they become unprofitable. The problem is therefore one of economic technicalities: market regulators need to identify a mechanism for pricing future costs of climate change and so internalize these to energy markets. At the same time substitute non-fossil fuel energy technologies need to be brought to market at costs commensurate with fossil fuels. These procedures require a target climate. Nordhaus commends 2° above pre-industrial temperatures for this purpose because it is within observed climates in the last 100,000 years (Nordhaus 1977).

The +2° target climate was taken up by the Advisory Group on Greenhouse Gases (AGGG) of the World Meteorological Organisation and the United Nations Environment Programme, on the basis that it is a threshold beyond which nonlinear climate responses might tip the climate into abrupt and catastrophic climate changes (Jaeger and Jaeger 2011). The 2-degree target was subsequently adopted by the European Union, and by the Conference of the Parties to the UNFCCC. For Nordhaus, a 2-degree target climate is preferable because it has occurred within the 'natural' history of humanity. This claim is combined with the claim that markets, as the dominant device for resolving climate change, are also 'natural' (Nordhaus 1977). The description of markets as 'natural' reflects the political economy of Adam Smith, for whom markets are a form of natural providence whereas government is more 'artificial' because it involves collective deliberation and planning (Rothschild 2001). The overlapping uses of 'natural' to describe dangerous climate change, and market mechanisms which may be used to stabilize greenhouse gas emissions, illustrate the extent to which climate change, as well as climate justice, are hybrids of 'nature' and 'culture' and involve multiple agents, both human and heavenly (Latour 1993).

20.2 Dangerous Climate Change

North Africa and the Middle East are identified in most Global Circulation Models of climate change as regions that will experience greater anthropogenic warming for a given level of global change. Climate change may therefore have dangerous consequences in these regions below the 2-degree threshold (Schilling et al. 2010). Evidence since 2009 indicates that these consequences may already be occurring. The Gravity Recovery and Climate Experiment (GRACE) uses satellite data on the force of gravity to estimate the presence of groundwater in the region. GRACE reveals that North African and Middle Eastern countries marred by violent conflict and war since the 'Arab Spring' of 2009 are also in the midst of an enduring and severe decline in year on year precipitation, the most recent phase of which began in 2007. The Euphrates Tigris River Basin includes the war-torn countries of Iraq and Syria as well as parts of Turkey and Iran. GRACE reveals a loss of 143 cubic kilometres of water between 2003 and 2009, representing the largest continental decline in fresh water availability known to science (Voss et al. 2013).

Drought in the Middle East has been exacerbated by Turkish hydrological works, since 2000, close to the source of the two rivers. This has led to a 70 % decline in river flow volume into Iraq, and provoked substantially increased pumped extraction for irrigation from cross-border subterranean aquifers in Iraq and Syria during the GRACE study period. This in turn depleted aquifers, and reduced the ability of farmers to draw on historic water in the drought since 2007. The resulting widespread crop failure, and sharply rising food prices, drove millions into urban areas looking for food, water, and employment. The problem is not confined to the Tigris/Euphrates basin. Libya extracts 600 % more historic water from subterranean aquifers than it receives in rainfall, and Kuwait 2,000 % (Michel and Yacoubian 2013). Hunger and internal migration are major sources of civil and sectarian conflicts in North Africa and the Middle East since 2011, conflicts that were sparked first in Tunisia by the suicide of a frustrated food hawker.

A target climate of plus 2 °C therefore turns out not to be 'safe' for one of the most populous regions on earth. In these circumstances some climate scientists propose revising the target to plus 1 °C (Hansen et al. 2008). GCMs typically estimate 2° of globally averaged warming as consistent with 550 ppm of CO_2 and 1° as consistent with 450 ppm. The planet passed the 400 ppm threshold in May 2013. At least 20 % of potential anthropogenic warming is retarded by reflective sulphates and other particulates from biomass fuels and forest burning in developing countries, and by emissions from heavily polluting coal plants in China and India. Climate inertia also ensures there is another 50 % of warming in the pipeline (Hansen et al. 2013). Hence if plus 1° is the target, it is already quite likely unattainable. Many politicians and climate scientists now envision that even the 2-degree threshold will be exceeded because of the failure of UNFCCC regulations to restrain growth in greenhouse gas emissions, which have accelerated during the first commitment period of the Kyoto Protocol (Hansen et al. 2013).

If we examine the reasons for the failure of the UNFCCC, principal among them is the resistance of the largest historic polluter – the United States – to the original World Meteorological Organisation and European Union plan for a 40 % reduction in emissions in the first commitment period of the Kyoto Protocol, a level of reduction the Europeans estimated would be needed if the Protocol were to have a discernible impact on global CO_2 emissions. Other large fossil fuel producing nations, including Australia, Saudi Arabia and Russia, also opposed the 40 % emissions reduction target. In the event the emissions reduction target for the first commitment period of the Kyoto Protocol – which remains the only global treaty restraining greenhouse gas emissions – was set around 8 %, which was far too low to have a discernible impact on atmospheric CO_2 emissions. At the same time, the exclusion from the emissions reduction regime of developing countries – especially China – ensured that the small target for reduced emissions in Europe was overtaken by growing emissions elsewhere.

The other reasons for the failure of the Kyoto Protocol to slow global emissions is the focus on emissions, rather than on the extraction of fossil fuels, and the related decision, again at the insistence of the United States, for carbon emissions trading to be adopted within the Kyoto Protocol regulatory regime. The only feasible means to slow the greenhouse gas emissions provoking global temperature rise is to reduce fossil fuel extraction, and keep most of the remaining reserves of fossil fuels in the ground (Hansen et al. 2013). Fossil fuels that are extracted will be brought to market and burned somewhere: as Jevons argued first in relation to coal extraction, energy efficiencies do not reduce energy use: they simply create opportunities for alternative and additional uses of energy (Jevons 1865; Sorrell 2009). Focusing on reducing extraction represents a 'supply-side' approach to fossil fuel production where extraction and marketing of the resource is limited to a level of annual emissions consistent with the target atmosphere (Sinn 2012). But the Conferences of the Parties to the UNFCCC consistently avoid discussion of means to keep fossil fuels in the ground, and instead focus on efforts to restrain emissions from fossil fuels without reference to extraction. Some argue that Carbon Capture and Storage (CCS) will permit use of fossil fuels beyond 'natural' atmospheric limits (Haszeldine 2009). But CCS remains an experimental technology, it can only be used with stationary power, storage reservoirs in sedimentary rocks leak, and it is, per unit of energy produced, more costly than already existing renewable energy technologies (Viebahn et al. 2007).

The focus of the UNFCCC regulatory regime on emissions leads to attempts by countries committed to emissions reduction to behavioural change by millions, or even hundreds of millions, of businesses, households and individual energy users. Even if these countries are successful in influencing the behaviour of so many users – by energy taxes or the currently highly ineffective vehicle of carbon emissions trading – avoided emissions may simply be outsourced to countries that choose not to price emissions, as the UK example indicates. The UK reported reductions in domestically attributed carbon emissions consistent with its 8 % reduction target for the first commitment period of the Kyoto Protocol. But in the same period UK consumption of carbon, including carbon embedded in imported goods, increased by 20 % (Helm 2012).

The most efficient supply side procedure to gradually reduce the supply of fossil fuels to a level consistent with a 2° target climate – assuming such precision is even possible – would be to ration fossil fuel extraction, for example by a global auction of extraction permits (Tickell 2008). The sites of major fossil fuel extraction, and the number of agents involved, are a few thousand, as compared to the billions of points of use of fossil fuels. But, despite the failure of territorial emissions accounting in reducing greenhouse emissions growth, there is still no focus on fossil fuel extraction and supply in the reports of the IPCC or in the Conferences of the Parties. Instead the Parties follow the advice of economists such as Nordhaus that they should rely on technical modifications to energy markets as the means to restrain carbon emissions consistent with the target climate.

20.3 Market Societies and Mesopotamian Justice

Reliance on markets for the resolution of hybrid problems of the 'economic/environment' variety indicates the preference of mainstream economists for utilitarian cost-benefit procedures in resolving such problems over other approaches (Hanley and Spash 1993). This preference arises from the belief that for any given social cost, a market-based approach is more 'efficient' because it gives market actors greater freedom of movement in estimating how best to respond to a market signal (Coase 1980). However for this preference to be consistent with an account of procedural justice, of the kind advanced by Rawls or Sen, we would need to assume that all market actors have equivalent power and agency in the network of procedures that determine the monetary values attributed by market mechanisms to ecological costs as compared to benefits (Rawls 1971; Sen 2009). But this is not the case. As is well known, the global distribution of property rights is asymmetric. Many agents, particularly in less industrialized countries such as those of North Africa, bring their labour or products to markets under highly coercive conditions where life and death may be at issue. In such conditions purchasers have more power than producers and derive asymmetric benefits from the costs – of labour or natural resources – borne by producers (Barrera 2005).

Economic and political liberals argue that freedom is a social good arising from a mix of lawful rule and market institutions in well-governed societies (Rose 1999). For the ascendant theory of neoliberalism, the best government is the least because this permits maximal freedom to market actors, and the 'natural' emergence of 'spontaneous order' (Hayek 1960). However archaeological anthropology reveals that spontaneous order and freedom from social coercion are more characteristic of small-scale hunter-gatherer groups, where personal achievement is the principal determinant of rank, than of large scale and complex agricultural and industrial societies in which property and social rank are often hereditary. Flannery and Marcus trace the emergence of hereditary inequality to the development of complex social structures – characterized by large temple structures, and monarchic and imperial patterns of rule – made possible by the rise of agriculture seven to eight thousand years ago (Flannery and Marcus 2012). In pre-agricultural societies generosity in gift giving and exchange is the principal source of social honour and prestige, while hoarding of wealth is a source of shame. These beliefs undergird a tendency to equitable distribution (Mauss 1966). But in agrarian societies, prestige is increasingly acquired on the basis of inherited land, property, and social status. Consequently justice, and in particular access to adequately watered land to grow food for oneself and one's kin, become predominant social concerns in agricultural societies. Hence in the Code of Hammurabi, the earliest Mespotamian legal code, the purpose of good rule is 'to promote the welfare of the people' and 'to cause justice to prevail in the land, to destroy the wicked and the evil that the strong might not oppress the weak' (Harper 1904). Similarly for the Hebrew Psalmist the just king 'judges on behalf of the poor' and such justice is mirrored in the heavens, and in 'showers that water the earth' (Psalm 72. 6). The Code of Hammurabi is addressed to Shamesh, the 'god of the skies', while the Hebrew Psalms are addressed to Yahweh who is 'creator of the heavens and the earth'. In both cases good rule mediates benign relations between earth and heaven.

20.4 Geography and the Concept of the Political

For contemporary liberals of a Rawlsian hue, the Mesopotamian belief that there is a relationship between inequity in land distribution arrangements and a climate that confers the sun's warmth and rain 'in due season' on the lands of the poor rests upon an unscientific and unverifiable metaphysical belief. Such beliefs cannot be used to guide public deliberation about economic distribution, because metaphysical reasons for public action reduce peoples' freedoms to choose their own goods, and so maximize their welfare (Rawls 1985). But the question arises whether Mesopotamian accounts of the climatic implications of good and bad rule are metaphysical, or even magical, rather than 'scientific'. Nations are collectivities of people who are acknowledged residents of a bordered land, a land moreover which will typically include river basins, uplands, upland forest, lowland fields, and in the majority of cases coastline. There is moreover an empirically verifiable relationship between large highly unequal patterns of national land ownership – such as obtain in Scotland, my country of residence, or in Brazil – unproductive land use, and ecological degradation. By contrast there is a growing body of anthropological and scientific evidence demonstrating that smallholder farming produces more food, sustains higher levels of biodiversity, and has fewer ecological side effects (Clawson 1985; Altieri 2004). The belief that there is a relationship between equity in landholdings and equable ecological conditions that favor productive harvests is not then only metaphysical. It also correlates with scientific evidence of the benefits of smallholder agroecology as contrasted with large industrial farms and plantation monocrops. (Natarajan and Willey 1996; Gliesman 1998).

Climate change represents an analogous example, but it does so on a planetary scale. Just as there are boundaries to nations, there is a boundary to the earth's atmosphere. Excessive use by some individuals, corporations, or nations of the atmosphere as a sink for carbon dioxide and other greenhouse gases reduces the availability of sinks for other less heavy users. At the same time the heaviest emitters will often have used their excessive energy to accumulate sufficient wealth to insure themselves against the vicissitudes of a destabilized climate system of the kind the earth is moving into. Ecological borders create limits: a refusal to recognize limits by some, even if ideologically sustained by a liberal account of the 'efficiency' of maximal market 'freedoms', does not change the existence of limits. It means instead that the existence of limits will, without restraint on consumption or pollution by some, impose more coercive and dangerous conditions on others.

Carl Schmitt argues that liberal accounts of freedom are incoherent because liberals do not account for the role of borders in the concept of the political. Nations as political communities necessarily distinguish between members and non-members on the basis of who belongs within their borders, and only those who belong have the rights of citizens (Schmitt 2007). Schmitt argues that the political in the twentieth century was increasingly subverted by borderless economic trading arrangements. But because liberals lack an understanding of the importance of borders, and of friendship within borders, to the sustaining of the political, liberals have not resisted these arrangements. Schmitt's argument is analogous to that of Adam Smith in Wealth of Nations when he maintains that capitalist advances in freedom over feudalism are at risk from collusion between global joint stock companies and governments, and the capture of state power by global corporations (Muthu 2008). When capital is borderless and 'free', citizens and small business owners are more likely to be coerced into unjust contracts, or into selling their products at prices that are incommensurate with the creativity and effort they represent. Hence workers in Mexico's Maquiladora factories receive less than a living wage, their children are malnourished, and their environments are polluted (Grineski and Collins 2008). But the North American Free Trade Area treaty between the Mexican government and those of the United States and Canada coerces poor Mexican workers into unjust and unsustainable labour contracts for foreign multinationals since it undermined local employment and environmental regulation (Hanson and Harrison 1999).

NAFTA and other intergovernmental trade liberalisation treaties sustain continued expansion in a fossil fuelled economy in which multinational corporations are the most powerful agents. Governments grant favourable conditions to multinationals under these agreements because they see this as a way to grow economic wealth without the inconvenient restraints of local citizen deliberation over just labour and social conditions, and environmentally sustainable production methods.

20.5 Misconstruing Climate Justice

Why after a dozen meetings have the Conferences of the Parties not begun to talk about a global treaty that regulates the extraction of fossil fuels despite growing citizen concern at the effects of climate change? Extensive commentary on these conferences indicates the power of veto exercised over the negotiations by governments who host large fossil fuel corporations, both public and private. Fossil fuel reserves are seen as too valuable to be written off, despite the threat they represent, if extracted and burned, to the health of farmers in North Africa, or fishers in Bangladesh, or the residents of Atoll nations in the Pacific Ocean and, ultimately, to many species and to future generations of humanity wherever they reside.

In their influential book Climate Justice, Eric Posner and David Weisbach resist the idea that the largest owners, and users of fossil fuel resources, and in particular the United States, have a greater responsibility for climate change than those who are being more directly harmed by it while they did little to cause it (Posner and Weisbach 2010). They argue that it is unjust to expect wealthy developed nations to forgo ongoing economic benefits from fossil fuel use, and that this is to confuse global wealth distribution with efforts to reduce climate change. This confusion is the reason no global treaty restraining fossil fuel use has been reached. Further they argue that it is wrong to insist that the largest historic polluters – and in particular the United States – accept the full pecuniary responsibility for the damage their historic pollution of the atmosphere inflicts on developing nations since for a long time the developed industrialized countries did not know their climate pollution would harm people in other states. It is also wrong to hold nation states accountable for the actions of corporations and individuals that reside within such states – or at least operate in part within their borders – when the nation state cannot morally be held responsible for all such actions. Instead, a treaty governing the behaviour of states regarding climate pollution ought to be drawn up on a 'Paretian' basis where the treaty is clearly advantageous to each party to the treaty. For Posner and Wiesbach asymmetry in property rights arising from historic fossil fuel use is irrelevant to climate justice. In saying this, as privileged North American economists, they illustrate the claim of Schmitt, and more recently of MacIntyre, that liberal conceptions of justice are not universal but contextual (MacIntyre 1988). To those in North Africa and the Middle East who are losing and will lose adequately watered land to dangerous climate change, climate justice is different than it is for the agencies which continue to extract the fossil fuel resource, and whose beneficiaries draw on accumulated wealth to insure themselves against extreme weather.

Wealth accumulation under the contextless liberal definition of justice favoured by economists, and by large fossil fuel companies which are the most powerful actors in the global economy, involves environmental exclusion and injustice in particular regions on the earth, as represented by the ongoing corporate and governmental takeover of community owned forests, fields and water sources, and the exile of self-sufficient smallholders to maquiladora and other zones of coerced wage labour. The process began in England, the birthplace of the coal-fuelled Industrial

Revolution, with the Enclosures of common forests, pastures and smallholder fields by the Tudor and Hanoverian governments of the seventeenth and eighteenth centuries and the exile of their peasant residents to rural and urban slums (Thompson 1991). Anthropogenic climate change however represents a new kind of exile, this time not from ancestral lands but from earth itself (Northcott 2013). The refusal to accept that there are earth related limits to justice distinguishes liberal capitalist from contextual and communitarian definitions of justice such as those that first arose in the religious traditions of ancient Mesopotamia, and are now advanced in the discourses of environmental justice (Rees and Westra 2003). If governments and their multinational clients continue to refuse to accept that there are terrestrial limits to fossil fuelled economic growth, earth citizens will be exiled not only from ancestral lands but ultimately from the earth itself. Governments and their multinational clients will perhaps at this point seek to identify extraterrestrial beings with whom they can continue the global trade liberalisation project in other solar systems, and this is the plot of James Cameron's science fiction movie Avatar, although it ends badly (Cameron 2003).

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Chapter 21
Environmental Justice, Ecofeminism, and Power

Chaone Mallory

Abstract This chapter explores the intersection between two major strains of environmental thought and praxis, *environmental justice* and *ecofeminism*, two fields of inquiry which each examine the conceptual and material linkages between the degradation of natural places and the marginalization and oppression of human communities. It shows how the critique of unequal power relations—both intra- and trans-human—central to each can help scientists and policy makers to comprehensively address current environmental issues. The current state of environmental discourse tends to view environmental issues as problems for science, and not as issues of social justice. Such an approach ignores the fact that not all groups of humans are situated equally in regard to ecological degradation and exposure to environmental toxins, as a direct result of histories of inequality and oppression. These histories are linked through processes of *dualism,* in which nature/humans, Anglo-European "whites"/people of color, and masculinity/femininity are placed into opposition. Such conceptual pairings are gendered, as well as raced, classed, and specied. Ecofeminism directly interrogates the sources and effects of these pairings, exposing the ways in which sexist ideologies are connected to "naturism." Therefore, this chapter argues, struggles for environmental justice that do not incorporate an explicitly gendered and ecofeminist analysis of ecological problems will not adequately understand the ways in which systems of oppression (such as racism, colonialism, gender discrimination, and environmental degradation) are interconnected and mutually reinforcing. For this reason, ecofeminism, a political movement and theoretical stance which identifies and articulates these interconnections, is a necessary intervention into discussions and debates about how to alter the fact of environmental injustice.

C. Mallory (✉)
Department of Philosophy, Villanova University,
800 Lancaster Avenue, Villanova, PA 19085, USA
e-mail: chaone.mallory@villanova.edu

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Keywords Environmental justice • Ecofeminism • Dualism • Intersectionality • Power

21.1 Overcoming Human-Nature Dualism

In Anglo-European Western traditions, that which has been assigned to the category of "nature" and that which is assigned to the category of "culture" have been constructed as radically separate, as have the movements concerned with the issues belonging to each realm. On one side, those who care about environmental issues and the health and well-being of the natural world are according to pervasive stereotypes concerned exclusively with the question of what people are doing *to* natural environments and with what can be done to stop the other side, the members of the parasitic, wilderness-destroying hegemonic, universalized, undifferentiated category of "the human." This view posits an archetypal universal "man," who, absent of any social location such as race, or class, or gender, dis/ability, ethnicity, nationality and so on has been labeled as a parasite, or worse, a cancer on the planet.[1] The main characters in this cultural narrative are the ecologically malfit and malevolent humans who exist apart from nature, who lack belonging, are out of place; who through their artifacts, cities, roads, and other cultural trappings are constituted as corporeally and ethically unconnected to the natural world. Narratives of human ontological separateness from non-human nature are responsible for producing such discursive interventions as the infamous letter-to-the editor from "Miss Ann Thropy" published in 1987 in the radical environmental journal *Earth First*!,[2] which remarked that AIDS is a positive thing for the planet from the perspective of an ecocentric radical environmentalism.

There's a flip side to the story of the human/nature binary however, this time told from the perspective of humanist struggles. Another stereotype this view asserts that those who care about social justice should not be overly concerned with problems extant to non-humans because environmental problems are not relevant (or at are best subordinate) to more pressing exigencies such as social inequality, discrimination, and oppression. Serving as mirror image to the view that humans are planetary ecological aliens, this view is founded on the notion that nature is something *out there*, removed, displaced from the social and cultural dwelling-places of people and the sites of human community. In *this* story nature and its moral and political status is not relevant to human concerns. Nature may serve as

[1] The view of human society as a cancer was portrayed, for example, in *The Population Bomb* (New York: Ballantine Books, 1971), the influential book by Paul Ehrilch who wrote that "A cancer is an uncontrolled multiplication of cells; the population explosion is an uncontrolled multiplication of people" (p.152)

[2] *Miss Ann Thropy* is the pseudonymous used by Christopher Manes to publish about population and AIDS in the Earth First! newspaper in 1987.

the background, the backdrop, the underlying substrata for human endeavors that provides culture's raw material, but environmental problems are fundamentally irrelevant to human problems of inequality and injustice—in fact, practicing environmentalism serves as distraction, is infused with class and race privilege, and examining our attitudes and values regarding the natural world won't get us very far in solving pressing social issues such as racism, gender discrimination, and poverty—or so the doxa goes.

Though both of these positions have been here caricatured and extremized, they clearly illustrate the limitations and problems of some of the prevailing Western worldviews So, how are we to reconcile these views, resolve this tension between anthropocentric humanist concerns for justice and a deep environmentalism? How can we move away from the human/nature dualism assumed by both these camps? How can we overcome the oppositional attitude this dualism produces, so that we can reform our scientific and political practices such that the possibilities for justice are increased?

This chapter aims to contribute to this indispensable task, and offer an alternative framework for thinking through the issues, by exploring the intersection between two major strains of environmental thought and praxis, *environmental justice* and *ecofeminism*. It explores how these distinct but related arenas of ecosocial activism can cross-fertilize to better pursue their liberatory goals by deploying an intersectional ecofeminist perspective. Such a perspective significantly aids in the analysis of the conceptual and material linkages between the degradation of natural places and the marginalization and oppression of human communities. Most importantly, it aims to show how the critique of unequal power relations, both intra-human and that between humans and what ecophilosophers term "the more-than-human world" can help scientists and policy makers to comprehensively address current environmental issues, such as global climate change, environmental racism, biodiversity loss, inegalitarian social arrangements, and recognition of ecosystem services in remote, rural, and urban areas.

21.2 Environmental Justice and the Need for an Intersectional Ecofeminist Perspective

Struggles for environmental justice that do not incorporate an explicitly gendered and ecofeminist analysis of ecological problems will not adequately understand the ways in which systems of oppression (such as racism, gender discrimination, and environmental degradation) are interconnected and mutually reinforcing. Such an analysis thus will be less powerful and effective. For this reason, ecofeminism, a political movement and theoretical stance which identifies and articulates these interconnections, is a necessary intervention into discussions and debates about how to alter the fact of environmental injustice.

Ecofeminism represents a unique moment within both environmental and feminist theorizing, explicating how it is that the association of women with nature so prevalent in Western conceptual frameworks (e.g. "Mother Earth", "Mother Nature".) has been deployed to justify their mutual oppression. As ecopolitical theorist Noël Sturgeon explains (1997: 23): "Ecofeminism is a movement that makes connections between environmentalisms and feminisms; more precisely, it articulates the theory that the ideologies that authorize injustices based on gender, race, and class are related to the ideologies that sanction the exploitation and degradation of the environment."

Central to feminist projects of all sorts are discussions of dualism: conceptual pairings which posit radical separation as well as radical opposition between members of a disjunct, privileging one side while simultaneously subjugating its companion. Feminist theorists find that such dichotomies as male/female, reason/emotion, white/colored, transcendent/material, culture/nature, mind/body, human/animal, and theory/practice tend to appear frequently within the process of dualism. Such pairings are gendered, in which the first term is associated with maleness and masculinity, thereby subordinating the female-identified second term. According to many feminist theorists (see Plumwood 1993; Hartsock 1998; MacKinnon 1989; Warren 1990), dualism is the process by which "difference gets construed as domination," suggesting that dualistic thinking depends on notions of dominance and superiority in which gender and sex become sites of struggle for social and institutional power. One of ecofeminism's greatest theoretical strengths is in its analysis of the way in which the more-than-human world is also subjected to the subordinating process of dualism, that nature is perhaps the ultimate "Other" upon which the human self gets constructed. Thus a core feature of ecofeminist thought is the rejection of false binaries and dualisms such as the human/nature dualism upon which the aforementioned attitudes are predicated, as well as a refusal to privilege "ecological" concerns over so-called "humanist" ones, and vice-versa.

Ecofeminists argue that the same value systems that in Anglo-European metaphysical systems of dualism associate women with nature also have historically regarded persons of color as "closer to nature." These systems have constructed women and people of color as belonging to the degraded categories of corporeality, emotionality, and immanence where they are considered "less rational" and "less human" than the dominant group. Among the ethical effects of such ideologies are the rendering of such persons, along with women and nature, as subordinate, able to be dominated, as exploitable resource. Because both women and nature, along with people of color, have been associated with the body, those so identified are then put in opposition to the more "masculine" realms of the mind and reason/rationality. The natural world is associated with the body as well, and since rationality/maleness/ transcendence/human-ness are privileged categories in western thought, while embodiment/femininity/materiality/animality are cast as subordinate, according to what the ecofeminist philosopher Karen Warren (1990) calls the "logic of domination," those beings who have membership in the first category are putatively entitled to dominate and exploit whatever lies in the second category.

Ecofeminism's analysis of the processes through which gender, racial, and ecological oppression are connected is not merely conceptual. It also shows how these ideological connections are dialectically entangled with the material condition of women and other oppressed groups. Many ecofeminist theorists have directly incorporated the concerns of environmental justice into their work, and have revealed the large presence and participation of women in the environmental justice movement. According to environmental historian Carolyn Merchant (1996: 161),

> Environmental equity is an ecofeminist issue. The body, home, and community are sites of women's local experience and local contestation. Women experience the results of toxic dumping on their own bodies (sites of reproduction of the species), in their own homes (sites of reproduction of daily life), and in their communities and schools (sites of social reproduction). Women's leadership and organizing skills gained in grassroots struggles empower them to change society and themselves.

Ecofeminism, by placing gender at the center of its analysis of environmental problems, also helps to make visible the ways in which women, and especially women of color, are particularly and specifically affected by ecological degradation, contamination, and by global problems such as climate change. Globally, women comprise over 80 % of grassroots environmental activists (Merchant 1996: 60), and women are frequently motivated to become active when the health and well-being of their children, families, and communities is negatively impacted as a result of environmental problems. Women's socially-assigned role as caregivers positions them, for example, to notice when local industries are having a deleterious effect on human and environmental health. Women are also affected by the presence of environmental pollution through their reproductive capacities, as when they experience such problems as miscarriage and birth defects, contaminants in breast-milk that enters the bodies of infants, and breast cancer, whose precipitous rise, like so many other cancers, experts agree are attributable to environmental causes (Steingraber 2001). Moreover, although persons of all genders are affected, of course, by harmful substances in air, water, and food, women's lives are in many ways more deeply impacted since women are the ones who typically must care for those who fall ill, and who world-wide are assigned the labor of the reproduction and maintenance of daily life.

One measure of the efficacy of ecofeminism for the environmental justice movement lies in its ability to simultaneously operate on the practical and conceptual levels to discern how it is that women, persons of color, the poor, and nature are mutually degraded and exploited through, to use the phrase of feminist cultural theorist bell hooks, "white supremacist capitalist patriarchal" systems, institutions, and ideologies. Lastly, but perhaps most importantly, ecofeminism, through its thoroughgoing conceptual analysis and challenge to normative dualisms, especially its interrogation of the nature/culture dualism, helps us understand why it is that issues of gender and racial justice, and environmental health, must be addressed together. Ecofeminism can help environmental justice advocates avoid reinscribing a bioculturally[3]-destructive normative dualism, by discouraging civil rights advocates from asserting that environmental concerns ought be subordinate to social justice concerns.

Environmental justice movements are not, of course, confined to North American and U.S. contexts; and nor is ecofeminism. And in fact, the global focus on challenging historically-sedimented forms of economic imperialism, tied to racist and ecologically-exploitative histories of colonialism and present-day neo-colonialist practices, is a hallmark of each movement, as each attempts to challenge the myriad ways in which power gets exercised over women, indigenous peoples, the poor, and other human groups who have been marginalized because of their constructed association with the categories of nature and/or the feminine. For example, in a Latin American context, *concheras,* women engaged in the collection of shrimp and other shellfish in coastal Ecuador, are subject to hardship and discrimination based on both their ethnic status and because of the depletion of the ecological resource upon which their livelihoods and cultural survival depends: the shrimp, critters (like all critters) who require a healthy and flourishing ecosystem. To protest and draw attention to the interconnections between their subordinate social status and the ecological exploitation visited on costal shrimp habitat by multinational corporations and the global economic system, the women *concheras* issued a communiqué which makes this interconnection, and the need for sustaining both, plain. As reported in Rozzi (2012), they asserted that:

> We have always been ready to cope with everything, and now more than ever, but they want to humiliate us because we are black, because we are poor, but one does not choose the race into which one is born, nor does one choose not to have anything to eat, nor to be ill. But I am proud of my race and of being *conchera* because it is my race which gives me strength to do battle in defense of what my parents were, and my children will inherit…Now we are struggling for something which is ours, our ecosystem, but not because we are professional ecologists but because we must remain alive…. (Rozzi 2012: 45)

Rozzi goes on to explain that "Biocultural ethics emphasizes that to achieve equity and sustainability we have to go one step further, and overcome the colonial anthropocentrism by regaining a perspective of co-inhabitation that integrates the well-being of both human and other-than-human beings" (Rozzi 2012: 46). Such statements, by both activists and theorists, illustrate that indeed, ecological issues not only have particular cultural manifestations, but are raced and gendered as

[3]The term *biocultural* is adapted here from its original use by Latin-American Environmental Philosopher Ricardo Rozzi, who has deployed the term in several publications and has been one of the primary founders of the Sub-Antarctic Biocultural Conservation Program, an international program in Cape Horn, Chile (http://chile.unt.edu/). *Biocultural*—a term containing no hyphen or slash—is a term that highlights the ways in which the biological/ecological is intimately intertwined with the cultural/social; disrupts the notion of an ontological separateness between the human and the more-than-human worlds, and how preserving and protecting one necessarily entails protecting the other—a notion quite in line with the fundamental premises of environmental justice *and* ecofeminism.

well—and that equity and sustainability go together. The *concheras* are women, women of African descent, whose cultural identity and engagement with the more-than-human world is irrevocably tied to particular ecosystems and ecological practices. Thus an ecofeminist lens brings into focus how the power of white supremacist Anglo-European capitalist patriarchy operates to marginalize women and nature simultaneously. An ecofeminist lens, in short, enables us to think gender, nature, race, class, nationality, and culture together, so that the exploitations common to all, both conceptually and materially, can be confronted.

21.3 Conclusion

I have argued here for the deployment of an intersectional ecofeminist perspective as a way to strengthen the environmental justice movement. An intersectional analysis of issues of race, class, and gender should be adopted by those involved in the environmental justice movement so that these theories' understanding of the causes and function of social inequality can be applied to the quest for environmental justice. An ecofeminist perspective enables the cultivation of an ability to think nature and culture together, to escape the ecosocially-destructive consequences of dualism. Ecofeminism also can help us to diagnose racism when it appears alongside environmental destruction, can help us see how the ecological harms are inequitably distributed and spur us to ask why the harms are disproportionately placed on women and people of color—locally *and* globally. Ecofeminism moreover makes visible the associations among women, people of color, and emotionality that sometimes appear in discursive representations of environmental struggles. Finally, an intersectional ecofeminist analysis helps us to use theory more effectively as a tool and site of environmental resistance and activism.

The current state of environmental discourse is valenced toward viewing environmental issues as problems for science and not issues of social justice, ignoring the fact that not all groups of humans are situated equally in regard to ecological degradation and exposure to environmental toxins, as a direct result of the histories of colonialism, racism, and sexism that continue to be visited on subordinated groups. Ecofeminist understandings of nature and the environment are predicated on the notion that human beings are ontologically *connected*, living in webs of human-nature relationality. Such a perspective also helps us to understand the ways in which oppression for various "out groups," *including nature,* is conceptually and materially entangled. Such an understanding asserts that the tools and methods of liberation for these groups are related, although importantly distinct. Ending oppression in one arena requires that we interrogate the way that similar practices of domination and subordination are at work in other areas of ecosocial life. To the cause of environmental justice such explication of the ways that the poor, people of color, women, and the more-than-human world become mutually degraded through "white anthropocentric capitalist patriarchy" is especially helpful.

Unlike conventional scientific epistemologies which dominate much environmental science, ecofeminism and environmental justice admit particularized or "local" knowledges as alternative epistemologies into our knowledge-generating practices. Environmental justice advocates, such as legal scholars Robert Collin and Robin Morris Collin (1998) and professor of environmental science Giovanna DiChiro (2008), have argued that local knowledges are absolutely essential in compiling the empirical data necessary to show that a local land use is harmful to a community's human and nonhuman residents. For example, knowledge of information as diverse as what time the local factory tends to emit its foulest odors to how many in a particular block have been diagnosed with cancer to how much of a village in Alaska has fallen into the sea lately or how sparse the hunt has been to who has recently experienced a miscarriage. An intersectional ecofeminist analysis can usefully inform and organize the struggles of those who are concerned with environmental justice, through its challenge to conventional rationalist, "dispassionate" epistemology and scientific methodology, as well as its relentless insistence on examining social and environmental justice together, as products of the same conceptual frameworks and social and economic systems that dominate western culture. The focus of ecofeminism is not simply on women's relation to nature but is a thoroughgoing critique of power; of the way that dominant socio-ethico-political systems and structures perpetuate ecosocial harm. As Noël Sturgeon stated, "feminism isn't just about women but is about power and its intersections and manifestations" (1997: 23). By the same token, environmentalism is not simply about "preserving" nature but concerns itself with the ways in which the more-than-human world is constructed as an "Other" available for exploitation and degradation. The struggle for environmental justice provides an important opening within science and policy for a rethinking of the relationship between human communities, state power, subordinating practices and institutions, and the natural world in which every human community is embedded.

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Part IV
Ecosystems: Science, Values, and Action

Chapter 22
Introduction to Ecosystems: Science, Values, and Action

Steward T.A. Pickett

Abstract In the early twenty-first century, the branches of ecology are much more intertwined than in the twentieth century. Part IV, "Ecosystems: Science, Values, and Action," further develops crucial theoretical and practical linkages between ecology and ethics through interdisciplinary, international, collaborative teamwork among ecologists and philosophers. It begins with two chapters on theoretical frameworks that have contributed to a shift in ecological worldview: *the f ux of nature*, and *hierarchy theory*. Steward Pickett provides a novel view of the shift in paradigm from the classical worldview based on the *balance of nature* to the new *f ux of nature*, which acknowledges the openness of ecosystems, the regulatory role of external influences, the lack of a single stable end point to dynamics, the relevance of disturbance and probabilistic dynamics, and the role of humans as components of ecosystems. Jianguo Wu introduces hierarchy theory to understand ecological and social systems as self-organizing, with a modular, nested structure, in which scaling relationships and partial decoupling are essential. To cope with contemporary socio-ecological systems, it is indispensable to move from prevailing reductionist approaches toward systemic, complex thinking. The next four chapters address contemporary socio-ecological challenges in economy, governance, and education. Shahid Naeem critiques ecosystem services, and proposes to move from a focus on human wellbeing to a framework that sees humanity as a contributor to the wellbeing of the biosphere as a whole. Stephanie Pincetl focuses on questions of fairness, justice, and power associated with city governance, considering the environmental needs and benefits in disadvantaged communities. Based on her long-term ecological studies in Los Angeles, she criticizes the ongoing shift from the government model developed for the modernist "sanitary city" toward a neoliberal "opportunistic city." Nalini Nadkarni highlights that ecosystem ecology provides a powerful framework to understand the environment, and the key is to enhance the capacity of ecologists to

S.T.A. Pickett (✉)
Plant Ecology, Cary Institute of Ecosystem Studies, Box AB, Millbrook, NY 12545, USA
e-mail: picketts@caryinstitute.org

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communicate and share ecological knowledge with people outside of academia, particularly with underserved audiences and those who have little exposure to science and nature. In the final chapter, Alexandria Poole and collaborators analyze the barriers to addressing ethics in education. Based on ongoing education programs in different regions of the Americas, from the United Sates to Chile, they show that conceptual frameworks and methodologies are available for an academic, interdisciplinary education of ecology and ethics both in school and higher education.

Keywords Ecosystem services • Environmental education • Hierarchy theory • Paradigm • Sustainability

A major purpose of this book is to lay out the constraints, opportunities, benefits, and pathways for improving the linkage between the science of ecology and the theory and practice of environmental ethics. The six chapters in this part together suggest a shared message.

- The dialog between ecology and ethics involves science, philosophy, individual people, social processes, and institutions;
- Each of these participants in the dialog between ethics and ecology is complex, and each employs a subtle intellectual structure suitable to sophisticated analysis;
- Understanding the complexities of each participant can identify points at which issues of value and unexamined values themselves can advance or inhibit the linkage.

Consequently, the intellectual structures exposed and the values highlighted can be used to go beyond problematic assumptions or naïve, often subjective assertions that thwart the deep analysis that can move the dialog along.

Chapter 23. Contrasting and shifting paradigms are one aspect of the complexity of ecological science that is relevant to its connection with ethics. Steward Pickett summarizes the predominant paradigm of contemporary ecology, plus several subparadigms that shape scientific research and application. Ethical application might have different shapes depending upon the paradigm employed in such application. The contemporary worldview of the flux of nature replaces one that was promoted by social values of stability, balance, and uniformity in nature. Objectivity under this new paradigm results from an open system of interrogating data and interpretations proposed by diverse members of the research community. Indeed, diversity of perspective, motivation, experience, and interest in the conversation contribute to the self-correcting process that is scientific objectivity (see Chap. 17 by Longino).

Chapter 24. Jianguo Wu explores hierarchy theory as a major conceptual structure that embodies a great deal of the complexity of contemporary ecology. Notably, hierarchy is not used here in the sense of social rank or chain of command, nor does it assume externally imposed decision making. However, at one level, hierarchy theory is a powerful metaphor, which deals with the *nested* and scalar structure of biophysical and social systems. The metaphorical dimension is, as in the paradigm of ecology, a doorway for the interaction with values. Hence, ethics can be informed and can address the issues of hierarchical structure in its dialog with ecological science.

The next four chapters deal with applications of ecological knowledge in the context of values of various sorts. In Chap. 25, Shahid Naeem critiques ecosystem services. He posits that focusing services on human wellbeing is flawed: It is too subject to instrumental values and monetization; it neglects processes and species that would be deemed irrelevant to human utility; and it could, if successful, lead to a fragile biosphere mostly filled by people and their domestic creatures and landscapes. Why not, he asks, explore the ethical implication of a framework that reverses the arrow, and sees humanity as a contributor to the wellbeing of the biosphere upon which it still ultimately depends?

Chapter 26, by Stephanie Pincetl, focuses on the shifting way in which power is used as cities struggle to become more sustainable. Questions of fairness, justice, and power arise pointedly in considering the environmental needs and benefits in disadvantaged communities. However, as the government model developed for the modernist "sanitary city" retreats in the face of neoliberalism and the seemingly unassailable desire for shared governance, unexpected negatives appear: Decision making splintered between formal government and non-governmental actors often lacks accountability and transparency. The ethical fault is that the values of the unempowered and disenfranchised will be neither recognized or honored by in this emerging governance philosophy, labeled the "opportunistic city."

Chapter 27 also attends to audiences who are often off the beaten path of scientific information. Nalini Nadkarni focuses on bringing appreciation, understanding, and experience with science to the vast majority of the public who are not aware of the nature and utility of science. She documents the size and internal diversity of this "audience" and presents stunning examples of success at engaging them in scientific understanding. Her clients, or perhaps, partners, range from religious congregations, to legislators, to incarcerated men and women. Lessons learned are summarized, and the power of seeking shared personal interests as the starting point for conversations is shown.

Chapter 28 explores the linkages of ethics and environmental education. Alexandria Poole and collaborators analyze the barriers to addressing ethics in education, but are convincing in arguing that people need to be literate about ethics in understanding and making environmental decisions. They explain how the two century culture war in the US has expunged ethics from public education, and left people unprepared to either understand or make sophisticated ethical arguments. The crippling effect of this cultural controversy leaves most people thinking that ethics are "feelings" that are entirely subjective, rather than a set of multifaceted philosophical stances that can be analyzed and discussed. There is great need to establish educational processes that admit the role of values – in addition to data – in making environmental decisions. There is also great need to have systematic educational, training, experiences guided by ecologists and philosophers together as illustrated by the case studies included in this chapter.

There are several themes that emerge throughout these six chapters.

- Science and ethics should not be expected to become the same thing. However, the bridging of these realms is crucial. The complexity of both ecological science and ethics need to be understood. Keeping their distinctive features in mind can facilitate dialog between them.

- Two chapters in this part highlight the multiple paradigms of ecology, and some of its flexible core concepts and theories, such as ecosystem theory and the theory of nested hierarchies. All ecological concepts have three dimensions. These are the abstract definition, the operational models, and the summarizing metaphors. Metaphors can alert people to the cloud of values that hover about a concept. However, using the concepts requires acknowledging the technical models and data they employ, along with the connection to values.
- Ethics is similarly complex, and that has been the weight carried by the first three parts of the book. In this part, the complexity of ethics and the philosophies that support them, emerge in two conspicuous ways. First, it supports Naeem in his questioning the appropriateness of an ecological services paradigm that points the arrow of benefit from nature to humans. An ethical analysis is implied and invited by his assertion that the benefit of nature's services ought to flow to the entire biosphere.
- The complexity of ethics is also exemplified by the role of power and fairness in emerging governance arrangements, and the inclusion of novel audiences in the generation and use of scientific understanding. Power controls the distribution of services and burdens, and the participation of people in both ethical and ecological decision processes.

This part, as a capstone for the book, shows the complexity of both science and ethics, and the benefits of understanding their distinctions while developing a bridge between them based on a shared understanding of the role of philosophy, assumptions, and values in both of those complex realms. Much is made of common vocabulary in such situations, but more important still is the quest for common meaning (Bohm 1996). Simply sharing the same words can be a snare and a delusion. Bridging ecology and ethics is too important to let sink into a mere shared vocabulary. Environmental and ethical literacy, and environmental appreciation and decision making will only benefit from something much deeper.

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Chapter 23
The Flux of Nature: Changing Worldviews and Inclusive Concepts

Steward T.A. Pickett

Abstract The interaction of ecology and the study and application of environmental ethics can be facilitated by understanding the status of the fundamental background assumptions of the science. The classical paradigm of ecology, now superseded, focused on organisms and framed the science in a primarily equilibrium perspective. Steady state, homeostasis, and stability were hallmarks of ecological systems under this worldview. With the benefit of hindsight, the specific assumptions of the equilibrium paradigm are seen to be that (1) ecological systems are materially closed; (2) they are self-regulating; (3) an equilibrium state exists for each system; (4) disturbance is rare or negligible; (5) recovery from any disturbance that does occur is deterministic, and leads to the expected equilibrium state; and (6) humans are external to ecological systems and are a negative force. As the organismal viewpoint gave way to more inclusive theories, such as the ecosystem and landscape ecology, and data sets extended for longer periods of time, it became clear that the equilibrium assumptions did not always hold. The shift in worldview occasioned by new data as well as by conceptual flexibility, can be summarized by a new inclusive or non-equilibrium paradigm. It accepts (1) the material openness of ecological systems; (2) the role of external regulation; (3) the absence or transience of equilibrium states; (4) the commonness and significance of natural and human-caused disturbances; (5) the multiple pathways of system dynamics, and (6) the pervasive involvement of human actors, both local and distant, in ecosystems. Ecological concepts engage technical definitions, technical models, and metaphorical implications that are relevant to their connections with ethics.

Keywords Ecosystem • History • Metaphor • Paradigm • Social-ecological system

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S.T.A. Pickett (✉)
Plant Ecology, Cary Institute of Ecosystem Studies, Box AB, Millbrook, NY 12545, USA
e-mail: picketts@caryinstitute.org

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23.1 Introduction

Considering worldviews exposes several complexities within the science of ecology. Because worldviews can shape the relationship of science and ethics, at its best, exploring the complexity of ecological paradigms may smooth the way for linking ecology and ethics. At least, such exploration can mark the sharp curves and rough spots in the road. Therefore the major goal of this chapter is to expose key aspects of the paradigms in ecological science. This complexity is expressed across the topic areas that the discipline covers, and across time, reflecting the changes that ecological paradigms have undergone.

23.2 Ecology's Initial Paradigm

The science of ecology grew out of the great eighteenth and nineteenth century flowering of biology. Ecology merges important threads from taxonomy, biogeography, physiology, anatomy, and evolution. These root sciences inform us about the diversity, distribution, internal functioning, internal structure, and change in organisms. Ecology as the inheritor of the riches of these older research traditions clearly is centered on organisms. However, it took the concerns of these other disciplines outside of the laboratory, and was originally considered by some to be field physiology. Broader definitions dubbed it the science of the relationships between organisms and environment. The organisms were the system and the air, water, materials, and physical conditions were then the environment.

The first ecological theories were shaped by two sciences in particular; one was biological and the other was not. Ecology was launched in the shadow of the master science of the nineteenth century, Newtonian physics, from which it learned determinism, direct causality, and ahistorical explanation. In addition, the progress-oriented interpretations of Darwinian evolution served as a model of ecological dynamics. This second fact may seem odd, given that natural selection, the principal mechanism of Darwinian evolution, says nothing about progress or "direction" of change.

The first paradigm of ecology therefore focused on organisms – mainly plants and animals – and sought explanation of change and regulation within conspecific populations or co-occurring assemblages of different species. Competition and predation were the predominant mechanisms proposed, and research into limiting factors and adaptation of species to physical conditions were important frontiers. The environment, the complex of physical and chemical factors and conditions external to organisms, was most often taken as a fixed background. Change in assemblages was directional and progressive, and led to stable collections of species. Emphasis was on the equilibrium conditions that emerged from organism interaction, and disturbance and disturbed sites were neglected as research topics (Simberloff 1980). Behind all these assumptions about organisms and their interactions, lurked another assumption – that the organisms of interest did not include humans (McDonnell and

Table 23.1 Background assumptions of the equilibrium paradigm

1	Ecological systems are materially closed.
2	Ecological systems are self-regulating.
3	An equilibrium state exists for each system.
4	Disturbance is rare or negligible.
5	Recovery from any disturbance is deterministic and returns to the equilibrium state.
6	Humans are external to ecosystems, and are a negative force.

Pickett 1993). This last was in spite of attempts by some researchers to include humans among the research topics in the earliest issues of America's then new journal, *Ecology*. The founding assumptions seem clear to us after decades of hindsight as components of a worldview, or a paradigm (Table 23.1).

This worldview, labeled the "equilibrium paradigm" (Pickett et al. 1992), flavored many generations of textbooks, and was associated with the dominant streams of ecological research (Botkin 1990).

23.3 Emergence of the Ecosystem

If ecology's first emphasis was on organisms and their interactions, it's next emphasis highlighted the feedbacks between organisms and environment. An early version of this was the *reaction* of the environment to the presence and activities of plants through the process of succession. Frederic Clements, the predominant theorist of vegetation change in ecology's pioneering decades, noted that an environment occupied by plants undergoes change as a result of the structures and activities of those plants (Clements 1916). As a consequence, the environment itself changes, and different plants are then favored. Hence, a feedback between plants and environment was a core process in his theory of succession. Clements' focus on the feedback was shaped by his attention to the adaptation of organisms to their environment. He used the metaphor of the community as an organism to symbolize the tightness and power of the feedback.

Many ecologists found Clements' use of the organismal metaphor harmfully inexact and problematical. Therefore, Arthur Tansley, perhaps the premier British plant ecologist of his day, mounted a critique of Clements' framing (Tansley 1935). As an antidote to the Clementsian metaphor, Tansley proposed the ecosystem concept in 1935. He claimed to use the concept of *system* in precisely the way it was used in physics, as a entity comprising other interacting entities. This concept allows analysis of components and interactions in the context of the larger collection, but also allows the properties and functioning of the more inclusive entity to be understood and characterized. The system concept provides more scientific utility than the organismal metaphor, which explains by analogy rather than mechanism.

Table 23.2 Background assumptions of the contemporary, non-equilibrium paradigm

1	Ecological systems are materially, energetically, and informationally open.
2	Regulating processes and events may arise outside of a focal ecological system.
3	There are many states a system can take, and there may be no single equilibrium.
4	Disturbance is a recurrent feature of natural systems.
5	Response to disturbance may be non-linear and exhibit multiple pathways and persistent states.
6	Humans and their effects are part of virtually any ecosystem on Earth.

Tansley's stroke of brilliance was to indicate that organisms and environment were in fact part of a single system. Recall that when ecology is seen as the study of organisms and interaction, that the organisms are the system, and the physical and chemical conditions are the surrounding environment. Tansley flipped the perspective, and indicated that the organisms were also part of a larger system. He defined this more inclusive, organism-based system as the ecosystem. Such systems would have to include what had previously been the external conditions – called the environment when the focus was on organisms as systems themselves. This step introduces the potential for confusion about the term "environment," however. The confusion is dealt with by specifying the model of the system of interest: what are the components, what are the interactions, what is the spatial boundary, what is the temporal scale? This approach is powerful enough in its generality and precise enough in its specification not to need the organismal metaphor to move it forward in research.

The ecosystem concept took several more decades to mature into a focus for research and a tool for application in mainstream ecology (Golley 1993; Hagen 1992). It eventually supported coarse scale budgetary approaches, in which inputs and outputs of large systems were documented, and in which the internal flows among living and non-living components were traced (Odum 1971). It compared systems of different ages and different positions on gradients of stress (Bormann and Likens 1979; Likens 1992). It ultimately began to focus on the roles of species, including composition and richness (Jones and Lawton 1995), and the effect of spatial heterogeneity within ecosystems on their structure, functioning, and change (Lovett et al. 2005). In addition, material and non-solar energy subsidies from outside a spatially delimited ecosystem were discovered to be common and important. As ecosystem ecology developed, a "process approach" took hold that broke budgets down into their component fluxes, pathways, and controls. Furthermore, ecologists came to study and understand systems that were far from compositional or biogeochemical equilibrium. Finally, ecologists came to recognize that people, their activates, and their structural legacies were often cryptic components of the ecosystems they had been studying as if pristine (McDonnell and Pickett 1993). The changes in focus and content during the maturation of ecosystem science helps complete the emergence of the contemporary paradigm in ecology (Table 23.2).

Is it a coincidence that Aldo Leopold (Leopold 1949) was struggling with how to conceptualize and recognize larger systems beyond individual organisms at roughly the same time that the ecosystem idea was being proposed and first put into play in research? His idea of a community of the land seems to have some of the same features as the ecosystem concept. It encompasses all the organisms – including humans – in a specified area of landscape. Although Leopold's poetry is hard to beat, it seems that his thinking has clear parallels to the emerging science of ecosystem ecology. He might have found the ecosystem concept useful had it been available and widely accepted. That was not to happen until the 1950s and 1960s.

23.4 Emergence of Inclusive Paradigms of Ecology

The individual-based approach of organismal ecology and the material-centered approach of ecosystem ecology are the bookends one of the major contrasts within the science of ecology (Pickett et al. 2007). Although research has increasingly exploited some combination of these approaches, much empirical work and conceptualization lies toward the extremes. The informal tag for this contrast is a conceptual axis of "things versus stuff."

A second contrast in ecology is the focus on contemporary, instantaneous relationships compared to a focus on history and echoes of the past as controls of current system structure and process. Contemporary or instantaneous causation was favored by the classical physics model of "good science." However, as ecologists accumulated increasingly long-term data on existing systems, or were able to extend their understanding by using paleoecological or historical records, the role of past system states became clearer. This methodological axis contrasts "then versus now" as the second paradigm within ecology. Together, the things-stuff and then-now axes define an ideal for integration in ecology (Fig. 23.1). The most comprehensive explanations and models will consider organismal and other structural entities – things – and the fluxes of materials, energy, and information – stuff. Comprehensive models or suites of models will also consider contemporary causal links, legacies of past interactions, and gradually emerging indirect effects – that is, both "then and now" (Cadenasso et al. 2006).

A third dimension of conceptualization in ecology is relevant to both these internal paradigms. In the early days of the discipline, researchers introduced the radical idea that ecological systems were not static. The theory of succession, introduced to codify, exploit, and test the implications of this assumption, was progress-oriented and deterministic, and proposed simple pathways of change. However, two things challenged this worldview. One, as ecology got older, so the data sets on system dynamics got longer (Weatherhead 1986). This accumulated knowledge showed multiple pathways of succession (Johnson and Miyanishi 2008), the common failure of an expected "climax" composition to emerge, and the pervasive role of natural disturbances (Botkin 1990; Pickett et al. 1992).

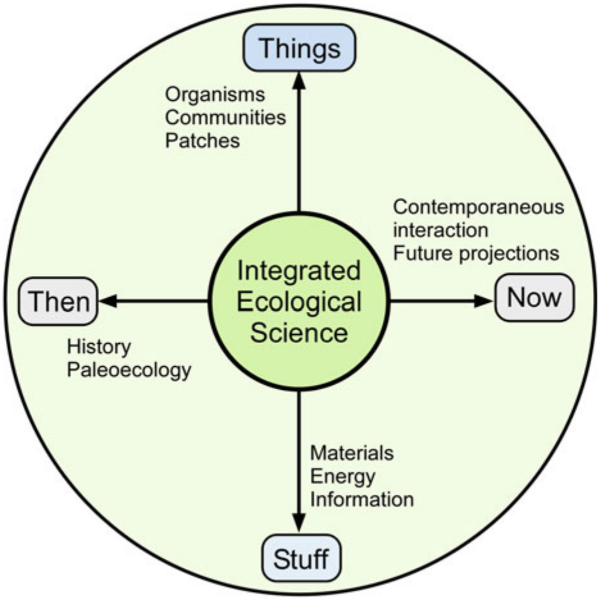

Fig. 23.1 The two axes of contrast in ecological science (Based on Pickett et al. 2007)

23.4.1 *The Inclusive Ecosystem*

The conceptual axes outlined so far suggest a space in which the ecosystem concept can be put to work. Combining that with the six points of the contemporary paradigm (Table 23.2) in fact suggests a more inclusive set of connotations for the ecosystem concept.

First, the ecosystem concept refers to any spatial scale. Some ecosystems can be walked into, some can be walked across in a day, and others can be trampled underfoot. As long as all the organisms, their interactions, and a boundary are specified, the concept is appropriate (Pickett and Cadenasso 2002).

Second, although the holological and biogeochemical approaches have characterized ecosystem ecology, focusing on organisms and diversity within ecosystems is productive. The identity of species in biogeochemical processes and the role of species diversity with its issues of redundancy and replacement are also appropriate concerns for ecosystem ecology (Jones and Lawton 1995).

Third, spatial heterogeneity is important for ecosystem structure and processes (Lovett et al. 2005). Internal heterogeneity may set up "hotspots" of transformation of energy and matter. Heterogeneity may affect the existence or location of sources and sinks for materials in ecosystems. Such heterogeneity may originate as part of a relatively permanent topographic template, or be the result of rapid growth of organisms or sudden mortal events. Heterogeneity is also important when looking beyond the modeled boundaries of an ecosystem. What other systems are nearby,

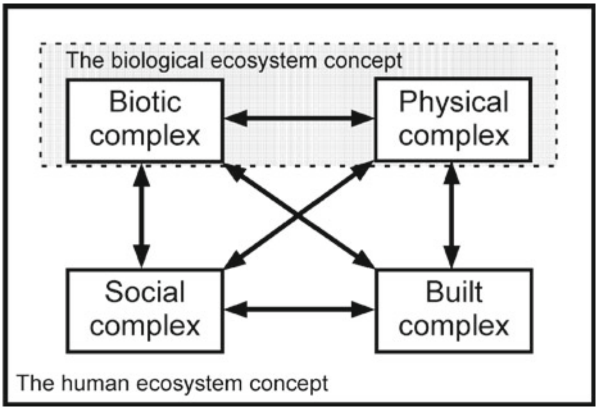

Fig. 23.2 The ecosystem concept of Tansley (*top portion*) with explicit addition of human and constructed elements. Additional pathways of interaction are required by this expansion compared to the original definition of Tansley

and whether the boundaries are permeable or resistant to the fluxes across them are important aspects of heterogeneity. In other words, not only internal but contextual heterogeneity can influence ecosystems (Pickett and Cadenasso 2013).

Fourth, the inclusive ecosystem recognizes humans as components. Such membership can be expressed in several ways. Humans may be internal agents within an ecosystem, responding to and affecting local conditions, pools of resources, and fluxes of resources and wastes. However, human agency may also operate from a distance, as when plumes of pollution from remote sources arrive via water, air, or infrastructure. Human artifacts are also parts of ecosystems. People modify such things as the surface and substrate, and the species composition of managed and unmanaged assemblages. However, they also add built structures and infrastructure (Fig. 23.2).

Finally, the inclusive ecosystem concept is temporally open ended. A model appropriate to such an open-ended conception of systems dynamics has emerged in the form of the resilience loop (Fig. 23.3). This model emphasizes that systems may experience repeated periods of growth and stabilization, disruption, and reorganization (Gunderson et al. 2002a; Holling 2001). Whether such dynamics result in fundamental shifts of a system from one array of states to another is the major concern of the resilience model. This model facilitates answering the question, “Does this system adapt or adjust to changing conditions, or does the system become fundamentally different?” The larger theoretical realm associated with this approach to ecological subjects is that of complex adaptive systems (Holling 2001). The resilience model takes this into account in a powerful way, though one that is still mostly metaphorical rather than mechanistic. This model focuses on system identity as defined by its content and interactive structure, and on whether that identity persists or adapts to internal and external changes (Jax et al. 1998). The ecosystem concept can also accommodate the direct and indirect actions and effects of humans (Pickett and Grove 2009). The original definition by Tansley was accompanied by a discussion of how important people are in ecosystems, and encouraging ecologists to study humans as agents and participants in ecosystems.

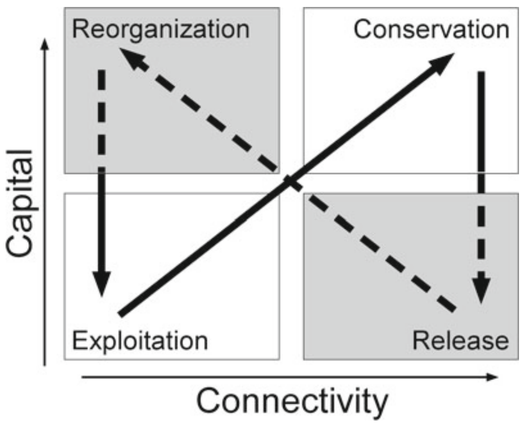

Fig. 23.3 The adaptive cycle of resilience theory. Resilience describes the movement of a system through a conceptual space defined by increase of incorporated resources, or capital, on one axis, and increasing connectivity within the system on the other axis. The *dark arrows* or parts of *arrows* represent the front loop of the cycle, which connects states represented by *white backgrounds*. The *dashed arrows* or parts thereof, represent the back loop of the cycle, connecting states in the *shaded boxes*. The reorganizing phase occurs in a resilient system after disturbance. Reorganization leads to exploitation of readily available resources. The conservation quadrant represents a system shifting to conservative life cycles and retentive material dynamics. The release phase represents the brittleness of a conservative system that is vulnerable to disturbance. This is a framework, not a model that predicts specific compositions or magnitudes of material and energy dynamics. Resilience is represented by the third dimension, or the capacity of the system to occupy both the back and front states of change (Based on Gunderson et al. (2002a))

23.5 Toward Application

The changing internal paradigms in ecology, the inclusive approach to the ecosystem, and the acknowledgement of an overall shift to a non-equilibrium worldview have altered ecology as a science. Contemporary ecology has emerged as "the scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the transformation and flux of energy and matter" (Likens 1992). This definition still is focused on living things and their actions and products. Some key activities to highlight are these: processes; interactions; and transformations. Key subjects are organisms, energy, matter, and information. Even though the term ecosystem does not appear in the definition of ecology, the new definition is well served by the inclusive conception of the ecosystem. This definition recognizes the breadth of the science, and its focus ranges from systems that are relatively less to those that are relatively more invested with human agency. It also can apply to individual organisms, populations of a single species, collections of many species, landscapes, and regions, as well as ecosystems, as already mentioned.

The definition above is not, however, the only thing affecting the application of ecology. The term ecology itself, along with its included concepts, has many connotations. All important ecological concepts are expected to have three dimensions that affect their application (Jax 2006; Pickett and Cadenasso 2002). One is the core technical definition. Core definitions are clearest when they are stripped down to their conceptual essence. The core definition of an ecosystem has already been mentioned. This definition has been seen to be scale-independent, inclusive of all organisms, and silent about equilibrium, stability, or robustness (Pickett and Cadenasso 2002). Another example can flesh out this idea of definitional generality. Succession as a core concept is simply the change in vegetation structure or composition through time. The definition does not say anything about end points, deterministic pathways, or mechanisms such as facilitation. This dimension of a core, stripped-down definition can be labeled "meaning."

The reason that meaning or definition is not enough for application is that many details are intentionally left out of the most general articulation of a concept. In order to use any ecological concept, the aspects of the concept that were omitted from the definition must be addressed through models. That is, a concept is *specified* or applied to real, experimental, or simulated situations through the use of models. It is in the models that assumptions about some of the silent details are laid out. The models clarify who the actors are supposed to be, and the kinds of dynamics they are expected to display. Hypotheses are derived from the models about how an aspect of the material world is expected to be structured or to behave under stated conditions. In other words, the models provide the tools that can test the assumptions about the specifics of mechanism, of context, and of behavior (Pickett et al. 2007). For example, in the case of succession, whether the change in a particular plant community is in the direction of increasing dominance by larger statured, slower growing species depends on the presence and frequency of intense disturbances, the availability of resources, and the openness of the area to migration, for example. A more detailed model is required to sort out such factors and the successional interactions that result.

There is a third dimension of any ecological concept: metaphor. Ecological concepts or terms often stand for values and vernacular assumptions about the living world (Larson 2011). Ecology itself can metaphorically stand for diversity, or stability, for example. Metaphorically, the term ecosystem in the public discourse can stand for integration, a discrete place, or a collection of organisms. Succession of vegetation brings to mind a stately, orderly process. The King is dead…. Even the term organism, mentioned with reference to pioneering theories in ecology, can itself be a powerful metaphor that suggests boundedness, integration, homeostasis, and development through an orderly life cycle.

Although metaphor is a powerful opening for conversation among different disciplines or between a science and practitioners, models soon enter as the vessels for empirical clarity, evaluation of claims, and testing hypotheses. Note that many of the attributes of ecological systems and processes embodied in the metaphors applied to them in fact call out assumptions about system structure and behavior. It is models which provide the tools to test such assumptions and to support adaptive application management employing ecological concepts and information. However, there are many cases where application rested on the bridge of metaphor alone, and relevant knowledge about structures, functions, limits, and constraints were not brought across a disciplinary divide. One example is the adoption of the organismal life cycle idea from biotic assemblages into the social ecology of the city (Light 2009). This move, made early in the twentieth century by the Chicago School of sociology was converted to a model of urban blight, and in that form was used to justify such things as mortgage "redlining" in the 1930s and urban renewal in the 1960s. This application resonated long after the initial organismal models of plant succession on which it was based had been challenged and replaced. Absent was a true engagement between the social ecologists and the bioecologists at the University of Chicago, or indeed elsewhere, that might have explored the models beneath the metaphor and alerted the social scientists to the shortcomings of the organismal approach they adapted from biology.

23.5.1 Application and Values

Application demands that values be in play. Some of these will be from society and some reflect the worldview of the science. What scientifically derived values attend the application of contemporary ecology? The prime value might be the respect for data about the actual behavior of ecological systems that challenged the idealized assumptions summarized as the old paradigm (Table 23.1). A second value in play is the desire to generalize across systems and to seek commonality of process. Of course, the fact that I used, without further comment, the word "scientific" in the definition of ecology above implies a set of materialist values about knowledge and its validation. Experts in philosophy and ethics may see other values hiding in the approach I have outlined here.

The relationship of sustainability and resilience may expose a way to think about values in the application of ecology. Sustainability is a socially derived conception that focuses jointly on environmental, social, and economic processes, to ensure that future generations and that people beyond those who benefit most directly from a development are not harmed by or excluded from relevant decision making (Berkes et al. 1994; Curwell et al. 2005; Holling 2001). That set of goals is freighted with values, and appropriately so. However, how is sustainability to be achieved and how is it to be assessed?

Resilience (Fig. 23.3) offers a framework for the mechanisms and the processes that might have to be manipulated and measured in the course of attempting sustainability, say in urban design, or in a resource-management system (Curwell et al. 2005). Whether and to what extent a socio-ecological system is resilient depends on the adaptive capacities within it. Adaptation, following evolutionary theory, is taken as the organizing device. Whether a system can adapt successfully to an internal or externally derived shock depends on such things as social capital, the availability and management of information, and material resources available (Yohe and Tol 2002). The biotic components of adaptive processes include resources, retention mechanisms available for limiting resources, genetic potential, and availability of

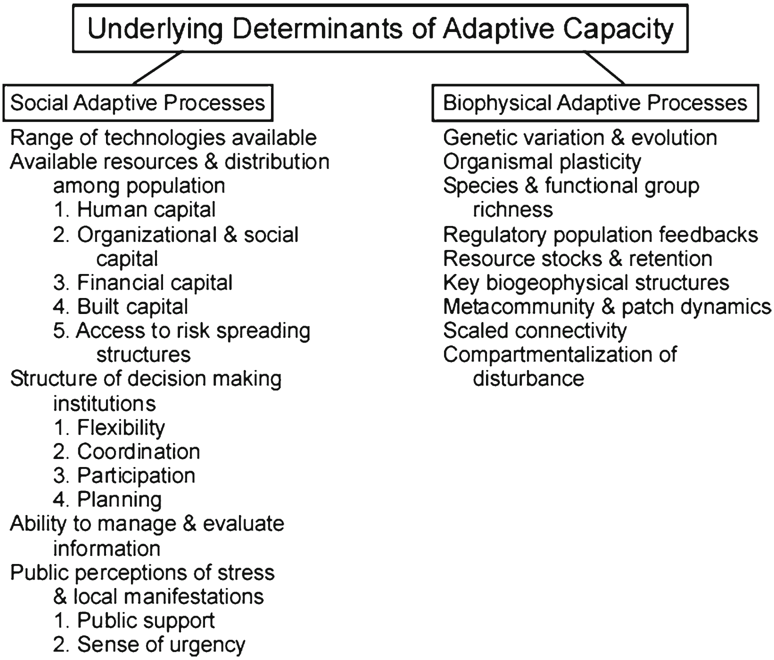

Fig. 23.4 Determinants of adaptive capacity in both social and biophysical realms (Adapted from BES LTER)

post-disturbance colonists (Gunderson et al. 2002b; Walker et al. 2004). Both the social and the biophysical adaptive processes can be summarized (Fig. 23.4). This structure separates the guiding values in a plan for sustainability from the values behind the ecological research to measure resilience and adaptive processes.

Because the issue of application is enmeshed in values, there are some questions that scientists will need help with: Are there norms that are legitimately a part of the paradigms and concepts reviewed here? Are any norms implicit or do they emerge only when the ecological knowledge becomes a part of a social dialog? Are there good and bad norms? What aspects of ecological science affect its relationship to ethics? With these questions in mind, the concerns of this chapter can be summarized.

23.6 The Flux of Nature: A View of Ecological Science

Ecological science may not be what many people think it is (Kolasa and Pickett 2005). It has changed over time. Its textbook generalizations may reflect superseded or challenged worldviews. This chapter has tried to suggest several complexities about the science of ecology that may be important in considering the linkage to ethics.

23.6.1 The Evolution of Ecological Science

Ecology has changed a great deal since its inception roughly a century ago. It has grown from its originally organismal focus to encompass additional scales, new kinds of interaction, and feedbacks among various kinds of units that did not figure in the founding of the discipline (Kingsland 1985, 2005). There is a new paradigm (Table 23.2) that expands the scope of model building and includes many more potentially explanatory factors (Callicott 2002; Pickett 1997). It has expanded explanations from a focus within the systems of interest to their spatial and temporal contexts.

The evolution of the science may not be reflected in the metaphors that are often used to describe it. The new paradigm, for example, is not well described by such cultural labels as "the balance of nature" (Callicott 2002). Because of the material openness of ecological systems, their dynamism over time, and the role of such formerly excluded factors such as disturbance and humans, it may be that there are more effective metaphors to open dialog that includes the newer views of ecology. The new conceptual frameworks and paradigms within the discipline may be poorly served by vernacular descriptions of the science. Models designed to operationalize the general concepts that are so often described in metaphorical terms, may be the crucial nexus for more effective communication among disciplines.

23.6.2 The Evolution of Norms for Application

If nature is in flux, driven by the kinds of events and processes summarized in the resilience cycle (Fig. 23.4), what are the implications for application? First, resilience in and of itself is neither good nor bad. Both desirable and undesirable features of socioecological systems can be resilient. The targets for management, design, and restoration can be informed by ecological knowledge of what is possible and what has been in the past under specific environmental conditions and species rosters.

Second, the norms of application should be examined for resonance with the new paradigm. The new paradigm is a highly generalizable set of statements that open up the formerly narrow assumptions about the structure and dynamics of ecological systems.

Third, points of reference for environmental actions are social choices, hopefully based in part on ecological knowledge about what is possible and what is adaptable. When choosing points of reference for management, restoration, or design, it is important to realize that some points will be less adaptive than others. In fact, it will be possible to choose points of reference that are beyond the physiological tolerances of all the organisms that could constitute a system, or beyond the tolerances of those organisms desired for their role in ecosystem services.

Furthermore, the rates of processes such as generation of genetic novelty, or the migration of species may be slower than the changes in the environmental context. While evolution has manifestly allowed adjustment to changing environments in the past, are the unmanaged evolutionary rates currently achievable adequate to match contemporary environmental change? If not, what are the points of intervention, and what choices are involved in making an intervention? These include economic costs and benefits, and the assessment of direct and indirect effects on other ecosystem services. It may not be possible to maximize all ecosystem services or mitigate all environmental hazards simultaneously.

23.6.3 This View of Life

When Darwin summarized the discovery of natural selection and the conceptual unification and empirical advances that it implied, he referred to a grand view of the process of evolutionary change. Nature was a network of inherited relationships, and contained a source of variation that allowed almost unimaginable diversification and adjustment. It was a striking image that provided a concluding cymbal crash for The Origin of Species (Darwin 1859). Darwin's grand view is ultimately one of flux – ebb and flow – of species against the background of an Earth that they themselves have changed over immense periods of time. That view must now include the rapid changes fomented by human density, behavior, and technology.

The contemporary image of the flux of nature may be a seed for such a grand view of ecology. The founding images of the science emphasized stability and firmness. Flux suggests that the stability is perhaps superficial. What matters most, as embodied in the new paradigm, is the underlying resilience of ecological systems, the degree to which they can adjust to new opportunities or adapt to changing situations.

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Chapter 24
Hierarchy Theory: An Overview

Jianguo Wu

Abstract In both the natural and the artificial worlds, complex systems are often hierarchically organized. In other words, they tend to be structured in layers or levels. The rates of interaction within components at any hierarchical level are much faster than the rates of interaction among components. Also, higher levels tend to be larger and slower whereas lower levels tend to be smaller and faster. This fundamental property of complex systems is called near-decomposability. Hierarchy theory is a general theory that aims to simplify the description, and thus improve the comprehensibility, of complexity by taking advantage of near-decomposability. In this chapter, I provide an overview of the theory, focusing on its core concepts and tenets. These include the following topics: definitions of hierarchy, hierarchical levels, ordering of hierarchical levels, vertical and horizontal structures, near-decomposability and the empty world hypothesis, the basic triadic structure, hierarchy and scale, the observer's role. I also discuss some common criticisms on hierarchy theory, and conclude with some comments on the nature and future of the theory.

Keywords Complexity • Near-decomposability • Loose coupling • Levels • Scale • The Basic triadic structure • Hierarchy-scale correspondence • Space-time correspondence • The Observer's role

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J. Wu (✉)
School of Life Sciences and Global Institute of Sustainability, Arizona State University, Box 874501, Tempe, AZ 85287-4501, USA
e-mail: Jingle.Wu@asu.edu

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> *Scientific knowledge is organized in levels, not because reduction in principle is impossible, but because nature is organized in levels, and the pattern at each level is most clearly discerned by abstracting from the detail of the levels far below. …… And nature is organized in levels because hierarchic structures – systems of Chinese boxes – provide the most viable form for any system of even moderate complexity.*
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> – H. A. Simon (1973, pp. 26–27)

24.1 Introduction

Many modern scientific marvels, from biology to medicine and from physics to engineering, have been achieved through reductionist approaches that treat a complex system as something no more than the sum of its parts. At the same time, however, increasingly challenging environmental and socioeconomic problems on broad scales seem to have defied the power of reductionism, demanding more comprehensive and integrative perspectives. Even on micro-scales with an individual organism, it has become increasingly clear that the meticulously detailed inventory of genes, proteins, and metabolites is not even sufficient to understand the complexity of a cell, much less the behavior of an organism (Hartwell et al. 1999; Oltvai and Barabasi 2002). Complexity makes wonders, but challenges understanding.

Both natural and artificial (man-made) systems can be complex when the number of components is large and when their interactions are nonlinear. For example, ecosystems are complex when one considers the large number of species interacting with each other and with their ever-changing environment. Socioeconomic systems are complex as their dynamics are determined by myriad factors involving government, society, and institutions from the local to the global scale. In general, coupled human-environmental systems may be even more complex because they encompass both natural and anthropogenic entities as well as the diverse interactions among them. To cope with complexity, the guidance of theory is often indispensable.

Great efforts have been made to develop theories and methods to deal with complexity during the past several decades. According to Herbert A. Simon, a polymath and a Nobel Laureate in economics, since the twentieth century there have been three "recurrent bursts of interest in complexity and complex systems" (Simon 1996). The first burst took place after World War I, and had a strong anti-reductionist flavor, as suggested by the terms of "holism," "Gestalts," and "creative evolution" (Simon 1996). The second burst occurred after World War II as systems science began to take shape. Research during this period was characterized by such terms as "general systems," "information," "cybernetics," and "feedback," focusing primarily on the roles of feedback and homeostasis in maintaining system stability (Simon 1996). Since then, systems theories and methodologies have continued to develop and been widely used in both sciences and engineering fields. The third burst probably started in the late 1970s or the early 1980s, characterized by terms such as "chaos," "catastrophe," "fractals," "cellular automata," and "genetic algorithms," "criticality," "adaptive systems," and "hierarchy," with a research focus on mechanisms that create and sustain complexity and on methods that describe and analyze complexity (Simon 1996). Hierarchy theory is an alternative and a complement to the other existing approaches to complexity, which is based on the premise that "complexity frequently takes the form of hierarchy" (Simon 1962, p. 468). In his epochal paper on the subject, Simon (1962, p. 481) argued that "one path to the construction of a nontrivial theory of complex systems is by way of a theory of hierarchy."

Although the concepts of hierarchy and levels of organization have long been used since ancient times, not until the early 1960s did hierarchy theory begin to emerge. As an offshoot of general systems theory, hierarchy theory was developed from a cross-disciplinary perspective, with important contributions from management sciences, economics, psychology, biology, and mathematics. The most important founder of the theory was Herbert A. Simon, whose series of writings not only laid the foundation of hierarchy theory, but also have continued to influence its further development ever since (Simon and Ando 1961; Simon 1962, 1969, 1973, 1976, 1981, 1995, 1996, 2000) (Table 24.1). Other important earlier contributions include Koestler (1967), Whyte et al. (1969), Weiss (1971), and Pattee (1973) (Fig. 24.1). Since the early 1980s, hierarchy theory has been further elaborated and expanded, with a distinctly biological and ecological emphasis, through several influential books, including Allen and Starr (1982), Eldredge (1985), Salthe (1985), O'Neill et al. (1986), Allen and Hoekstra (1992), and Ahl and Allen (1996) (Fig. 24.1). Particularly in ecology, the influences of hierarchy theory became pervasive and prominent between the 1980s and the early 2000s, contributing to the new ecological paradigm that centers on pattern-process-scale relationships (Wu and Loucks 1995; O'Neill 1996).

The objective of this chapter is to provide an overview of hierarchy theory, focusing on its key concepts and tenets that are particularly relevant to ecological and human-environmental systems. This is not an easy task because hierarchy theory is not a formal theory, meaning that it lacks clearly-defined terms, well-developed methodologies, and unambiguous predictions. Different versions of hierarchy theory exist. While I discuss some of the different perspectives when necessary, this is not intended to be an inclusive treatment of the subject in terms of its developmental history or diverse viewpoints.

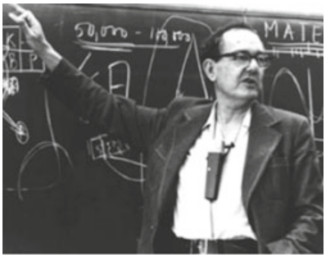
24.2 Hierarchy: A Word with Many Meanings

24.2.1 What Is Hierarchy?

The online Merriam-Webster Dictionary (http://www.merriam-webster.com) defines the word "hierarchy" as follows:

> (1) a division of angels; (2a) a ruling body of clergy organized into orders or ranks each subordinate to the one above it; especially: the bishops of a province or nation; (2b) church government by a hierarchy; (3) a body of persons in authority; (4) the classification of a

Table 24.1 The architect of simplifying complexity – Herbert A. Simon – and his seminal publications on hierarchy theory (Photos from http://www.techcn.com.cn/). The number of citations to his publications was obtained from Scholar.Google.com (May 10, 2013)

	Herbert A. Simon (1916–2001): *Economist, psychologist, political scientist, sociologist, and computer scientist; Nobel Laureate in economics in 1978*	Number of citations
	**Some publications on hierarchy**	
	Simon, H. A. and A. Ando. 1961. Aggregation of variables in dynamic systems. Econometrica 29:111–138	628
	Simon, H. A. 1962. The architecture of complexity. Proceedings of the American Philosophical Society 106:467–482	3,997
	Simon, H. A. 1969, 1981, 1996. The Sciences of the Artificial. 1st, 2nd, and 3rd edition. The MIT Press, Cambridge	14,607
	Simon, H. A. 1973. The organization of complex systems. Pages 1–27 in H. H. Pattee, editor. Hierarchy Theory: The Challenge of Complex Systems. George Braziller, New York	650
	Simon, H. A. 1976. How complex are complex systems? Pages 507–522 *in* PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association	48
	Simon, H. A. 1995. Near decomposability and complexity: How a mind resides in a brain. Pages 25–44 *in* H. Morowitz and J. Singer, editors. Mind, the Brain, and Complex Adaptive Systems, Santa Fe Institute Studies in the Sciences of Complexity. Addison-Wesley, Reading, MA	50

group of people according to ability or to economic, social, or professional standing; also: the group so classified; (5) a graded or ranked series <a hierarchy of values>.

[Origin: Middle English *ierarchie* rank or order of holy beings, from Anglo-French *jerarchie*, from Medieval Latin *hierarchia*, from Late Greek, from Greek *hierarches;* First Known Use: 14th century.]

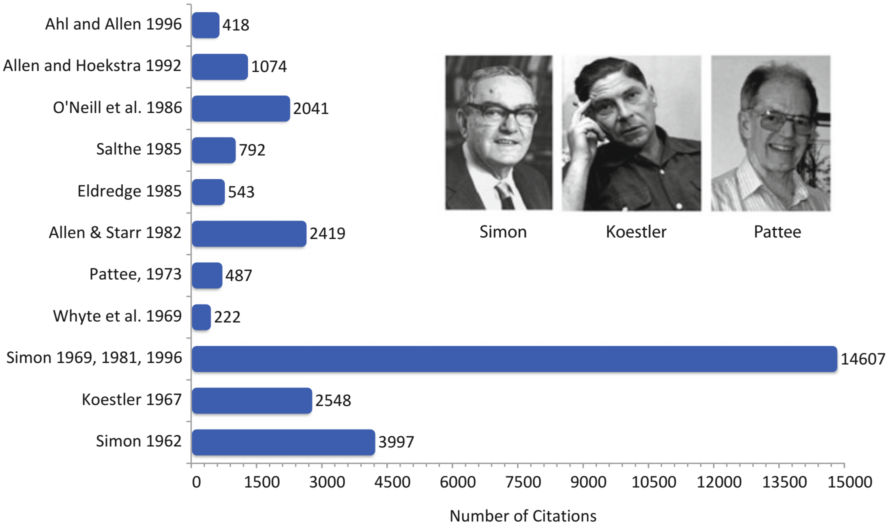


Fig. 24.1 Some key works on hierarchy theory. Information on citations to the publications was obtained from Scholar.Google.com (May 10, 2013)

The above definitions indicate that hierarchy originated in a religious context, and that its connotations are often human-centered, with a strong sense of authority, dominance, or ruling power. However, none of these definitions adequately captures the breadth of modern-day use of the term.

In general, a hierarchy simply refers to a system that is structured in layers or levels that have asymmetric relations. From a systems perspective, Simon (1962, p. 468) defined hierarchy as "a system that is composed of interrelated subsystems, each of the latter being, in turn, hierarchic in structure until we reach some lowest level of elementary subsystem." Simon (1962) further noted that determining the level of elementary components in a hierarchy is somewhat arbitrary. Mathematically, a hierarchy is a partially ordered set or poset in which not all elements are related (e.g., the set of all plant species in an area ordered by their phylogenetic relationship, or the set of postal codes for a country).

Hierarchy has much broader meanings than an authoritarian system or a pecking order. Chinese boxes, Russian dolls (also known as Matryoshka dolls), trees, and pyramids of sorts are common analogies of hierarchy. As Simon (1973) pointed out, however, a set of Chinese boxes (or Russian dolls) is a complete ordering, whereas a hierarchy is a partial ordering which is structurally more similar to a tree. The concept of hierarchy is closely related to "levels" of organization, dating back to ancient times (Wilson 1969). In biology and ecology, for example, the hierarchy of life and the spatial hierarchy have long been used in the classic and modern literature (Tansley 1935; MacArthur 1972; Odum and Barrett 2005). For example, when Arthur G. Tansley (1935, p. 299) coined the term "ecosystem," he apparently envisioned it as a level of a grand hierarchy of the universe: “These ecosystems … form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom.”

24.2.2 What Kinds of Hierarchy Are There?

Hierarchy is ubiquitous in both the natural and artificial worlds (Simon 1962, 1996). For example, the universe consists of galaxies that in turn consist of planetary systems that in turn consist of satellite systems (Shapley 1958; Simon 1962, 1976; Wilson 1969). Biological systems, classification schemes of all kinds, governments, postal codes, software packages, and social, economic, and scientific organizations are structured in levels, i.e., hierarchical. Ecological organizations (e.g., organisms-populations-communities-ecosystems-landscapes), food webs, and pyramids of numbers, biomass, and energy are familiar examples of hierarchy to ecologists. Even human aspirations can be organized hierarchically according to prepotency, as shown in the Maslow’s hierarchy of needs (Maslow 1954).

Hierarchies can be classified into different kinds based on various criteria. For example, in terms of their content and dimensions, we may have spatial versus non-spatial hierarchies, structural versus functional hierarchies, living versus nonliving hierarchies, and political, social, religious, economic, ecological, and physical hierarchies. Wilson (1969) identified three broad categories of hierarchy: “hierarchy as concept” (mental models), “hierarchy in nature” (from elemental particles to the universe), and “hierarchy in artifact” (from computers to human organizations). From a different perspective, Salthe (1991) recognized two forms of hierarchy: scalar hierarchies are organized by spatio-temporal scales (e.g., atom-molecule-cell-organ-organism-population), whereas specification hierarchies are composed of nested “integrative levels” or stages of development (e.g., physics-chemistry-biology-sociology-psychology). Similarly, Ahl and Allen (1996) distinguished scalar hierarchies that are composed of “levels of observation” (empirically derived) from definitional hierarchies that consist of “levels of organization” (stipulated by the observer). The levels in conventional ecological organizational hierarchies from organisms to the biosphere are definitional, and do not necessarily meet scalar criteria (Allen and Starr 1982; Ahl and Allen 1996; O’Neill and King 1998).

Another classification, which is important in hierarchy theory, is the dichotomy of nested versus non-nested hierarchies (Allen and Starr 1982; Ahl and Allen 1996). Many natural, social, and organizational hierarchies are nested hierarchies in which higher levels contain, or are composed of, lower levels. Familiar examples of nested hierarchies include the compositional hierarchy that connects the nonliving and living systems (i.e., elementary particles-electrons + nuclei-atoms-molecules-cells-tissues-organs-organisms-populations-communities-biomes-the biosphere) and the biological taxonomic hierarchy (i.e., species-genus-family-order-class-phylum-kingdom). Systems made up of spatial units of different sizes are nested hierarchies (e.g., the world map, a photo mosaic, and a Russian doll set). Non-nested

Table 24.2 Comparison between non-nested and nested hierarchies (Based on Allen and Starr 1982; Ahl and Allen 1996)

Non-nested hierarchies	Nested hierarchies
Examples: the military command hierarchy; food webs	Examples: the army consisting of soldiers of all ranks; taxonomic systems
Not suitable for exploration	Suitable for exploration
Same criteria (or measurement units) pressing across all levels	Different criteria (or measurement units) at different levels
Comparison between hierarchies is more feasible	Comparison between hierarchies is less feasible
System-level understanding can not be obtained by knowledge of parts	System-level understanding can be obtained by knowledge of parts

hierarchies may have all other asymmetric between-level relations, but not the one of containment (e.g., the trophic hierarchy, the army command hierarchy, and the Maslow's hierarchy of human needs). Although the general concepts and principles of hierarchy theory apply to both types of hierarchies, they differ in several ways (see Table 24.2).

24.2.3 Why Is Hierarchy So Common?

Simon (1962, 1973) answered this question by telling his favorite "watchmaker parable" (Fig. 24.2). The parable started with two fine watchmakers who made equally fine watches consisting of the same number of basic parts. Both attracted many phone calls from customers which interrupted their work. Such interruptions forced both men to let the unfinished watch at hand fall apart. The fate of the two watchmakers, however, was quite different: one became rich and the other went bankrupt. The structure of the watch (i.e., the organization of parts) turned out to be the difference maker. The winner's watch was structured hierarchically or modularly, whereas the loser attempted to assemble his watch directly from the parts without any intermediate assemblies (Fig. 24.2). The parable suggests that "hierarchies will evolve much more rapidly from elementary constituents than will non-hierarchic systems containing the same number of elements" (Simon 1973, p. 8). In general, a non-hierarchical complex system is less likely to evolve; if it does exist, it can not be fully described; if it could, it would be hardly comprehensible (Simon 1962, 1973, 1995).

In the artificial world, a hierarchical architecture is often advantageous. It is hard to think of any complex human-made system – from brick buildings to software systems, societies, and institutions – that does not have a hierarchical structure. The watchmaker parable suggests that a system with a large number of components is unlikely to be efficient and stable if it is not hierarchically organized. Of course, this does not mean that hierarchy guarantees efficiency and stability. When a hierarchical

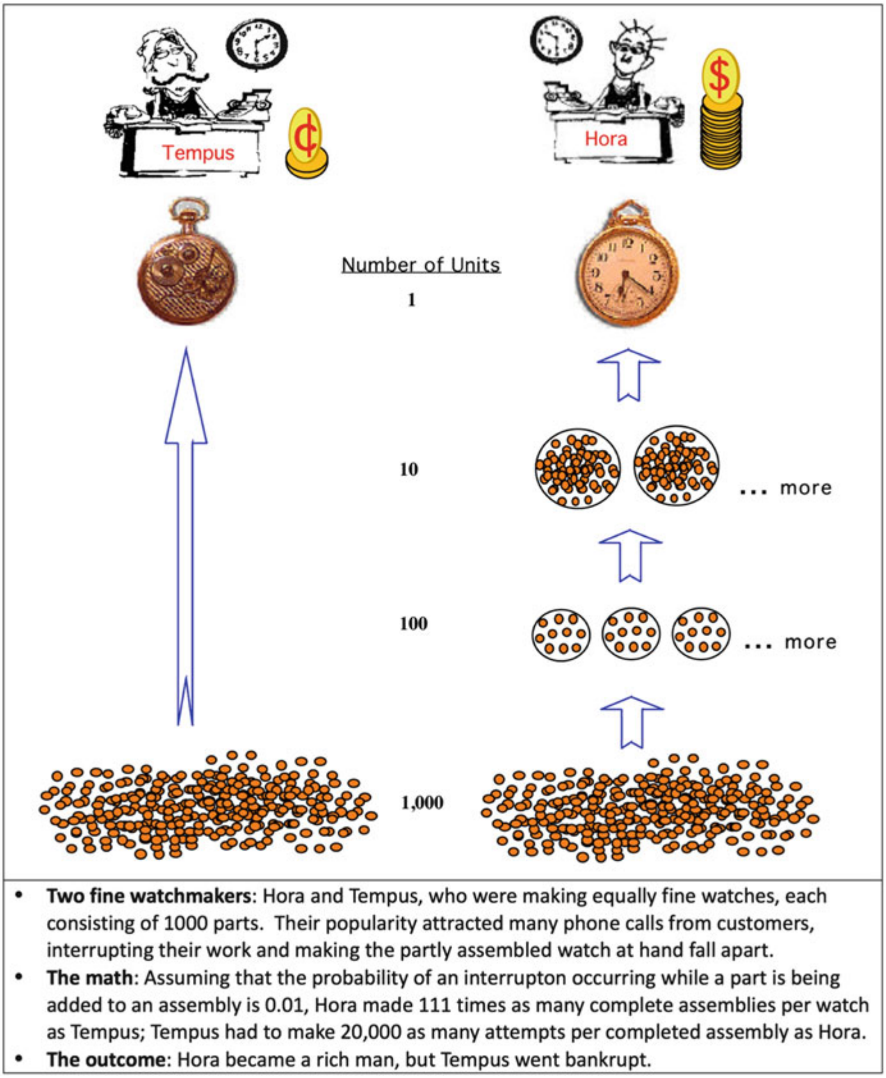


Fig. 24.2 Illustration of the watchmaker parable (Based on the description in Simon 1962)

system is too deep (too many levels) and too rigid (too strong top-down controls), its performance is doomed because of low efficiency and low adaptability.

From a thermodynamics perspective, dissipative structures and stratified stability theory have also been invoked to explain why physical and biological systems are hierarchically organized. Dissipative structures help explain how ordered structures emerge hierarchically in open systems, while stratified stability provides a description of how such structures persist and form building blocks for higher levels of organization (O'Neill et al. 1986; Wu 1991). For example, functional groups or guilds in ecological systems are more stable and enduring than their component species, and thus serve as building blocks for ecosystems (O'Neill et al. 1986). On micro-scales, interacting molecules of different types make up functional modules who carry out various cellular functions (Hartwell et al. 1999).

Furthermore, from a spatial perspective, dividing a geographic region into subregions and further into smaller areas, according to either natural or human criteria, always results in a spatially nested hierarchy. The eminent ecologist, Robert H. MacArthur (1972, p. 186) described the nested-hierarchical structure of the environment quite nicely:

> A real environment has a hierarchical structure. That is to say, it is like a checkerboard of habitats, each square of which has, on closer examination, its own checkerboard structure of component subhabitats. And even the tiny squares of these component checkerboards are revealed as themselves checkerboards, and so on. All environments have this kind of complexity, but not all have equal amounts of it.

Thus, maps are the most common way of showing spatial hierarchies of different kinds. Maps of the world, nations, and administrative units are familiar examples. Maps of climate, soils, vegetation, ecosystems, and land use are routinely used in ecological studies. Spatial hierarchies are always nested, and they may or may not correspond exactly to rate hierarchies that are defined for the same systems (O'Neill et al. 1986).

24.2.4 Is Hierarchy Real?

Do hierarchies exist in reality external to the observer, or are they merely the observer's mental models that do not necessarily correspond to the real world? These are ontological questions, begetting philosophical and epistemological arguments. Allen and Starr's (1982) version of hierarchy theory advocates a "process-oriented" framework, in which the ontology of entities is considered unimportant. These authors are clearly in favor of the view that hierarchies are observer-imposed constructs which may or may not correspond to reality (Allen and Starr 1982; Ahl and Allen 1996). Subscribing to Allen and Starr (1982) version of hierarchy theory, Wilby (1994, p. 657) claimed that "It is the content of the hierarchies that is the reality, not the organization framework we call 'hierarchy' that is real." This suggests that hierarchies constructed in studies, influenced or even determined by the observer's epistemology, are never real. On the other hand, Salthe's (1985) version of hierarchy theory is based on a "thing-oriented" framework in which entities or objects are not only real but also essential for describing and understanding hierarchical structuring. The fact that organisms are composed of organs that are further composed of tissues, cells, molecules… exists independent of the observer's epistemological stance. Explicitly recognizing and relating these levels has contributed significantly to advances in modern biology.

Although not discussing the ontological issue explicitly, most other authors seem to assume that many physical, biological, and organizational hierarchies exist in reality, admitting that some conceptual hierarchies may be constructed without realism. As Tansley (1935, p. 300) stated, “The mental isolates we make are by no means all coincident with physical systems, though many of them are, and the ecosystems among them.” Simon (1962, p. 468) asserted that “hierarchy … is one of the central structural schemes that the architect of complexity uses.” This implies that hierarchy exists in real-world complex systems although the observer or investigator may inevitably play a role in the process of observing and constructing the hierarchy. In other words, “complexity may lie in the structure of a system, but it may also lie in the eye of a beholder of that system” (Simon 1976, p. 508).

In scientific studies, therefore, hierarchies neither are absolutely the reality nor merely the perception of the observer; but rather, they are the products of the interactions between the reality and the observer. The degree of “realness” of hierarchy not only depends on the nature of the real system, but also the observer’s abilities, including the theoretical framework, methods, and data used to discover the hierarchy. Although sometimes it is relevant to know whether hierarchies are real or whether they are at least reflective of reality, hierarchy theory can be, and has often been, used without explicitly addressing the issue of ontological reality. In most cases, one may simply take “an epistemological stance in a utilitarian philosophy” as Allen and Starr (1982) preferred.

24.3 Main Tenets in Hierarchy Theory

24.3.1 Hierarchical Levels

Hierarchies are characterized by layered structures, and the discrete layers are also called levels. A hierarchical system is composed of multiple levels, each consisting of one or more components or subsystems (Fig. 24.3a, b). The nature and characteristics of components comprising levels vary with the type of hierarchies. For example, a *scalar hierarchy* is composed of empirically-based levels of observation, while a *definitional hierarchy* is comprised of the observer-defined levels of organization (Ahl and Allen 1996; Allen 2009). Although Simon (1962, p. 468) noted that “hierarchic systems have certain common properties independent of their specific content,” hierarchy theory does not apply to all kinds of hierarchies mentioned so far. The power of hierarchy theory usually resides with scalar hierarchies, both nested and non-nested.

The components or subsystems that make up a hierarchical level are called “holons” (from the Greek word *holos* = whole and the suffix *on* = part or particle as in proton or neutron), a term coined by Koestler (1967). A holon is like a “Janus-faced” entity with a dual nature, acting as a whole when facing downwards and

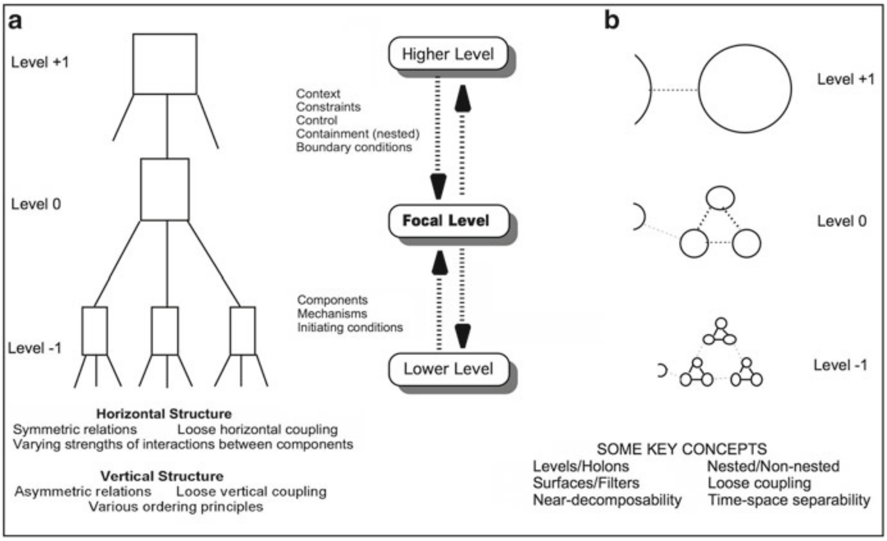


Fig. 24.3 Illustration of key terms and concepts of hierarchy theory, in which (*A*) and (*B*) are two schematic representations of a hierarchy (*A* redrawn from O'Neill 1988 and *B* redrawn from Urban et al. 1987)

as a part when facing upwards (Koestler 1967). The boundaries between levels and holons are also termed "surfaces," which correspond to places exhibiting the highest variability in interaction strength (Allen and Starr 1982; Ahl and Allen 1996). Surfaces sift the flows of matter, energy, and information crossing them, and thus can also be perceived as "filters" (Allen and Starr 1982; Ahl and Allen 1996).

In applying hierarchy theory, it is desirable to derive hierarchical levels from data using quantitative methods. For example, in the recent decades, remote sensing, geospatial analysis tools, and computing capacities have enabled ecologists and geographers to quantify spatial structures from the local ecosystem to the globe. Such studies have repeatedly shown that hierarchical structures exist, external to the observer, in both natural and human-dominated systems, which can be revealed through spatial pattern analysis regardless of the observer's perception. Also, recent studies in systems biology and network analysis have shown that "network motifs" or modular structures (e.g., small subgraphs-significance profiles-superfamilies-networks) exist in biological, sociological, and technological networks, ranging from protein signaling networks to power grids, World Wide Web links, and word-adjacency networks in different languages (Oltzvai and Barabasi 2002; Milo et al. 2004). These hierarchical modular structures now can be detected using new methods with increasing efficacy and objectivity (Oltvai and Barabasi 2002; Milo et al. 2004; Itzkovitz et al. 2005; Zhou et al. 2006; Sales-Pardo et al. 2007).

24.3.2 Ordering of Hierarchical Levels

Central to hierarchy theory is the ordering of hierarchical levels. Simon (1962, 1973, 1976, 1996) emphasized that process rates and the frequency and strength of interactions among components are the fundamentally important criteria for the ordering of hierarchical levels. He indicated that, in both social and physical systems, faster and higher frequency dynamics are associated with lower levels, whereas slower and lower frequency dynamics are related to higher levels (Simon 1962, 1973, 1996). Pattee (1991) noted that there are numerous criteria for ordering hierarchical levels, including scalings of time, rate, space, number, and connectivity. Allen (2009) summarized five general principles for ordering levels in ecological hierarchies:

1. higher levels operate more slowly and at a lower frequency than lower levels;
2. higher levels exert constraints on lower levels;
3. higher levels function as a context to lower levels;
4. higher levels have weaker bond strengths between holons and thus lower integrity than lower levels;
5. in the case of nested hierarchies, higher levels contain or consist of lower levels.

While different hierarchical ordering criteria may suit with different purposes, process rates-related measures (e.g., behavioral frequencies, relaxation time, cycle time, and response time) are considered the most general and fundamental criteria, and that levels in biological and ecological hierarchies can most easily be characterized by response time. Hierarchical levels can also be identified or defined in terms of tangible boundaries (e.g., spatial hierarchies), but such hierarchies may differ from rate-based hierarchies although they share many properties (O'Neill et al. 1986; Urban et al. 1987).

The process of identifying and ordering hierarchical levels is a critical step in simplifying a complex system using hierarchy theory. After a large number of components are organized into a much smaller number of levels and holons, the dimension of the system is greatly reduced, the problem at hand becomes much more tractable, and the comprehensibility of the system is substantially enhanced.

24.3.3 Vertical and Horizontal Structures

From a process perspective, complex systems often have a number of different processes operating over a wide range of time scales. If a systems is hierarchical, a certain number of levels can be extracted from observation data. Components with similar process rates will be grouped into the same level. These different levels form the vertical structure of the hierarchy which is a simpler but accurate representation of the original complex system. The asymmetrical relationship between levels is the most salient characteristic of the vertical structure of hierarchies. The number of levels in a hierarchy represents its depth. The deeper a hierarchy is, the more elaborated its hierarchical structure tends to be. Natural and human systems may differ in both the number of levels and the strength of top-down constraints and bottom-up initiating forces. For example, industrial sectors are often hierarchically organized with different number of administrative layers, and the "degree of hierarchy" (a transaction network-based measure) of the automotive sector is higher than that of the electronics sector (Luo 2010). On a general level, this pattern also exists in biological and ecological hierarchies (e.g., food webs of different habitat types). An extremely shallow hierarchy with only two levels and with the lower level populated by a huge number of components is called a "flat hierarchy" (e.g., a crystal or a volume of gas) (Simon 1962). Such systems may seem quite complicated, but are not really complex (Ahl and Allen 1996).

On the other hand, the relationships among holons at the same level are symmetric, and can be characterized by interaction strength. In general, interactions among components within a holon are much stronger and more frequent than those among holons. It is the stronger and more frequent inter-component interactions, and it gives rise to the apparent identity and integrity of holons at each level. For example, the strength of interactions between subatomic components is much stronger than that between atoms, which is in turn stronger than that between molecules (Simon 1962, 1973). Also, both the strength and frequency of between-component interactions decrease from the level of organisms to the levels of local populations and metapopulations.

The above discussion indicates that components in a hierarchical system are only "loosely" coupled in both the vertical and horizontal directions: the "loose vertical coupling" enables and maintains the separation between levels, whereas the "loose horizontal coupling" allows for each holon to operate dynamically in independence of the details of the other holons (Simon 1973). The loose coupling of system components provides a fundamental basis for the near-decomposability of complex systems, a key concept in hierarchy theory which is discussed below.

24.3.4 Near-Decomposability and the "Empty World Hypothesis"

"Near-decomposability," or "nearly complete decomposability," refers to a central property of hierarchical complex systems: *rates of interaction within components at any level are much higher than rates of interaction between components* (Simon 1962, 1973). Complete decomposability occurs only when system components are completely decoupled from each other. Clearly, this is not the case for complex systems. If the components are strongly coupled, the system cannot be "decomposed" and then its description requires the consideration of all components – no matter how many of them. As mentioned earlier, hierarchical systems consist of components that are loosely coupled, and thus they are near-decomposable. It is this near-decomposability that permits simplification necessary for clearly describing and adequately understanding complexity (Simon 1962, 1973, 1976, 1996). To explain near-decomposability, Simon (1973, p. 10) provided the following example:

> If we now observe the behavior of the system over a total time span, T, and our observational techniques do not allow us to detect changes during time intervals shorter than τ, we can break the sequence of characteristic frequencies into three parts: (1) low frequencies, much less than 1/T; (2) middle-range frequencies; and (3) high frequencies, greater than $1/\tau$. Motions of the system determined by the low frequency modes will be so slow that we will not observe them – they will be replaced by constants. Motions of the system determined by the high frequency modes … will be so rapid that the corresponding subsystems will appear always to be in equilibrium … The middle band of frequencies, which remains after we have eliminated the very high and very low frequencies, will determine the observable dynamics of the system under study…

In brief, to describe the dynamics of a hierarchical system parsimoniously and adequately, select a focal level, treat slow behaviors at the higher levels as constants and fast behaviors at the lower levels as averages or equilibrium values. For a specific problem, it is not only possible but also wise to "scale off" the relevant levels from those above and below, thus achieving a greater simplification and better understanding (Simon 1962, 1973, 1996).

Although the degree of decomposability varies among different systems or even among different processes of the same system, the principle is generally applicable. For example, hydraulic and aerodynamic systems are full of turbulence and thus chaotic and unpredictable in detail, but they become "manageable" when they are dealt with as aggregate phenomena (Simon 1996). The principle of near-decomposability has been demonstrated mathematically for both linear and nonlinear dynamic systems in economics (Simon and Ando 1961; Ando and Fisher 1963) and ecology (Overton 1975a; Cale and Odell 1979; O'Neill and Rust 1979; Gardner et al. 1982; Iwasa et al. 1987, 1989). Simon (2000, p. 753) pointed out that "Near-decomposability is a means of securing the benefits of coordination while holding down its costs by an appropriate division of labor among subunits. So, if we design complex systems to operate efficiently, we must incorporate near-decomposability in the design." Thus, organizations are often hierarchically structured, and serve as the most powerful tools to cope with the problem of "bounded rationality" by combining people's thinking powers (Simon 1996, 2000).

Simon (1962, p. 478) stated that "A generalization of the notion of near-decomposability might be called the 'empty world hypothesis' – most things are only weakly connected with most other things; for a tolerable description of reality only a tiny fraction of all possible interactions needs to be taken into account." Apparently, the statement that "everything is connected to everything else," often encountered in the ecological literature, is not helpful or even may be misleading, in dealing with complex problems.

24.3.5 The Basic Triadic Structure

Conceptually linked to the principle of near-decomposability, Salthe (1985) proposed the basic triadic structure for studying complex systems. While near-decomposability focuses on rate differences, the basic triadic structure is based explicitly on the structural levels of a hierarchy. Specifically, it states that three adjacent hierarchical levels need to be considered for both a parsimonious and sufficient description of the behavior of the focal level in the middle (Salthe 1985). This assumes that the dynamics of the focal level is determined primarily by the initiating processes at the level below and the boundary conditions and constraints at the level above. Also, the significance of the focal-level dynamics is understood at the higher level, where as the mechanistic explanations of the focal-level dynamics comes from the lower level.

The basic triadic structure can be linked to process rates based on form-function and space-time relationships (Salthe 1985; Wu 1999). So, it is not just a "structural" approach. As a heuristic guide, it has been widely used in natural and social sciences. Exceptions to the basic triadic structure rule exist when certain nonlinear effects penetrate through several levels above or below (e.g., O'Neill et al. 1991a), which are referred to as "perturbing transitivities" by Salthe (1991). Also, three here is not a magic number, and some studies may need to consider four or five adjacent hierarchical levels, depending on the nature of the phenomena and the research objectives. So, the basic triadic structure should be considered the minimal hierarchical structure for dealing with complex systems.

24.3.6 Hierarchy and Scale

Hierarchy theory provides a powerful framework for understanding scales in time and space. Recent developments in hierarchy theory have made increasingly explicit the relationship between hierarchical levels and scales. Hierarchical levels, which are inherently related to temporal and spatial scales, become more useful when this relationship is quantitatively expressed. This is especially true for relating patterns to processes and for translating information across scales or scaling. Hierarchy theory suggests that the characteristic scales of patterns and process in a complex system should change discontinuously in correspondence to hierarchical levels. When hierarchical levels are defined based on "scale breaks" using statistical methods, a marriage between hierarchy and scale is made (O'Neill 1989, 1996; O'Neill et al. 1991b; Levin 1992; Wu 1999; Wu and Li 2006). This may be called the hierarchy-scale correspondence principle.

Closely related to the hierarchy-scale principle is the time-space correspondence principle: the characteristic scales of complex systems in space and time are related in such a way that the ratio between the two (the so-called characteristic velocity) tends to be relatively invariant over a range of scales (Blöschl and Sivapalan 1995;

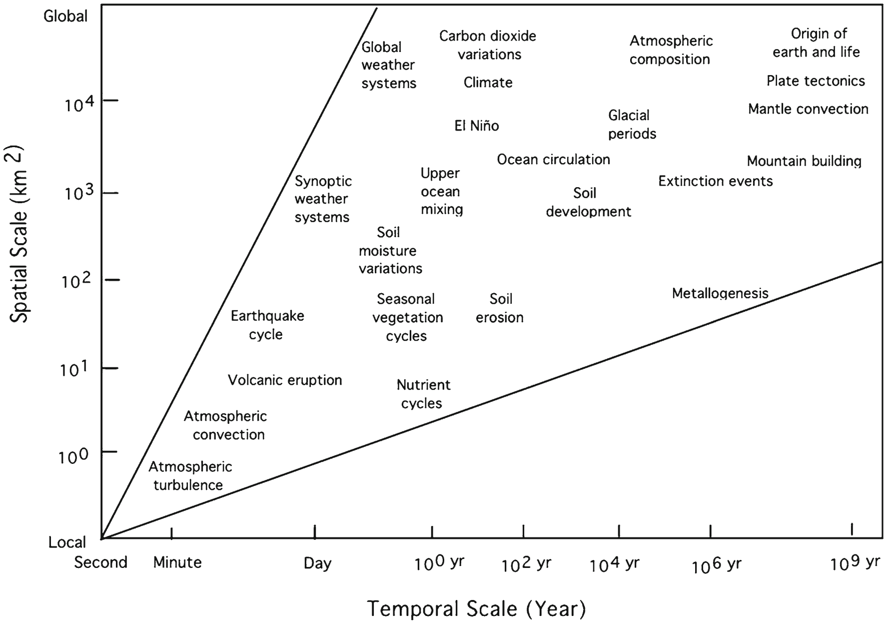


Fig. 24.4 An illustration of the space-time scale correspondence principle. Physical and ecological phenomena tend to line up, approximately, along the diagonal direction in the space-time scale diagram although variations increase with scales (From Wu 1999 and references therein)

Wu 1999). In the parlance of hierarchy, higher levels tend to be slower in time and larger in size, whereas lower levels faster in time and smaller in size (O'Neill et al. 1986, 1991b; Urban et al. 1987; Wu 1999). The space-time correspondence principle is often illustrated by space-time scale diagrams or "Stommel diagrams" (Stommel 1963; Urban et al. 1987; Levin 1992), indicating that hierarchical complex systems can be decomposed in time and space simultaneously (Fig. 24.4). The hierarchy-scale correspondence principle and the space-time correspondence principle provide an essential conceptual foundation for the hierarchical patch dynamics paradigm that links pattern, process, scale, and hierarchy in ecological systems (Wu and Loucks 1995; Wu 1999; Wu and David 2002).

24.3.7 The Observer's Role

In hierarchy theory, the importance of the observer's role in understanding complex systems is generally recognized. When the observer is considered as part of the study hierarchical system, his or her exact position relative to levels (below, on, or above) and holons (within or outside) greatly influences what is to be observed because of the functioning of surfaces and filters (Allen et al. 1984). In this sense, hierarchy theory is sometimes viewed as a "theory of observation" that emphasizes the paramount importance of the role of the observer (Allen and Starr 1982; Allen et al. 1984; Ahl and Allen 1996).

The observer-within-the-hierarchy analogy illustrates nicely why changing the scale of observation and analysis often leads to different results when studying complex systems. But when the role of the observer is over-emphasized, everything that comes out of the study at the end would appear subjective or arbitrary. In this case, the scientific value of hierarchy theory may be compromised. While there is no absolute objectivity, how closely a constructed hierarchy corresponds to the structure of the real system significantly and how the hierarchy is analyzed would undoubtedly affect the usefulness and power of a hierarchical approach (Wu 1999; Wu and David 2002).

24.4 Critiques on Hierarchy Theory

Hierarchy theory has been criticized on several grounds. Some of them are due to misinterpretation, and others are mostly related to the immaturity of the theory. For example, in social sciences, hierarchy is still often perceived as "a top down, authoritarian, if not dictatorial, systems design" (Wilby 1994, p. 665). Thus, "the very word 'hierarchy' grates for a sociologist, as it smacks of an endorsement of domination, whether intended or not" (Bell 2005, p. 474). This is unfortunate because the theory is quite relevant to a broad range of problems with social systems (Simon 1962, 2000; Giampietro 1994; Warren 2005). Control or dominance hierarchies do exist in both the natural (e.g., pecking orders or dominance hierarchies of animals) and artificial worlds (e.g., totalitarian regimes and human-engineered modularly-structured control systems). However, as Simon (1973, p. 5) observed long ago, hierarchy is a general term that is "divorced from its original denotation in human organizations of a vertical authority structure." In fact, hierarchies can be constructed and interpreted from both an authoritative and emancipatory perspective (Wilby 1994).

In a critical review of the theory, Wilby (1994, p. 653) pointed out that "hierarchy theory has been deemed successful in the systems field." She went on identifying several difficulties with hierarchy theory, including: (1) the lack of a single, coherent set of definitions and principles for all variants of the theory, (2) the lack of a specific, systematic methodology for the application of the theory, and (3) the lack of a precise and capable mathematical framework. While these criticisms are helpful for further developing hierarchy theory, much of the relevance depends on how the word "theory" is interpreted here. For example, Allen et al. (Allen et al. 2009, p. 2939) stated:

> Hierarchy theory is a special sort of theory that may not meet criteria for what many would have theory be, because of its relationship to hypotheses and predictions. It does not make predictions per se, but rather explicitly extracts the functional structure of the system from the data, rather than relying on an arbitrary designation of components.

If hierarchy theory is taken as a general theory, which it is, developing a single set of precise and coherent definitions and mathematical frameworks may just be a desirable but unachievable goal. Does systems theory have such a set? On the other hand, as hierarchy theory is used in a more specific problem setting, be it ecological, economic, or social, the terms have assumed unambiguous meanings, testable hypotheses have been formulated, and appropriate mathematical frameworks have been developed. In fact, this has been happening since the seminal work by Herbert A. Simon (e.g., Simon and Ando 1961; Simon 1962, 1976, 1995, 1996). During the past few decades, the further development and application of hierarchy theory in ecology have resulted in a large number of such examples in diverse research areas, including ecosystem modeling, species-habitat relations, ecological succession, animal foraging behavior, habitat fragmentation, and patch dynamics of sorts (Overton 1975b; McIntire and Colby 1978; O'Neill et al. 1986; Senft et al. 1987; O'Neill 1988, 1996; Kolasa 1989; Pickett et al. 1989; Waltho and Kolasa 1994; Wu and Levin 1994, 1997; Yarrow and Salthe 2008). Undoubtedly, hierarchy theory will continue to develop as a general theory and, at the same time, produce specific principles pertaining to problems in diverse fields in natural and social sciences.

24.5 Conclusion

Complex systems are perceived by people as complex because their large number of interacting components resists easy description and understanding. Then, how do we approach such systems. One approach would be to treat them as "black boxes" – try to understand them by knocking on their walls and corners from the outside and then interpreting their responses without knowing anything inside. This would be an extremely holistic approach, which has proven to be of limited value. Another approach would be to treat them as nothing but the sum of their parts – an extreme reductionist perspective. Newly-developed computationally intensive approaches, such as cellular automata and genetic algorithms, assuming that complexity is only generated by iterating simple rules or that complex patterns can be derived solely from interactions of local processes, represent improved but still fundamentally reductionist methodologies. If the complex world is hierarchically or modularly structured, which seems true in many situations, none of the above-mentioned approaches should work. In these cases, hierarchy theory has proven useful and effective.

Several key elements of hierarchy theory can be identified, and most of them have originated in the work of Herbert A. Simon in the 1960s–1970s. Among the most essential are the observation that hierarchy is a central architecture of complexity, the generality and fundamental importance of rate-based ordering of levels, the loose coupling of system components, and near-decomposability of hierarchical systems. The theory has been further developed and applied rather extensively during the 1980s, most noticeably in the fields of biology and ecology through a series of books. Today, hierarchy theory has pervasive influences in ecology and also broad applications in a number of other fields, including geophysical, computer, economic, psychological, and management sciences.

To conclude, hierarchy theory is a general theory of simplifying complexity by taking advantage of the fundamental property of many complex systems – near-decomposability. From a philosophical perspective, it integrates reductionism and holism, as Simon (1962, p. 468) pointed out: "In the face of complexity, an in-principle reductionist may be at the same time a pragmatic holist." Hierarchy theory considers both top-down influences and bottom-up processes as important, and provides a theoretical basis for multiple-scale analysis and synthesis. In fact, hierarchy theory suggests that a proper balance between top-down constraints and bottom-up processes is key to the performance and persistence of most complex systems. Hierarchy theory neither implies inflexibility nor a lack of diversity and creativity. On the contrary, an appropriate hierarchical, dynamic structure provides opportunities for diversity, flexibility, and creativity, as well as higher efficiency and stability that are difficult to obtain in non-hierarchical complex systems.

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Chapter 25
Ecosystem Services: Is a Planet Servicing One Species Likely to Function?

Shahid Naeem

Abstract Human wellbeing is more likely to be secured if we work in the service of nature rather than attempt to force nature to work in the service of humanity. The success of ecology and evolution is attributable to subscription to the philosophical principles of naturalism and pragmatism, neither of which admit romantic, spiritual, moral, or other humanist constructs. Currently, however, environmental science is investing heavily in the idea of ecosystem services which mixes naturalism and pragmatism with humanism. It imagines that we can select those ecological and evolutionary processes that fit humanist ideals while eliminating all others. I suggest that this immiscible blend of philosophies is untenable. Natural science has revealed a biosphere that is governed by nothing that maps well onto humanist ideals. The biosphere is not designed to serve a single species and will collapse if we force it to do so. The way forward is to think less about ecosystems servicing or disserving humanity, and to think more about humanity living in the service of nature as all species do. This idea should not be confused with pantheism, enslavement to dark Malthusian fears, or cold-hearted adherence to evolutionary principles like survival of the fittest – such primitive thinking is as much a formula for planetary demise as blind faith in ecosystem services. Rather, I propose that living in the service of nature yields a biosphere in which *all* of life prospers and, in so doing, achieves the environmental sustainability that is a necessary precursor to attaining humanist ideals.

Keywords Ecosystem services • Naturalism • Pragmatism • Anthropocene • Biosphere

S. Naeem (✉)
Department of Ecology, Evolution, and Environmental Biology, Columbia University in the City of New York, 1200 Amsterdam Ave., MC5557, New York, NY 10027, USA
e-mail: sn2121@columbia.edu

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The development of science since the Renaissance can be characterized as an expansion of the knowledge of phenomena, as increasing specialization, as a growing of empiricism with many techno-practical consequences. It can also be considered as an institutionalization of science and the dominance of research, as emancipation from theology and philosophy, as separation from the humanities or a loss of historico-theoretical interests within the natural sciences. Dietrich von Engelhardt (2000)

25.1 In the Service of Nature

Ecology, or the study of the relationship between organisms and their environment, is a scientific way to examine nature, an approach consistent with naturalism and pragmatism and therefore limited in its utility for resolving environmental issues. Naturalism is a philosophical perspective that sees the world as understood solely from what is verifiable from an empirical investigation; nature contains nothing supernatural. It does not preclude the ideas of gods, God, spirits, or the human spirit; it only says that understanding what these are must emerge from a scientific approach. Pragmatism is a related philosophical perspective that sees a concept as the whole of its practical effects on the objects it relates to; there is nothing metaphysical about nature. Like naturalism, it too does not preclude concepts of nature as a goddess or reflecting design by an intelligent being; it only says that if the practical implications of one's concept cannot be revealed, then one should focus effort elsewhere. Unlike ecology, however, environmental issues concern ethics, morality, spirituality, fairness, and other human values and constructs that are not consistent with naturalism or pragmatism. If we are responsible for bringing a species to extinction and we do nothing about it, is that unethical, immoral, contrary to the human spirit? Is it unfair to displace people from the last remaining patch of forest to preserve that endangered habitat? Ecology can provide insight into how we might rescue a species from extinction if we decide to do so, how to preserve a forest patch if we remove its human occupants, or how to manage a forest patch if people remain, but the questions of ethics, morality and fairness are for society to answer.

The success of ecology, as in all the Western sciences since the Renaissance, has been its emancipation from the humanities. It would be odd, after hundreds of years, to now recouple natural science with the humanities. However, this is what has happened in recent history.

In this essay, I will argue that the modern environmental framework of ecosystem services, though it has its uses, is neither a scientific framework nor consistent with achieving environmental sustainability, the necessary precursor to transitioning from traditional development to sustainable development. An ecosystem is a set of plants, animals, and microorganisms and the physical, chemical, and biological processes that govern its functioning. Ecosystem functions are element, nutrient, and material cycling and energy flows through the system such as carbon cycling, plant biomass production, and the decomposition of dead organic matter. Ecosystem services (sometimes referred to as *environmental services*) are variously defined, but most often they are simply considered the benefits humans derive from nature (de Groot 1992; Myers 1996; Daily et al. 1997, 2009; Kremen 2005; Gomez-Baggethun et al. 2010). Examples of ecosystem services include the production of food, climate regulation, pollination, biological control of pests, disease regulation, inspiration, recreation, and much more. Together, the constructs of ecosystems, ecosystem functions, and ecosystem services allow us to evaluate human activities based on how they enhance, sustain, or jeopardize the flow of nature's services to humanity. If, for example, deforestation provides us timber (a provisioning service) and new land for agriculture but increases soil erosion and greenhouse gas emissions (regulatory services), then we should either stop deforestation or find ways to continue forestry but compensate for or prevent the loss of services due to the tradeoff between provisioning and regulating services. There are also sustaining services, such as soil formation and nutrient cycling, but I will focus on provisioning, regulatory, and cultural services as these are more commonly part of our economic systems (Naeem et al. 2009).

The Millennium Ecosystem Assessment (MEA) used the ecosystem service construct as the central link between ecosystem functioning and human well-being in its framework (MEA 2003). The MEA assembled over 1300 social (e.g., economics, anthropology, political science) and natural scientists (e.g., ecologists, climate scientists, biogeochemists), and to a certain extent the humanities (e.g., religion, art, philosophy) to work together for 5 years on the state of the world's environment at the dawn of this millennium. Their framework, I would argue, coupled the naturalism and pragmatism of ecological science with the supernatural and metaphysical dimensions of the humanities. I suggest this is not tenable and yields an unstable basis for managing eco- and earth-systems.

To illustrate the issue, let us consider cultural ecosystem services first and then consider provisioning and regulating services afterwards. If a habitat harbors no unique biodiversity nor provides any significant provisioning or regulating ecosystem services (e.g., it does not produce much timber, does not stabilize slopes, does not sequester much CO_2, etc.) but is a sacred area or home to a sacred grove (e.g., Daniel et al. 2012), then it provides cultural ecosystem services. In this example, the MEA framework links natural ecological processes like elemental cycling and community metabolism (ecosystem ecology) and food-web dynamics (community ecology) to religious practice (theology) – it links naturalism with spiritualism which are not compatible philosophies. We can use ecological principles to manage the habitat's biodiversity and ecosystem functions and perhaps devise a program to sustain the habitat as a functioning ecosystem for generations, but at no point do we manage its spiritual content. We assume that so long as the ecosystem is intact (something that is verifiable), it retains whatever supernatural and metaphysical properties make it sacred (something that is not verifiable). Indeed, if those who view the habitat as sacred were to abandon their beliefs, even though neither biodiversity nor ecosystem functions changed because intensive management insured that the ecosystem remained intact, it loses its sacredness.

While this incompatible linkage between naturalism and spiritualism might seem peculiar to cultural services, provisioning and regulating services suffer the same sort of problem. If the same habitat did, in fact, have biomedicines, such as *Taxus* shrub species with chemotherapeutic anti-cancer compounds we valued (Cragg and Newman 2005) (provisioning services) and these shrubs helped regulate flooding by retaining water and sediment during storms, if the market for the biomedicine collapsed because a more effective substitute was found and people relocated to urban areas so flooding was no longer an issue, the services vanish even though biodiversity and ecosystem functioning did not change.

Expand the ecosystem service approach to a global scale, which is the trend before us, and we now have human values ostensibly substituting for the entirety of biodiversity and eco- and earth-system functioning as the foundation for an operational biosphere. Figure 25.1 illustrates how rapidly the ideas of ecosystem services and sustainable development have grown in recent history by plotting its reference in all literature and the biological science literature. Sustainable development shows the fastest growth in recent literature, but ecosystem services, a construct designed to enable achieving sustainable development, has shown a parallel rise. It has not received as much attention by biologists, but it is growing there as well.

The alternative to the ecosystem-service construct I explore in this essay sees every species, including humans, being in nature's service. The difference in wording is subtle but important. Being *in nature's service* is much the way James Bond, Agent 007 (the main character in the popular fictional series about the British secret service), is *in her Majesty's service*. He serves the Monarchy, a proxy for his country, and for this he receives what appears to be a handsome stipend and other perks (sex, martinis, sports cars, and the like). The ecosystem service construct, in contrast, essentially sees nature, or all species and ecosystems, *in humanity's service*. This would be akin to Queen and country being in James Bond's service. The wording issue of nature being in humanity's service or humanity being in nature's service goes beyond semantics.

25.2 Humanity as Part of the Living World

25.2.1 An Evolving Vision of the Biosphere

In spite of scientific advances, our Western view of ourselves and life on Earth has not changed for hundreds of years. The modern scientific view of life is that it exists within a slim sphere; the biosphere which suffuses into the hydrosphere and atmosphere. The biosphere, a term that did not originate until 1875 (Smil 2002), is nestled between an underlying sphere of rock and magma and the vast expanse of the cosmos above. This vision of Earth as a series of nested spheres has not changed much in Western Science as can be seen in the works of Robert Fludd, one of several Paracelsians during the heyday of the overthrow of the Aristotelian paradigm during the European Renaissance (Naeem 2002). The details of biology, physics, and chemistry have changed and, as described above, we no longer admit the spiritual or mystical into our thinking (which was commonly done prior to the Renaissance), but the overarching world view of nested spheres is essentially the same.

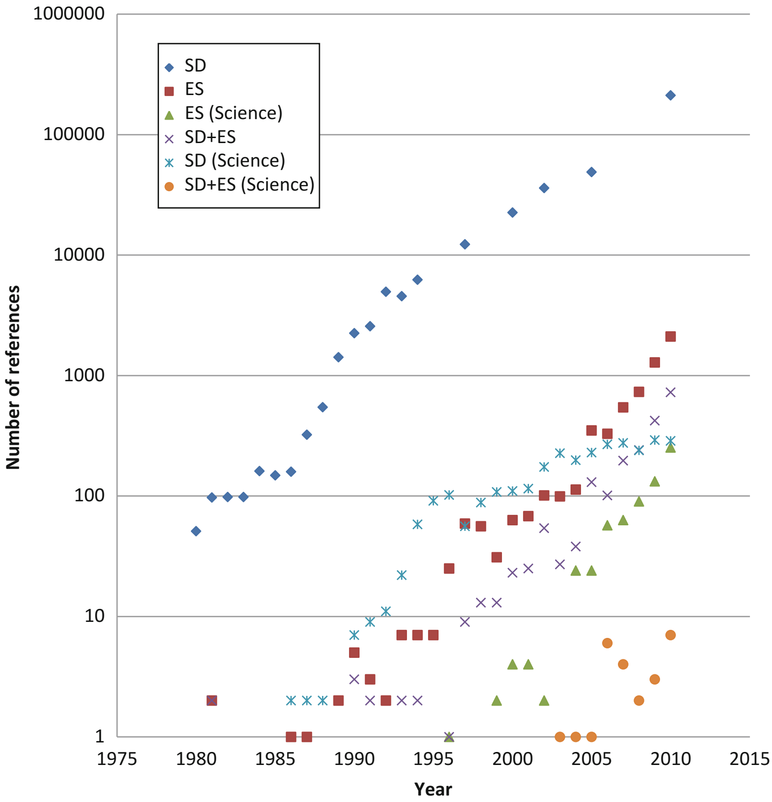

Fig. 25.1 Ecosystem service and sustainable development in public and scientific discourse. References using the term "ecosystem service" (*ES*),"sustainable development" (*SD*), or both (SD+ES) are plotted on a $\log_{10}$ scale. Straight lines mean exponential increases in the number of references. ES, SD, and ES+SD references were tabulated from Lexis Nexis Academic which includes newspaper, journal, blogs, and many other forms of text media. ES (Science), SD (Science) and SD+ES (Science) were tabulated using Biosis (Biological Abstracts), the leading literature database for the biological sciences. This figure illustrates that "sustainable development" is by far the more widely used concept in public and scientific discourse, as tabulated by these databases, occurring nearly 100 times more frequently between 1980 and 2010. The concept of "ecosystem service" occurs more frequently in public discourse by a factor of roughly 10. The lowest use of these terms is where both "sustainable development" and "ecosystem service" co-occur in a document, by far the lowest being in the scientific literature. These data do not support the idea that ecosystem services are understood to be an integral part of sustainable development (*Note that the y-axis is a $\log_{10}$ scale*)

Removing the spiritual and mystical from our thinking of the biosphere, however, allows us to focus on it from a mechanistic and utilitarian perspective rather than trying to comprehend it as a whole with some higher order functioning or purpose that naturalism or pragmatism does not address. Comprised of roughly ten million species (Mora et al. 2011), it is made up of one trillion tons of carbon (Whitman et al. 1998) that is invested in a variety of organic compounds, such as oils, fats, proteins, carbohydrates, and nucleic acids. The biosphere is primarily a solar-powered mass that cycles gigatons (10^{15} g) of mostly lighter elements such as hydrogen, carbon, nitrogen, oxygen, phosphorus and sulfur between organic and inorganic forms. While a trillion tons of carbon may sound like a lot, it is actually little to work with. The carbon mass of the biosphere is only 0.000001 or one millionth ($10^{17}/10^{23}$ gC) of the carbon on Earth. Yet, this tissue-thin coating of life spread between rock and space transforms our planet through its biogeochemistry to the habitable home within which we prosper. It keeps CO_2 levels low, produces oxygen which is not only important for aerobic respiration but for the ozone layer that shields us from harmful UV radiation, it cycles nitrogen, phosphorus, sulfur, and other essential elements through our waters, soils and sediments, and it contributes to our climate system.

25.2.2 Biosphere: The Anthropic Edition

Every individual organism, plant, animal or microorganism, contributes to this biogeochemistry. Individuals among species vary widely in their contributions while individuals within species will have similar influences on biogeochemistry, the contribution of each species being a function of their numbers, their individual masses, and their physiology. It is true that each individual organismal contribution to the biosphere is miniscule, whether it is a blue whale or a bacterium, but each is in the service of the biosphere and collectively they run the biogeochemical machinery that allows Earth to sustain life in the thin layer between our rock planet and the vacuum of space above. As biological organisms, we do the same, though through our ingenuity and technology, as I describe below, we have contributed to biogeochemical functioning more than any other species.

From a terrestrial perspective, all the species of all the plants, totaling roughly 300,000 species (Kreft and Jetz 2007), remove 56.4 Pg C year^{-1} (Ito 2011) from the atmosphere and return it directly through plant respiration or indirectly through the respiration of the heterotrophs that consume dead or living plant material. These 56 gigatons of biofuel are shared by millions terrestrial species that, like their counterparts in marine systems, do the biosphere's biogeochemical work. Humans, once consisting of several species but now consisting of just one, appropriate nearly a third of this production (Haberl et al. 2007). Thus, from a biogeochemical perspective, the significance of humanity can be semi quantitatively described as a species that appropriates 15.6 Pg C year^{-1} of the total 56.4 Pg C year^{-1} while leaving the remaining 40.8 for its ~6.2 million fellow terrestrial species. That is, humans get 15.6 gigatons of carbon in the form of biofuels every year while all other species in terrestrial ecosystems get 0.00066 gigatons of carbon each. Such inequity can be viewed as a remarkable testament to our species' ingenuity and superiority or a testament to how unfair we are to the millions of species that cohabit our planet and work to make it a livable home, or proof that nature is in the service of humanity. These are not scientific questions, however, so I leave it to the reader and to ethicists better informed than I. The numbers, however, do allow us to quantify the massive influence of our species on eco- and Earth-system functioning relative to other terrestrial species.

What is sometimes left out of these exercises is the fact that most of the biomass that has replaced the Holocene biomass is made up of a few species of terrestrial domesticated plants and animals that are quite different from their ancestors and were mostly bred only 10–12,000 years ago, with aquaculture starting to catch up (Duarte et al. 2007). There are an estimated 40 species of animals and 7,000 plant species used in agriculture, but only 30 crops provide 95 % of human food energy needs and of these only four provide 60 % of human food energy (FAO 1997, 2007, 2010). This means that the third of the ice-free terrestrial world that is now agriculture or pasture (Ramankutty et al. 2008) is novel habitat (i.e., the last 10,000 years) dominated by a low diversity of novel species.

25.2.3 Biogeochemistry + Anthrogeochemistry = Novel World

We should not focus solely on pre-Holocene biogeochemical processes, however, because humanity's influence goes much further. Sen and Peucker-Ehrenbrink (2012) examined human influence over global elemental cycles for 77 elements, several of which involve primarily anthropogenic processes (such as iridium, helium, osmium, gold, mercury, and lead cycles). Natural elemental cycling is driven by a variety of processes, such as primary productivity followed by consumption and respiration, fluxes to oceans due to river transport, naturally occurring soil erosion, eolian dust (mineral dusts created from wind erosion of soil and other processes), sea-salt spray, cosmic dust, and volcanic emissions. Anthropogenic processes include mining, fossil fuel burning, biomass burning, construction, human appropriation of primary production, and our own contributions to soil erosion and eolian dust (generated from industrial activities and wind blowing over soil we eroded). Compared to what happens in the absence of such human activities, Sen et al. concluded that 62 of the 77 elements (80 %) were significantly (>50 %) influenced by humans. We can distinguish between anthropogenic and natural processes, but as humans are biological organisms, it is safe to say that post-Holocene biogeochemistry includes not only alterations of common biological elements, but also of many other elements, including rare and heavy metals, many of which are toxic (such as lead, osmium, and mercury).

This new biogeochemistry, which we might consider natural biogeochemistry plus *anthrogeochemistry*, makes for a different world chemistry, a novel biosphere.

25.2.4 Anthrogeomorphic Processes

We have not just altered geochemical flows, however, but we have also physically altered the geology of Earth. Mining, for example, responsible for many of the elemental cycles in Sen and Peucker-Ehrenbrink (2012) study, totals 35 Gt year^{-1}

of rock and sediment intentionally moved and an estimated 80 Gt $year^{-1}$ of soil eroded through agriculture, both of which rival many natural geological processes (Hooke 2000).

Arguably no anthropogenic global influence is more astonishing than our geological activity. Wilkinson (2005) described the impact quite nicely which I summarize here. Consider that Earth's surface is initially formed by rocks that emanate from its interior in hot, liquid form. A complex series of physical and chemical processes, often carried out over millions of years, leads to the production of an enormous variety of rocks and minerals that make up the surface of Earth. However, weathering, scouring by glaciers, repeated bouts of freezing and thawing that crumble rock, erosion and abrasion from rain and water, and chemical processes that soften and crumble rock surfaces, turns rocks into sediments. Over the last half billion years, 630 million cubic kilometers of sedimentary rocks have formed from the continents (85 %), equaling a layer 3 km thick if it were distributed evenly over the surface of the ice-free continents. For terrestrial surfaces, that averages to a creation of sedimentary surfaces of about 24 m per million years. Humans, however, via transport of rock and sediments for construction and by increasing movement of sediments in managed lands by tilling, irrigating, and removing vegetation cover by clear cutting, harvesting, or intensifying grazing, have moved enough surface material that, over a million years, would raise the surface of the Earth 643 m. This land movement translates to a stunning 28 times greater movement of terrestrial surface material than seen on Earth in the last 500 million years. Another way to look at this is that if humans distributed this removal of terrestrial materials uniformly over all of ice-free terrestrial earth (that is, not just over agricultural and grazing lands), they would bring down the surface by about 360 m per million years – ten times the erosive forces of glaciers, rivers, and other natural processes over a similar length of time.

25.2.5 Human Significance

Determining which of ten million species is the most significant can be settled in many ways. Who is the fastest? Who is the largest? Who is genetically the most unique? For our purposes, who has the biggest influence on eco- or Earth-system functioning is the right question to ask.

From the above overview, focused on a scientific perspective, human domination of the world has transformed the Holocene to the Anthropocene, a transformation that reflects the activities of humans pursuing many of the things they value. Our appropriation of naturally produced biofuel (terrestrial plant production) is sufficient to argue for the status of being the most significant species of the roughly ten million on Earth since we appropriate a staggeringly disproportionate amount of Earth's fuel for doing the biospheric work of making a habitable planet. If we used the energy in much the same way the species we replaced used the energy, the world might operate much the way it did in the Holocene, but we have used much of this energy to carry out novel functions and activities. We are moving elements and materials that, in several instances, were relatively ecologically inactive, some of which are highly toxic, and we have physically altered Earth in ways that rival natural geological processes.

Clearly, by multiple criteria, we are the single most significant species on Earth, perhaps throughout all its history, for never has one species achieved what we have achieved.

25.2.6 Humanity's Scorecard

To be the most significant species is a mixed blessing. As a community ecologist who studies the relationship between biological diversity and the functioning of ecosystems, it is awkward for me to comment on issues that lie more properly in the realm of the humanities. With that as a sort of caveat, I offer that to be the most significant species on Earth can be an honor or a worry. It could be an honor because we are the guardians of the living world and there is a pride that comes with being a guardian. It could, however, be a worry because we could make a mess of things and jeopardize the future of all living things, ourselves included.

How have we done as the most significant species and the guardian of all life on Earth? To assess stewardship at a global level is difficult because one needs some sort of scorecard. At a global scale, I suggest that safe planetary boundaries may serve as proxies for human stewardship scores. Rockstrom and colleagues (2009) considered Earth as a dynamic system whose functioning could change dramatically and put life at risk if certain thresholds were crossed. They referred to these thresholds as *safe planetary boundaries*. These boundaries were based on the idea that environmental conditions during the Holocene (about 12,000 years ago – long before the development of agriculture and the domestication of plants and livestock) – were conditions under which humanity prospered. Our current geological period is referred to as the Anthropocene because, many argue, Earth's environmental conditions under human influence are significantly different from those prior to the development of agriculture some 10,000 years ago (Crutzen 2002; Zalasiewcz et al. 2008; Steffen et al. 2009). The *anthro* in *Anthropocene* refers to a geological period that is the result of humanity's activities and is unique in the sense that no single species has ever been solely responsible for defining a geological epoch.

Rockstrom et al. assembled a list of 11 conditions and specified the levels of each that represented safe boundaries. If we crossed any of those boundaries or thresholds, Earth system functions would be at risk. Their list included (their value for the threshold is in parentheses)

1. atmospheric CO_2 concentration (350 ppm),
2. change in radiative forcing (11.5 W m^2),

3. rate of biodiversity loss (10 >100 species per million species lost per year),
4. amount of N_2 removed from the atmosphere for human use (35 MT $year^{-1}$),
5. quantity of P flowing into the oceans (11 MT $year^{-1}$),
6. concentration of ozone (276 Dobson unit),
7. ocean acidification (2.75 global mean saturation state of aragonite in surface sea water),
8. global freshwater consumption by humans (4,000 km^3 per year),
9. change in land use (15 % of global land cover converted to cropland),
10. atmospheric aerosol loading (to be determined), and
11. chemical pollution, such as organic pollutants, plastics, endocrine disrupters, heavy metals, nuclear wastes, or other sources of pollution that adversely impact ecosystem and Earth system functioning (to be determined).

Using these safe planetary boundaries as scores, we can evaluate our stewardship. A perfect score would be for these 11 environmental metrics (though metrics for 10 and 11 are yet to be devised) to be at or near Holocene values in spite of the fact that we appropriate a third of Earth's biofuel. It would mean that we serve the biosphere as other species do and are good substitutes for the species we drove to extinction. It would mean we have used the third Earth's biofuels in a way that has had no harmful effects.

In most cases, according to Rockstrom et al., our current scores are nowhere near Holocene conditions. Of the 11, we have already crossed the safe planetary boundaries for biodiversity loss, climate change (1 and 2 above), and N cycle amplification (4 above). These boundaries are like the dashboard of a vehicle or other system in which meters or indicator lamps relay the current state of the system's function. The needles can be in the danger zone and the lights flashing and the system keeps going, but it is worrisome.

Systems operating outside their safe boundaries are worrisome to operators, but to those who maintain, design, or are otherwise involved with the system, crossing safe boundaries are challenges and opportunities to restore or modify the system so that it performs better. Metrics informing that a system is close to failing may also be an opportunity to evaluate operator performance and provide guidance on how to run the system better. For example, geoengineers imagine that they can regulate atmospheric CO_2 by enhancing C sequestration through industrial scale chemical means, enhancing algal growth in the oceans, or increasing plant production and insuring that the new biomass does not decompose (i.e., improve the system). Alternatively, one could identify the sources of anthropogenic CO_2 and reduce or eliminate them (i.e., improve operator performance). Using an automobile as an example, if the tachometer indicates that we are exceeding the number of engine revolutions per minute that the designers consider safe, we can learn to apply pressure to the brakes and slow the car down whenever the tachometer is in the red, or we can purchase a car better designed to provide the performance we desire – one that can provide us ample speed without the threat of engine malfunction (i.e., improved design).

25.3 Discussion

25.3.1 The Ecosystem-Service Construct – Necessary but Insufficient

From the broad overview above, humanity has gone from contributing to nature's functioning in ways largely indistinguishable from the way other species do, to becoming a species whose influence over eco- and Earth-system functioning is enormous, unprecedented, and dwarfs the contributions of all other species. Biologically, chemically, and physically, in the service of humanity, nature has become, by Holocene standards, something novel; something that has operationally crossed or is rapidly approaching a number of safe planetary boundaries.

Whether one sees our dominance as testament to the magnificence or the folly of humanity is not for science to judge. It does, however, reveal the impacts of the unregulated pursuit of the benefits ecosystems provide us.

The ecosystem-service construct, as the central part of the MEA framework, provides the means for us to consider how we might move forward in the Anthropocene. The goal is to transition from economic development founded on unregulated exploitation of nature's benefits to one that is better attuned to achieving environmental sustainability and greater equity in the distribution of human well-being. It is a construct that focuses on nature in humanity's service, so does not represent a radical departure from the traditional anthropocentric view.

The ecosystem-service construct does, however, link human well-being to the diversity of life on Earth and the multiplicity of ecosystem functions that underlie ecosystem services, and these are important advances in environmental thinking. The construct better integrates nature into economic development (Gomez-Baggethun et al. 2010). It is also an important part of strategies for achieving environmental sustainability (Jordan et al. 2010). Payment for ecosystem services has fast become a popular means for developing conservation projects that range from single species conservation to carbon credits for avoided deforestation (Wunder 2007; Engel et al. 2008; Kattoomba Group and UNEP 2008; Wunder et al. 2008; Farley and Costanza 2010), though market-based schemes for ecosystem services have their limitations (Kinzig et al. 2011). The construct is also central to international agreements such as the Convention on Biological Diversity's 2020 Targets (Perrings et al. 2010, 2011) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) which will become a major body for facilitating international collaboration and discourse on environmental action much the way the Intergovernmental Program on Climate Change has (Larigauderie and Mooney 2010; Larigauderie et al. 2012). For reasons such as these the ecosystem-service construct has been showing a tremendous rise in popularity (Fig. 25.1).

The ecosystem service construct is clearly important, but it is insufficient by itself to form the foundation for our environmental actions aimed at achieving environmental sustainability. It is insufficient because it continues to promulgate the notion that nature is in the service of humanity when the evidence thus far suggests that such an approach may be an impediment rather than a catalyst for achieving environmental sustainability. It seems unlikely that we can return to Holocene conditions, retain what we have, and continue on to 9 or 10 billion people before we stop growing.

25.3.2 Biodiversity: What if Cats or Roaches Ruled?

The ecosystem-services construct sees the biosphere in humanity's service which is understandable. Probably any species, were it sentient and capable of influencing eco- and Earth system processes the way we do, would devise the very same construct of ecosystem services as a link between eco- and Earth-system functioning and its own well-being. For example, if cats ruled the world, they might develop the idea of ecosystem services as the benefits ecosystems provide cats. If roaches ruled, they would do the same. Many species do, in fact, modify the environment to suit their needs which can affect their evolution and the evolution of their ecosystems (Jones et al. 1994; Wright et al. 2002; Laland and Sterelny 2006; Menge et al. 2008; Thorpe et al. 2011). Humans, however, are less coupled to the natural world than N-fixing plants, termites, beavers, or other well-known examples of ecosystem engineers. Whatever limit or negative feedback nature might impose, we find ways to circumvent it. If our consumption of primary production leads to nutrient depletion, we fertilize. If it leads to water depletion, we irrigate. If dense plantings or dense packing of livestock increase the incidence of disease, we improve sanitation, develop and use drugs like antibiotics, and invest in research to find ways to reduce or eradicate the disease. Cats and roaches would do the same – a world full of mice or a world full of crumbs. Humans are not guilty of doing anything any other species would not do if it had the chance, or so I am guessing.

Whether the Anthropocene (human world) or Felidopocene (cat world) or Blattodocene (roach world), any biosphere in the service of a single or limited number of species will, if feedbacks and regulations are overcome, yield a planet that will ultimately cross safe planetary boundaries. The way the world generally functions is that millions of species, not one or a few, contribute to eco- and Earth-system functioning. This diversity of life is instrumental in governing the magnitude and, more importantly, the stability of ecosystem functions, which means that they are obviously instrumental to governing the magnitude and stability of ecosystem services as well (Cardinale et al. 2012; Naeem et al. 2012). Diversity has this effect for many reasons, but one of the best demonstrated mechanisms for the positive influences of biodiversity is that some species complement each other in their biogeochemical activities, which makes for greater efficiency of resource use, while other species are redundant, which allows one to substitute for another when environmental conditions fluctuate. The complementarity among millions of species and redundancy among other millions of species serves to make Earth an efficient and robust habitable planet. It is highly unlikely that any single or relatively small

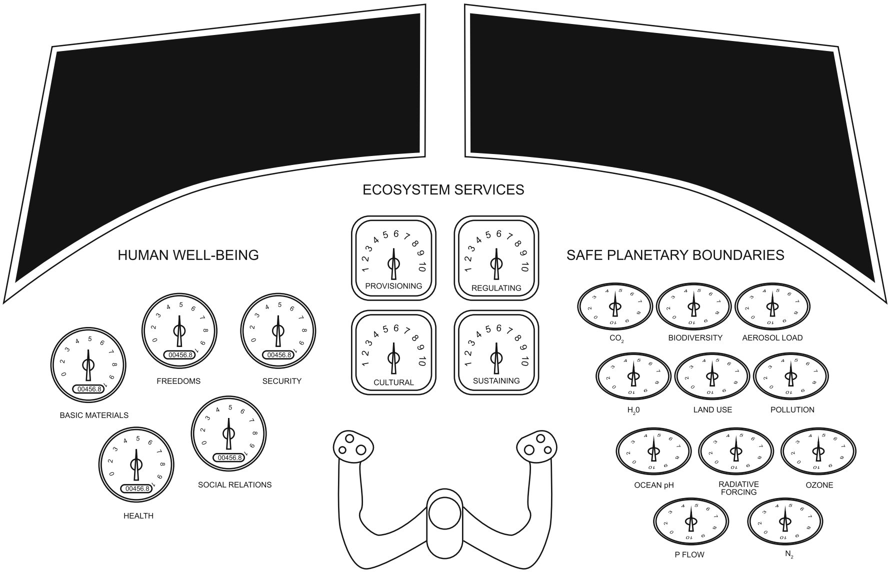

Fig. 25.2 Ecosystem-service centered helm of Spaceship Earth. The image represents the helm or cockpit of the biosphere in which humanity uses indicators for operating eco- and earth-systems. Lower center object is a steering wheel. Instrument layout on the panel suggest that the current trend is to focus on ecosystem services (*center*) to maximize human well-being (*left*) while keeping an eye on safe planetary boundaries (*right*). The *top black* panels represent windows

number of species can do the same, be they humans, cats, or roaches, because they will not represent the tremendous complementarity and redundancy necessary in the biosphere to contend with environmental variability.

It is clear a single-species or low-diversity (e.g., humans plus 40 species of domestic animals and 30 species of domestic plants) ecosystem-service platform for eco- and Earth-system functioning is unwise.

25.3.3 Humans at the Helm

Humans dominate the biosphere and, though it may not have been our collective intention, we are at its helm. The idea of humans at the helm relates to the concept of Earth as a spaceship whose living systems function like a life-support system and with the right economic and ecological guidelines we can operate it (Boulding 1966; Fuller and Snyder 1969; Odum 1989; Andreae 2002). Using this analogy of nature as the life-support system of a spaceship we operate, the idea of a dashboard can help us visualize what human well-being, ecosystem services, and safe-planetary boundaries tell us (Fig. 25.2). Accepting Holocene conditions as the set points, the dashboard shows that most boundaries for safe planetary functioning have either been exceeded or are being approached rapidly (Rockstrom et al. 2009). This means life-support functioning is at risk and we should consider ways to lower system stress, redesign the system, or find other ways to get the indicators in the red back into the green. We would see the indicators of human well-being taking on worrisome values and those for ecosystem services starting to plummet. Continuing with the analogy, when the indicators are signaling trouble, we take the steering wheel and shift our course, watching all the indicators on the dashboard to help guide us. Figure 25.2 shows a dashboard layout in which the indicators we use most for guidance are in the ecosystem service panel.

The current state reflects what happens when humans are free to meet their desires and how far it took us from Holocene conditions. Earth's local biotic richness, or the number of species per unit area, has shrunk dramatically – in the Holocene, a random walk would have led to encounters with many more species than one encounters now, especially since most of our random walks today would find us in highly managed and simplified landscapes. That Earth's biogeochemistry is novel, with one species out of ten million dominating key biological elemental cycles and significantly influencing 80 % of 77 elemental cycles investigated, and that humanity's need to plow, excavate, mine, and transport elements in massive quantities is unlike anything other species do or have ever done, clearly demonstrates that meeting our needs has led to an unrecognizable planet.

Biologically, biogeochemically, geologically, and in other ways we have reconfigured our life-support system to better serve us, but we had no dashboard or manual to help us understand the significance of our activities. Ecosystems are novel, with possibly 75 % exhibiting evidence of human influence (Kareiva et al. 2007; Hobbs et al. 2009). Eco- and Earth-system functions have indisputably deviated substantially from Holocene conditions. With our hands on the wheel and the instruments inundating us with information about the biosphere, we are in the middle of pondering what we should do next.

The ecosystem-service construct in just one of many guiding principles proposed for managing Earth's life-support system. Here, I have addressed the fact that this construct relates human values, which include things like recreational, inspirational, spiritual, religious and other values related to human well-being, to ecosystems as if what we value can be ultimately linked to chemistry, biology, and physics. Human well-being, as defined by the MEA, includes basic materials for a good life, freedom and choice, health, good social relations, and security (MEA 2005). The MEA framework suggests that all these constituents of human well-being, because they can be linked to biodiversity and ecosystem functioning, can also serve as a basis for centrally placed instrumentation on Spaceship Earth's dashboard, as I have illustrated in Fig. 25.2.

Given humanity's success in rising to become the number one species of all time, one would think that business as usual would be a good plan, but, as the MEA showed in its analysis, the distribution of human well-being is highly skewed (MEA 2005). Consider the basic numbers describing the current state of human well-being: a billion hungry, two billion poor, and three billion living in water-scarce habitats. Given almost half our current population of seven billion is in dire straits, it is not clear that human well-being has actually acted as our top priority.

25.4 Conclusion

25.4.1 The Perils of Ptolemaic Thinking in Environmental Biology

Viewing nature in humanity's service, as the ecosystem-service construct does, requires judging ecological and evolutionary processes and outcomes centered on human values. If judgment is based solely on human values, however, then any aspect of nature that does not serve us well will be seen as an environmental problem, something that needs to be fixed. Some go so far as to refer to anything nature does that seems not in our favor as an *ecosystem disservice* (e.g., Dunn 2010; Limburg et al. 2010; Power 2010; Escobedo et al. 2011), which reflects a complete subscription to the belief that everything revolves around humanity.

This anthropocentric perspective is akin to the second-century thinking of Ptolemy of Alexandria who viewed the Earth as the center of the universe. Although counter theories existed long before Copernicus's famous heliocentric theory of the sixteenth century, in which the sun rather than the Earth was placed at the center of the cosmos, finally displaced the Ptolemaic, there was tremendous appeal to the idea that Earth was at the center so the natural science construct persisted for perhaps 2,000 years. The Ptolemaic view concerned earth as a central sphere among other spheres. The ecosystem-service construct concerns humanity, or the anthrosphere, as the center of the biosphere. From an ethical standpoint, humanity's place may be at the center, but such a view is not scientific. One might argue that our singularly massive impact on the biosphere places us at the center, so perhaps this Ptolemaic-like perspective is scientifically defensible, but I leave this for others to address.

The thesis of this essay is that the ecosystem-service construct is not a natural science construct and while it has its values, is insufficient to achieve the goals it was constructed to achieve. The natural scientist can describe nature's workings, its structure, its dynamics, and its properties such as its stability, its past and future states, and more. It is not for a natural scientist, however, to judge any aspect of nature as a service. They can do so, of course, from their own personal beliefs or people can give the ecologist a list of what they deem as nature's goods and services and ask the ecologist to devise methods for securing them. Since the Brundtland report (WCED 1987), it is expected that the ecologist would devise and people would ask for sustainable methods for securing ecological services. If people indicate that they prefer paper pulp from a sustainably harvested plantation of pine than owls calling in the evening among cathedral redwoods in a mossy old-growth forest, then the ecologist designs the plantation. The ecosystem construct, if part of environmental policy, may require an ecological or environmental economist to determine if the old growth owl habitat is more valuable than the pine plantation. There are many who uncritically believe that the owl inhabited old growth will come out on top. The outcome, however, will hinge on unemployment, the demand for paper in relation to its supply, supporting economic development in a struggling neighboring urban community that needs clinics and schools, a perceived need to eliminate ravens and crows that thrive in the old growth and serve as reservoirs of West Nile Virus and eliminating mosquitoes that serve as vectors. Their analyses may be further affected by a terrestrial version of Pauly's (1995) shifting baseline concept where the current generation does not hike or hunt as their parents did, or for those that do, a small park nearby satisfies their needs, so see no important recreational values for the old growth. They may also find that contemporary religious beliefs in the region no longer give special status to owls, ravens, bears, ancient trees, and generally harbor no strong cultural values for old growth. In fact, residents may prefer the sight of healthy plantations that speak to economic prosperity and a peaceable kingdom depending on their views of what constitutes Eden (Merchant 2003). Owls and old growth are not guaranteed to qualify as ecosystem services, especially if the extremist views of nature as a disservice prevail. Personally, I confess I see this as unfortunate, but as a natural scientist, my only concerns should be that the ecology and evolution were properly understood by the economists who provided the analysis and social scientists can vet the economics.

Viewing nature in humanity's service means that if climate does not suit us, we need to fix it. If species are edible we favor them over those that are not. If economic development means species extinction, we decide if that is permissible. If soil is not fertile enough for our needs, we enrich it. If pollutants threaten ecosystems, we decide if that is acceptable. If nature is not esthetically appealing, we alter it. Ecological science can be used for monitoring, assessing, managing, restoring, or even redesigning nature into something it never was. There is, however, nothing in the structure and dynamics of nature that reflects a design to serve humans. It is the end product of three and a half billion years of ecological and evolutionary processes that reflects no design that serves any single species.

Nature neither serves us nor disserves us. In fact, it neither serves nor disserves any species in its current stock of ten million.

If anything, natural science best supports the perspective that species serve each other because we all serve the biosphere, much as we serve our gods or countries. This is not a pantheistic view or alternative to Deep Ecology – it is a natural science view based on the evidence that biodiversity is critical to the magnitude and stability of eco- and Earth-system functioning. That is, all species derive benefits from nature by dint of the fact that they all serve their ecosystems and, scaling up, their biosphere, the slim little system between rocks and the cosmos that makes our world habitable.

If we return to the analogy of the biosphere as a spaceship whose helm we now occupy, as illustrated in Fig. 25.2, the steering wheel of this imaginary helm has never been used in over 3.5 billion years. The biosphere was on a sort of autopilot – an evolutionary, ecological, geological, astrophysical, and cosmological set of processes that led to the development of the biosphere which in its complexity and design became the home we know. From a standpoint informed by naturalism and pragmatism, this complexity and design reflects no divine intervention or preordained outcomes. One can consider the supernatural or metaphysical to better understand our place and destiny in the biosphere and the cosmos above it, but valuable as such perspectives might be, it is best to keep them parallel to scientific views, not linked.

I suggest if we see ourselves in the service of nature and are not overly distracted by untenable ideas of nature serving (or disserving) humanity, we will be the first real stewards nature has ever had and, if we so choose, its best.

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Chapter 26
Linking Ecology and Ethics for a Transition to the Sustainable City: Values, Philosophy, and Action

Stephanie Pincetl

Abstract Cities in the United States have faced declining public funds for at least two decades, and in California since the passage of the 1978 property tax initiative, Proposition 13. The first areas cut were parks and recreation. This chapter describes the emerging new urban ecosystem and greenspace public/private initiatives for greater urban sustainability taking place in Los Angeles. It argues that a complex heterarchic (self-organizing) set of opportunistic relationships and programs have evolved involving tree planting, stormwater infiltration, small park creation and street tree planting. They are led by public/nonprofit partnerships and characterized by opportunism. Little accountability or transparency exists – there are rarely public hearings or documents that can be accessed by the public. This is quite different than the twentieth sanitary/modernist city that was built on siloed departments with public hearings, developed workplans and capital budgets (Melosi MV, The sanitary city, urban infrastructure in America from colonial times to the present. Johns Hopkins University Press, Baltimore, 2000). While projects are created and implemented, they are done so with the expectation of public acceptance – but no hearings or consultation. In low income communities, they may create an additional burdens of responsibility and labor for maintaining these new infrastructures.

Keywords Green infrastructure • Urban ecosystems services • Opportunism • Public private partnerships • Accountability • Sustainable cities • Sanitary cities

S. Pincetl (✉)
Institute of the Environment and Sustainability, University of California Los Angeles, 300 La Kretz Hall, Los Angeles, CA 90095-1496, USA
e-mail: spincetl@ioe.ucla.edu

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26.1 Practice of Power in Urban Ecosystems – An Ambiguous Terrain: The Case of Los Angeles

Los Angeles is the second largest city in the United States, and in a Mediterranean climate. With hot dry summers and rain in the winter, local vegetation was largely coastal scrub in the lowlands, with wetlands irrigated by annual and perennial streams, oak forests lining the foothills and pine forests in the higher altitudes. The city is ringed by the Los Angeles and San Bernardo National Forests, providing hundreds of thousands of acres of open space and recreation lands, as well as providing significant watersheds that replenish ground water.

Down in the plain though, the landscape has been highly urbanized with only a few sizable parks, concrete channeled creeks, and a predominance of non-native vegetation. While Los Angeles uses less water per capita than any other city of over one million inhabitants (at about 117 gal per person), outdoor irrigation is a significant portion of water use, and much of it goes for lawns. Over the past decade much attention has been paid to disparities in park and open space distribution in the city, and recently to the disparities in tree canopy cover (TCC). There is abundant evidence that low income communities of color suffer from less access to open space and lower tree canopy cover (Wolch et al. 2005; McPherson et al. 2011; Sideris and Sideris 2009, 2010, http://www.laparks.org/planning/pdf/exeSum.pdf). At the same time the city is tax poor, as is California in general. The passage of Proposition 13 in 1978 reduced property taxes to 1 % of the value of the property and decreased property taxes by assessing property values at their 1975 value. It restricted annual increases to 2 % per year. Moreover it required a two-thirds majority vote in both legislative houses for any future increases of any state tax rates or amounts of revenue collected including income tax rates. It also required a two-thirds majority vote in local elections for local governments wishing to increase special taxes (Pincetl 1999). Subsequently, Proposition 218 was passed in 1996 that requires majority voter approval on general tax increases and then in 2010 Proposition 26 passed, requiring a two-thirds majority vote for some new fees at the local level. This series of tax restricting propositions has led to dramatic cuts in city budgets, including programs for parks and open spaces, tree and road maintenance, and the ability to implement novel ecosystem services. As Joassart-Marcelli et al. note, when budgets are tight and incomes fall, parks and recreation are among the first programs to be cut (2011). This is certainly the case in Los Angeles. Additionally, Los Angeles is a poor city with about 17 % of the population below the U.S. poverty line in the metropolitan area (American Community Survey 2012).

While historically the city of Los Angeles has not been parks and open space friendly (Hise and Deverell 2000; Pincetl 2003), opting for land development and low taxes over park creation and the fiscal austerity of the past 30 years or so has exacerbated the difficulty of addressing open space needs of the city's growing populations. Thus access to urban ecosystems – which in cities is usually seen as parks and open space, and the distribution of ecosystem services like trees – is defined by a set of related fiscal, political, social and cultural forces that shape resources allocated to their maintenance, and/or creation. In the case of Los Angeles, and California in general, the context over the past 40 years has been one of severe constraints.

26.2 Urban Ecosystems in Los Angeles

Despite being surrounded by National Forest on the North and East, the ocean to the West, and bisected by the Santa Monica Mountains hosting a National Recreation Area, and a state conservancy preserving over 200,000 public acres, access to such spaces is difficult for many people due to distance and lack of automobile ownership among disenfranchised communities (Byrne et al. 2009). Further some of these natural areas pose other kinds of obstacles to use, such as lack of hiking equipment, knowing how to swim, map and trail reading skills, knowledge about the existence of these vast mountain resources, and simple unfamiliarity with "wild" landscapes. While there are several fairly well distributed large urban regional parks, there is a lack of smaller accessible parks in many low-income neighborhoods, and where they exist, there is a fear of crime that inhibits their use in comparison to those in more affluent neighborhoods (Sideris and Sideris 2010). At the same time, there are multiple efforts at different levels of the city (and the county), in neighborhoods, and by non-profits to enhance access to parks and to increase ecosystem services in the urban fabric. Park space and urban ecosystem services are not infrequently conflated in public discourse, especially by park advocates who attempt to provide multiple services in parks, including stormwater infiltration spaces, and the augmentation of tree canopy cover.

In August 2012, the Mayor announced a 50 Parks Initiative, primarily in park-poor, population dense neighborhoods, and by summer 2013 all 50 sites should have been acquired. The parks will have less turf, more permeable pavers, more mulch and will be easier to maintain, and add to an ongoing effort to increase parks and park access. Two notable large and gated wetland/water parks in south Los Angeles, historically African American, now predominantly Latino, have been recently created. One is on a 4.5 acre former rail facility and remediated brownfield whose remaining contamination has made it unsafe to reinfiltrate stormwater; the other, just over a mile away, is on a former 8.5 acre cement pipe storage yard and has a 24 h ranger on site for security. Interestingly neither park hosts playing fields and they both focus mostly on walking recreation, picnicking and environmental education.

In East Los Angeles, a 93 acre open space park has just been opened – Ascot Hills Park. Currently featuring only a few miles of dirt trails, an amphitheater, picnic tables and a small stream, it is largely dusty and dry until the spring rains. Ascot Hills Park is located in a primarily low income Latino neighborhood of Los Angeles and was formerly a Los Angeles Department of Water and Power outdoor training facility.

Alongside these small and large park efforts are activities to enhance ecosystem services both in parks, as mentioned, and in the urban fabric. Million Trees Los Angeles, launched when Antonio Villaraigosa was elected mayor nearly 12 years ago, has succeeded in planting about 400,000 trees, targeted at neighborhoods with low tree canopy cover – largely low income neighborhoods of color. Several initiatives have been undertaken by public private partnerships between nonprofit organizations and the city, and funded in part by a storm water bond initiative Proposition O, to install storm water infiltration projects that direct storm water into cisterns and infiltration trenches. Located primarily in the San Fernando Valley , characterized by good infiltration and high volumes of stormwater from the mountains during rainy spells, these have also been placed in low-income communities of color.

Early accounts of the Los Angeles plain recount a patchwork of grassy prairie, wetland, scrub, oaks and dense willow thickets, creating a swath of 130 square miles in the Los Angeles plain (Dark et al. 2011). Meandering wildly and unpredictably, irrigating these wetlands was the Los Angeles River and numbers of creeks and streams, supplemented by artesian springs. To counteract the channelization of the Los Angeles River by the Army Corps of Engineers to reduce flooding, the so-called restoration of the Los Angeles River, replete with mini stormwater parks, and bike trails, is intended to create more park space for disenfranchised communities. The project employs the imagery and imaginary of the long lost river and wetlands to appeal to residents. At first the idea of restoring the Los Angeles River was seen as a joke – it is currently a concrete channel built for flood control and well known in many films. But as urban ecosystems have become more popular, and urban river restoration more common, little by little restoring the Los Angeles River has become a viable project. With money from the U.S. Army Corps of Engineers, planning for its revitalization is well underway.

In addition to these large scale, capital intensive efforts, smaller improvement plans are also underway. These include street improvement projects that introduce parklets, add street furniture such as benches and tables, planting more street trees, greening street medians – all to be accomplished through the fund raising and labor of residents and for which guidelines and codes have been developed (York Vision Work Plan 09 26 12).

26.3 Power and Ecosystems in the City, Mobilizing Resources and Momentum

What to make of all these efforts in a time of budget shortages and rise of nonprofit philanthropy? How are the agendas set and carried out? What community participation is involved and whose vision is being advanced?

To the extent that the city's own capacity to provide parks and now urban ecosystems through green spaces has eroded due to budget cuts, this has led to far greater participation by the nonprofit sector, as well as quasi public entities such as conservancies established by the state, but whose revenues are derived from park bonds, philanthropic donations, and fees (Pincetl 2003). In addition, the city itself has raised its fees for the use of public amenities like the public golf courses, recreation center offerings, municipal swimming pools and with bonds, though they will no longer be able to due to Proposition 23, also limiting taxation. Thus tax limitation measure after tax limitation measure is shrinking even this strategy. The shift toward short term sources of funding that require constant renewal, was part of the larger shift in the late twentieth century away from the more centralized sanitary modernist city that relies on gray engineered infrastructure with a tax supportive distributive state, toward a more cobbled together public/private hetararchic (or self organizing) and opportunistic city organization, funded by bonds, grants and philanthropy that is also attempting to transition toward greater environmental sustainability (Pincetl 2010). So not only are sources of funding complex and cobbled together from bond initiatives, and public/private partnerships, but questions of power and justice are often occluded in this shift. The transition represents a complex set of interactions, interrelationships and interdependencies that are opaque, dispersed, scattershot and rarely integrated; they nonetheless seem to be transforming the urban fabric.

Take for example the Million Tree initiative. There is no question trees have been planted, but there is no publicly available map of their locations, no plan for where they should be planted, no climate appropriate guidelines for tree species selection. There were no community meetings about where to plant trees, what kinds of trees, or whether trees were wanted at all. In the traditional sanitary/modernist city model (Pincetl 2010; Graham and Marvin 2001; Melosi 2000), new infrastructure proposals (and trees were touted as green infrastructure), hearings would have been held, plans developed, bids solicited. Whether the result was democratic or driven by the power elite, the *form* of the process was transparent, and predictable. In this new opportunistic city, things are done through the determination of clever and dedicated city staff identifying funding sources such as fines, federal programs, bond monies or philanthropic donations, and/or, with the collaboration with environmental (or other) nonprofits to develop new sources of funding, like bond funds. This public/private partnership may also come to the project with different pots of funds that each, due to their particular structural position, can access.

In the case of the Million Tree program, the Mayor's office – implementing the campaign promise of the Mayor – partnered with nonprofit organizations to target low canopy neighborhoods for tree planting. Through grant writing by the city and the nonprofits, tree stock contributions by the Los Angeles Department of Water and Power, lawsuit settlement funding from the Southern California Air Quality Management district and other small grants, a steady trickle of funding for the nonprofits to plant trees was developed. Of course, the fee per tree planted yielded salary levels far inferior than would have been paid to city employees. Each nonprofit has been conducting outreach with residents, asking for permission to plant street trees for them, and promising to water them for the city-requisite amount of time for a new street tree. The results of this effort may mean the city will require additional water resources to irrigate the trees, while potentially reducing the urban heat island, depending on the size of tree planted, and its longevity. It also, in the longer run, means that the residents in the neighborhoods will bear the burden of tree maintenance as the city has no funds to do so. Further there is no transparency regarding the funding of the program (Pincetl et al. 2012).

Stormwater infiltration projects have been largely initiated by nonprofit organizations, convinced that through better stormwater capture and infiltration, the city will be able to reduce its dependency on imported water. Led by two rival organizations, TreePeople and The Council for Watershed Health, expensive demonstration projects have been built in areas of the San Fernando Valley which once experienced flooding and did not have stormwater infrastructure. Instead of building traditional culverts that would drain the stormwater to the sea, with the participation of the city and the county, one of the stormwater projects was built in the school yard of Broadous Elementary School where it infiltrates stormwater into 220 plastic units that together can hold up to 95,200 gal. The system is engineered to collect 100 % of the runoff from a 10 year storm. The school project was encouraged by a local environmental justice nonprofit, Pacoima Beautiful, as the flooding of the streets and sidewalks surrounding the school during severe rainstorms prevented students from getting to the school. Another project, the Elmer Street Project, installed infiltration trenches to a cistern under a city block, to capture storm water in another San Fernando Valley area where there was also no storm drain infrastructure and there was flooding. Both hugely successful projects were also enormously expensive, and in the Elmer Street case, The Council for Watershed Health must do regular maintenance, including picking trash out of the infiltration bioswales along the street. Further, despite intensive public education of the residents of the block, and some transformation of gardens to more climate appropriate landscaping and infiltration inducing land shaping, one resident simply entirely paved the front yard.

One of the major looming issues facing these projects is the lack of maintenance funding over the long term. While park bond funds, for example, make money available to build new parks and facilities, the budget of the city's Recreation and Parks Department has not been commensurably augmented to maintain the new parks. As discussed above, while fees had risen before the passage of Proposition 26, they are not sufficient to address the maintenance of the new facilities, and the tax and fee restrictions voted by the public create very difficult thresholds to overcome going forward. Proposition O, the aforementioned stormwater bond initiative for $500,000,000 that passed with more than 2/3rds majority vote (Park et al. 2009) in 2004, created funding for multiple purpose projects, allowing the use of the funding to create stormwater infiltration small parks, for example. But it was also used to modernize antiquated irrigation systems in city parks, repair leaking park lakes and ponds, and install water purification systems to improve stormwater quality to comply with the regional Total Maximum Daily Load thresholds set by the Regional Water Quality Control Board. The funding was critical, but fell far short of what is needed. Still, the bond's approach was innovative, allowing multiple purpose projects, a genuine departure from the traditional sanitary city approach. And the initiative was written by a group that included city officials and the leaders of local environmental nonprofit organizations. No environmental justice organizations were directly included or consulted.

26.4 The Double Edged Sword of Opportunism

The sustainable city of the twenty-first century is emerging chaotically and patchily. There is no real planning for this city, in the way that the modernist city came about. This is an era of no big plans, as it is resource scarce. Instead interventions are punctual, the changes opportunistic, with the hope that over time, the distributed access to urban ecosystems will add up to be like the distributed infrastructure of the sanitary city. Sanitary cities delivered potable water, sewage sanitation, electricity and so forth in each home and residence. The urban ecosystem-based approach is not nearly as systematic. Its innovations include street bioswales for water infiltration, also creating more green space in the city, the planting of street trees for more shade to cool the city, small watershed parks that serve to create more neighborhood open space while adding additional infiltration, complete streets, vegetated walls and permeable paving. But with no clear governance structure, rules or conventions, public/private partnerships bringing these new gray/green infrastructures to the city are shaped around opportunities and ideas, project by project. The resource constrained sustainable city operates catch as catch can, and power is fleeting and dispersed. Finding a source of funding, allying with the right elected official or city agency or bureaucrat, can make a project come to fruition in any part of the city. While historically in Los Angeles, power, parks and affluence have been concentrated in White neighborhoods, the city's demography is changing rapidly toward a no ethnic or racial majority, and the politics have as well. There is greater consciousness of inequality in access to and the location of, urban ecosystems and more and more projects are being located in disenfranchised communities. At the same time, there is no guarantee that such projects, opportunistically undertaken, haphazardly located, will be either maintained in the long run, or add up to providing noticeable ecosystem services at a larger scale that will make the city more sustainable and these new ecosystem services meaningful. Further, there is also the danger of these projects entraining gentrification, or simply not being appreciated, as in the Elmer Street example. A city in which there is greater ecosystem infrastructure dispersed throughout, looks and functions differently than a grey centralized infrastructure city. Each parcel of land becomes a participant in this new urban form, contributing its potential to infiltrate stormwater, grow a shade tree, or provide habitat for fauna and flora. This then means that the resident must assume responsibility for that function – the city does not have sufficient funding to manage these distributed systems, nor, probably, the legal authority. Thus an important question is whether a sustainable city using its parcels for ecosystem services, needs different private property laws.

26.4.1 The Los Angeles River

The restoration/revitalization of the Los Angeles River is case in point in ecosystem power in the city. Rhetorically described as a restoration project, funded by state park bond monies and by funds from the Army Corps of Engineers, the River restoration's real funding will come as a result of real estate development along its banks. Thus, recalling David Harvey's *Social Justice in the City* (1973), and Molotch's (1976) "The City as a Growth Machine," it is worth being concerned about whose interest will be served by any number of these urban ecosystem projects, despite best intentions, especially in a time of resource constraints. Already in some parts of the city where extensive street tree planting has taken place, such as in Pacoima, there is anecdotal evidence, and street level feeling, that it is leading to displacement of local residents as there can be higher rents charged.

26.5 Conclusion

The practice of power in urban ecosystems is anchored in the local social, economic, cultural and political conditions of place. But with the decline of the modernist, distributive state and city and the rise of concern about sustainability, especially at the urban scale, the type of governance and government organization is central to the questions of democratic accountability, legitimacy and transparency. The practice of power in this new shifting and emerging terrain of trying to get things done in an ambiguous terrain of funding availability, scientific understanding of urban ecosystems, and shift in type and look of nature in the city, is opportunistic. It is more difficult to carry out grand projects à la Robert Moses, if not practically impossible. Power depends on coalitions, collaborators, funding, and opportunities rather than vision and force.

The sanitary city of the early twentieth century was ushered in by a political movement, inspired at the injustices, insalubrious living conditions and poor work conditions of the industrial age (Melosi 2000). The Progressives, supported by the public, reformed government, banking, labor laws, and urban environmental management (water, sanitation systems, parks, zoning, housing). The sustainable city has no such broad based political movement supporting extensive and intensive change in how cities should be organized. There is little engaged public debate and dialogue about the reform of urban systems and changes in urban morphology. Rather the need for urban ecosystems tends to be asserted by a technocratic environmental elite that does not accompany its projects with long term, sustained funding and thoughtful social reform that might lead to greater capacity for transformation.

And yet, such opportunities are surely present. Going back to the 1992 uprisings in Los Angeles, a set of demands from the Bloods and the Crips, two notorious gangs, listed the need for open space, rodent control, better pay for teachers. Disenfranchised communities have been – in some parts of Los Angeles – deeply involved in developing park projects and demanding brownfield remediation. The connections between the opportunistic efforts of city leaders and managers and the nonprofit organizations and these grass roots organizations offer a potential, at the local level, for building a cross city political movement. But doing so will require a lot of heavy lifting.

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Chapter 27
Not Such Strange Bedfellows: Underserved Public Audiences as Collaborators for Ecologists

Nalini M. Nadkarni

Abstract Ecosystem ecology provides a powerful framework to understand and care for biota and the environment. However, ecosystem ecologists have been limited in their abilities to share their knowledge with people outside of academia – particularly underserved audiences and those who have little exposure to science and nature – even though this would benefit scientists and society at large. I have developed the Research Ambassador Program, a project that recruits and guides ecosystem scientists of all ages to carry out innovative science outreach to audiences that traditionally have little or no contact with nature or the enterprise of ecosystem science. I present case studies that provide models for ecosystem scientists to link the ecological values of the organisms and processes they study to other societal values, including recreational, religious, aesthetic, emotional, and social justice values. I describe how non-scientific values have inspired and motivated some of the prominent ecologists of our time.

Keywords Science communication • Broader impacts • Ecosystem ecology • Environment • Research Ambassador Program

27.1 Introduction

Ecosystem science – and science in general – must explore new approaches to implement and disseminate ecosystem research to help change the ways that scientists view society, and the ways that society views science. An understanding and appreciation of how to think critically about biota and the environment is one of the key ingredients of a well-educated populace and a healthy society and a healthy

N.M. Nadkarni (✉)
Department of Biology, Center for Science and Math Education, University of Utah, 401/402 Aline Skaggs Building, Salt Lake City, UT 84112, USA
e-mail: nalini.nadkarni@utah.edu

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planet (Thomas and Durant 1987; Gregory and Miller 1998). However, 70 % of Americans lack knowledge of the scientific process, and less than 15 % describe themselves as well-informed about science (National Science Board, NSB 2010).

Specifically, the field of ecosystem ecology provides a powerful framework for identifying ecological mechanisms that interact with these environmental problems, such as global CO_2 increases, habitat degradation and loss, and the eutrophication of aquatic ecosystems. Ecosystem scientists hold critical roles in addressing these problems through their research and by informing and inspiring others. However, communication of the knowledge and excitement for nature that individual ecosystem scientists hold have not been well supported by funding agencies (McCallie et al. 2009). Over 80 % of National Science Foundation (NSF) funding for informal science education (ISE) goes to large-scale science education entities (e.g., museums, zoos, films); only 6 % goes to university-based programs that support single-researchers or small-scale projects (Bell 2008).

In this chapter, I present an approach and examples of how ecosystem and environmental scientists can carry out synergistic public engagement. First, I outline the background of academic ecological research with respect to the ways its culture views efforts to close these gaps and connections. Second, I describe the Research Ambassador Program (RAP), which has yielded examples of how engagement of underserved public audiences can be synergistic with the goals of ecosystem ecologists and may help solve environmental programs. Third, I describe how some prominent ecosystem ecologists trace their professional roots of inspiration stem to emotional links to ecosystems in which they were raised, as well as their current intellectual connections. Finally, I pose questions about how ecologists might bring the "humanist" aspects of their work to provide more compelling arguments to connect humans with nature to help solve environmental problems.

27.2 Background

Traditionally, communication pathways between scientists and the public have been forged and maintained by ISE institutions or the media (Fig. 27.1). However, these pathways only incompletely bridge the gap between ecological and environmental scientists and the public. Although many members of the media are articulated and dedicated, they are often hindered by fixed deadlines, lack of technical expertise in specialized subjects, and the perceived need to sensationalize research results (Friedman et al. 1986). This has resulted in a mistrust of the media (on the part of many scientists), and an impatience with seemingly defensive or inconclusive statements of scientists (on the part of the media) (Dunwoody 1992).

What about participation by scientists themselves? Participation by ecologists and environmental scientists in public engagement is limited (Poliakoff and Webb 2007). A recent analysis of nearly 300 abstracts of grant proposals to NSF's Ecosystems Studies program (2000–2010) revealed that of those proposals whose abstracts contained a Broader Impacts statement (65 % of all abstracts), 57 (19 %) included just one of five NSF Broader Impacts activities. The most frequent component was

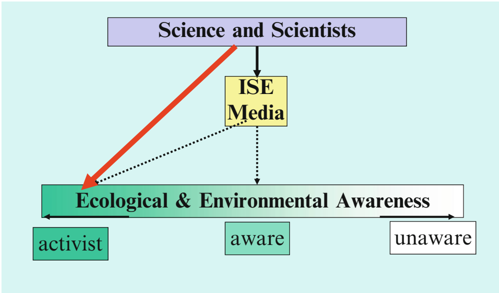

Fig. 27.1 Traditional model of science dissemination of research from the scientists' perspective. The media generally serve as mediators between researchers and the general public at all levels of interest (*black lines*). When scientists do communicate, their audiences tend to be scientifically active (*red line*)

teaching and training (37 %), and the least was assistance with underrepresented groups (Fig. 27.2). Most proposed audiences were small (less than 50 people, 61 %), and were culturally close to academics (e.g., museums) (Nadkarni and Stasch 2013).

The lack of broadly reaching public engagement – especially with underserved audiences – may be because scientists generally perceive an academic cultural bias that undervalues public outreach within the reward system recognized by scholars (Leshner 2007). From the standpoint of the scientist, public outreach by scientists is still only minimally valued within the reward system recognized by scholars; efforts at popular communication are viewed at best as a distraction from the "real work" of academics (e.g., writing grant proposals, producing scholarly articles for scientific audiences) (Bodmer 1986; Leshner 2003). In addition, the lack of training, guidance, and appropriate community contacts hampers those who wish to and are encouraged by their peers and departments to participate.

The picture is not entirely bleak, however. High-level administrators have recently called for increased engagement of scientists with non-scientists to bridge the growing gap between science and society (e.g., Leshner 2007; Bell et al. 2009; CAISE 2009). In its 2012 Merit Review document (NSB 2012), the National Science Board emphasized the importance of scientist engagement with Broader Impact Criteria – to be on a par with Intellectual Merit.

Programs for public engagement specific to ecology now exist: e.g., *Aldo Leopold Leadership Program* prepares environmental scientists to engage with the policy-makers and the media; *Citizen Science projects* bring together scientists and scientifically aware volunteers to perform research-related tasks that may be used by an academic scientist (e.g., *Project FeederWatch*, Project BudBurst). The *Portal to the Public* project (Pacific Science Center 2010, Seattle, WA) mixes ISE professionals, scientists, and public audiences in science museums (http://www.pacsci.org/portal/). The Cary Conference in Ecosystem Studies, a premier venue to examine fundamental issues in ecology has held recent Conferences that focus on themes relating to the need for "translational" organizations and to involve ethics and other areas of the humanities to close the society/environment gaps (http://www.caryinstitute.org/science-program/2011-cary-conference).

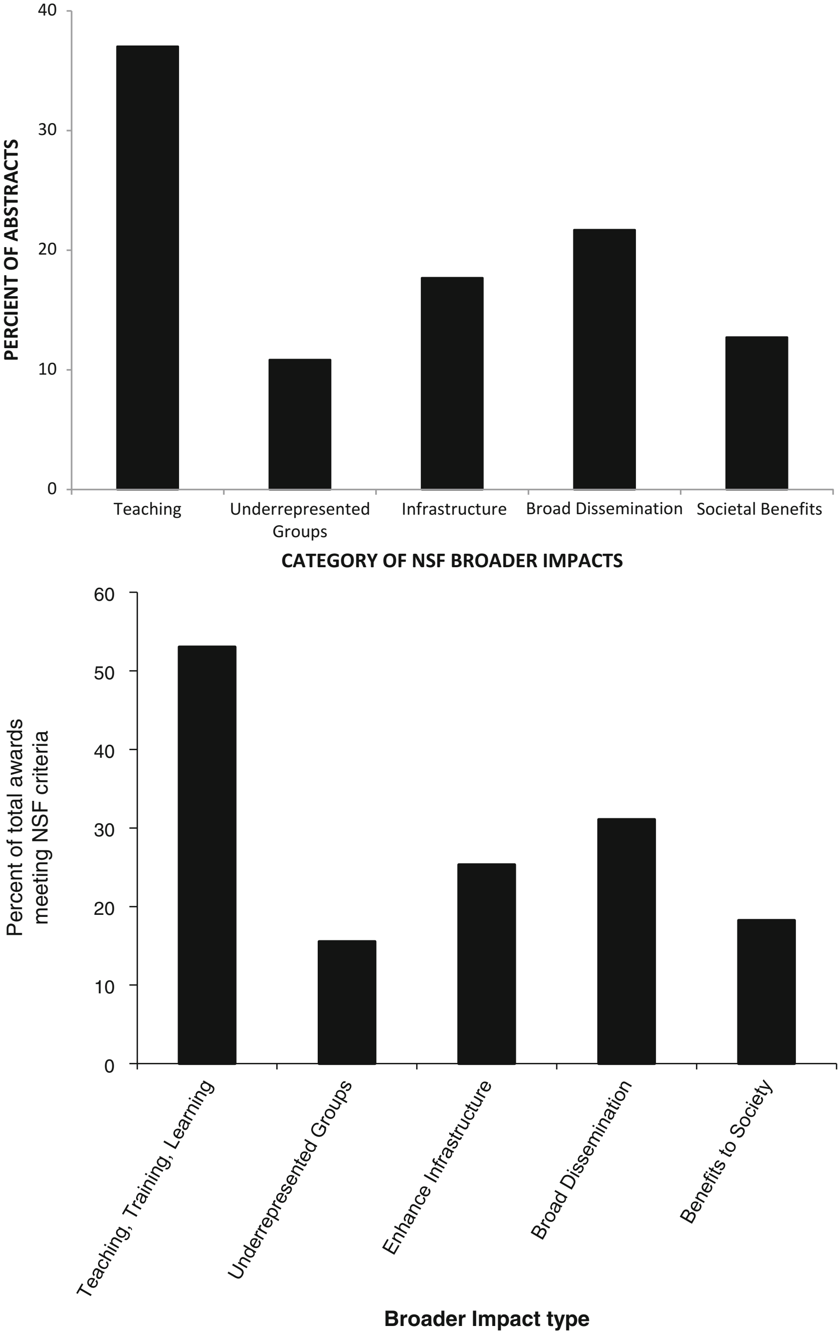

Fig. 27.2 In an analysis of proposed broader impacts by ecosystem scientists, Nadkarni and Stasch (2013) analyzed abstracts of 296 proposals for broader impacts activities. For those grants that proposed BIAs (65 % of the total), the distribution for the five categories were: teaching, training, and learning; broad dissemination; enhancement of infrastructure; benefits to society; and underrepresented groups

Despite this progress, there is still much for individual ecologists to do. When scientists do disseminate their research to the public, their audiences are almost always portions of the public who are already interested and knowledgeable about science – the scientifically "active/aware" (e.g., natural history groups, visitors to botanic gardens, readers of natural history magazines) (Fig. 27.1). Most scientists feel most comfortable with these scientifically literate audiences, as the listeners/readers already grasp the value of what might otherwise be considered esoteric research. Choosing to communicate with these societal segments makes the limited time scientists allow themselves for dissemination to be put to the apparently most efficient use. A negative consequence, however, is that the "scientifically unaware" segments of the population that most need direct input from scientists remain the least frequent targets of dissemination efforts of scientists.

To help reverse these trends, scientists themselves must become more directly involved in transmitting research to public audiences. Scientists can be powerful advocates for scientific studies for two reasons. First, they have specialized, technical knowledge of the subject matter. Second, their passion about what they study is infectious; it can inspire others to take an interest in science with surprising effectiveness. The need for scientists to have more direct interplay with non-scientific audiences, and to address audiences who would not typically gravitate to the normal forums for ISE has been recognized by informal science educators (Gregory and Miller 1998). These interactions can and must be synergistic if they are to be sustainable by the academics involved. In longer- term and larger-scale perspectives, such efforts can result in positive feedback for scientists via an improved social and political climate that is supportive of research activities and funding (Fig. 27.2).

27.3 Project Approach

I describe the Research Ambassador Program (RAP). This project recruits and guides ecosystem scientists of all ages to carry out innovative science outreach to audiences that traditionally have little or no contact with nature or the enterprise of ecosystem science. The program combines elements of informal science education and values assessment to implement synergistic public engagement in ecology and the environment (Fischer 2005; Nadkarni 2006, 2007). Recent research strongly suggests that the more the influential spheres of family, school, work, and elective learning overlap in people's lives, the more likely they are to become successful lifelong learners (Brice Heath and Smyth 1999; Epstein 1995). Traditionally, "free-choice learning" (Falk 2001) has referred to the type of learning characterized by being nonsequential, self-paced, and voluntary, and recognizes that the interchange goes on between the individual and his/her sociocultural environment.

The activities can reach all segments of the general public, categorized as follows: (1) the *scientifically active* – those who express a high level of interest in a particular issue, and feel well-informed about it (termed the "attentive public" in NSF 2002); (2) the *scientifically aware* public, who claim to have a high level of interest in an

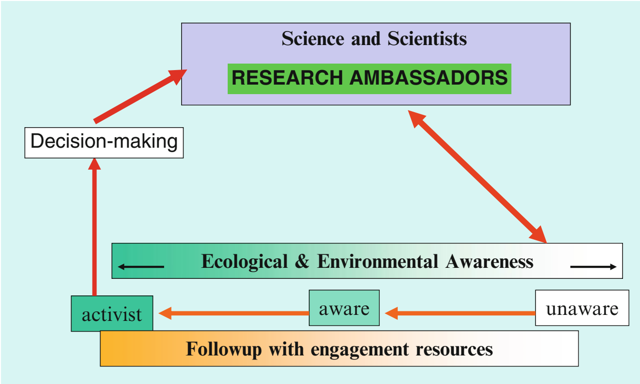

Fig. 27.3 Research Ambassador model of dissemination by scientists. RAs disseminate information to the unaware, which is followed up by subsequent exposure to websites and research resources. This promotes stepwise increments of growing awareness that may lead to environmental actions and societal support for science and scientists

issue, but do not feel well-informed about it (= "interested public"); and (3) the *scientifically unaware* – those who are neither interested nor feel well-informed about an issue (= "residual public", i.e., those who might not ordinarily watch a Public Broadcasting Service (PBS) television special, subscribe to a natural history magazine, or visit a science museum).

My approach is to train scientists to communicate to non-scientists, especially to the 'scientifically unaware', in arenas of free-choice learning that are based on the interests of the audiences themselves. My research team and I will help guide the RAs to relate what they are studying to aspects of life that segments of the scientifically unaware are passionate about, and in doing so, motivating them to become more aware about science. My approach is partially patterned after the U. S. Department of State's Foreign Service. That agency successfully recruits and intensively trains its cadre of ambassadors, attachés, and liaisons from diverse backgrounds to communicate information about their home country to citizens in other countries, and to gather information about them for their own countries.

The central idea is that a scientifically unaware person is best reached by identifying the activities or realms of society that excite or intrigue him or her, and then linking the science research to those activities or realms. For the RAP, this involves our team understanding the research of the Research Ambassador (RA); developing a strategy to link the content to something that the scientifically unaware public values; developing talks, articles, or other media to enter into the other "country"; and providing materials that will give greater depth after the public communication. This will lead to a jump from unaware to aware, and from aware to active via the public gaining more insights through access to websites or other research resources. This in turn can lead to a greater appreciation and actions that the public can take, which will provide a positive feedback loop for the process (Fig. 27.3).

27.4 Case Studies for Public Engagement with Forest Ecology

27.4.1 Approach

I describe my experiences with synergistic engagement of forest ecological research to segments of the scientifically aware public. My research broadly concerns the ecological interactions of tropical and temperate forest canopies, which has received continual NSF support since 1987, including effects of human and natural disturbances on canopy communities. In the montane landscape of Monteverde, Costa Rica and Washington State, my research team and I have quantified canopy plant and insect community composition, structure, and function, focusing on plant reproductive and nutrient dynamics within the canopy and on the forest floor, and the effects of predicted global climate change (Nadkarni and Solano 2002; Nadkarni et al. 2004). We learned that the diverse canopy communities play important roles in intercepting and retaining atmospheric nutrients, providing important resources for birds and mammals; and serving as a repository for carbon. The emerging scientific messages are that canopy biota function as "keystone" organisms: the ecological roles they play are more significant than their relatively small biomass suggests.

Below, I describe some of the pathways the RAP developed to communicate these ecological values of forest canopies and forest ecosystems to a broad range of public audiences and venue: religious congregations, young girls, artists and musicians, urban youth, legislators, and incarcerated men and women. These activities constitute a first step in engaging the public with science. However, it is critical to provide content and pathways for action as a followup. We provided further information on forest canopies, including materials that are both academic and non-academic (www.researchambassador.com).

27.4.2 Religious Venues

About 80 % of humans currently consider themselves as adhering to a religion (Pew 2012). Some religious people may not be inclined to engage with nature or science. Therefore, if a scientist can link what she studies to something that is valued by that religion, then the church itself could provide a venue for dissemination of research by the scientist, which would raise the churchgoer's awareness about science.

In 2001, I started outreach work in places of worship. I visited places of worship of many faiths, focusing first on Christianity. I downloaded the Old Testament from the web, did a search for all references to the term "tree" and "forest", and categorized the 328 references into seven groups. References to trees and forests encompass an enormous breadth of Biblical values and activities. I was invited to give sermons on "trees and spirituality" to over a dozen Protestant and Catholic churches, interfaith congregations, Jewish synagogues, and Buddhist temples (38 total in the Pacific Northwest). I also wrote articles for church newsletters. At each talk, I made available information sheets to inform listeners about scientific sources of information about forest canopies (websites, publications, popular articles). The RAP has extended this to making congregants more aware of nature by creating pamphlets with information about the trees grow in the churchyards of these places of worship, mapping trees and providing biological and religious information about each species. These help reinforce a sense of stewardship of biota protected on their own sacred grounds. Although the RAP has not carried out formal evaluation, positive expressions of all of these experiences have been evidenced by congregations introducing me other churches, and the lack of antipathy toward scientific topics that could be interpreted as being counter to religious beliefs (e.g., creationism versus evolution). Congregants nearly always sought more contact with me and requested further information about the science behind trees and forests, as well as invitations to join in their conservation and Earth stewardship efforts (e.g., local tree-planting efforts).

27.4.3 Sports and Toys

The RAP created a "TreeTop Barbie Doll", which present an alternative to traditional dolls – one that embodies exploration, strength, and an image of a young woman interested in forest science. TreeTop Barbie is accompanied by 12-page handbook that provides images and descriptions of the canopy plants of the Pacific Northwest (Fig. 27.4). Links to website of the International Canopy Network (www.evergreen.edu/ican) accompany the package. Although formal evaluation instruments have not yet been applied to assess the impacts of this approach, since 2006, over 570 dolls and booklets have been distributed, with frequent feedback from girls and family members describing strong interested about canopy science and the profession of studying forest canopies.

27.4.4 Links with Art and Music

The RAP has organized four "Canopy Confluences" in tropical and temperate forests. These bring people who focus on aesthetic values to the canopy. We installed platforms in the canopies of primary and secondary forests, and invite a combination of forest ecologists, musicians, dancers, visual artists, forest managers, and high school educators to the site for a week, with 3-h shifts in the canopy. The results have been stunning: pastels, acrylics, charcoal images; and oboe, bamboo flute, opera, and classical guitar music that capture the aesthetic values of the forest canopy. Several art shows and musical performances have ensued. As well, with the support of a grant from the

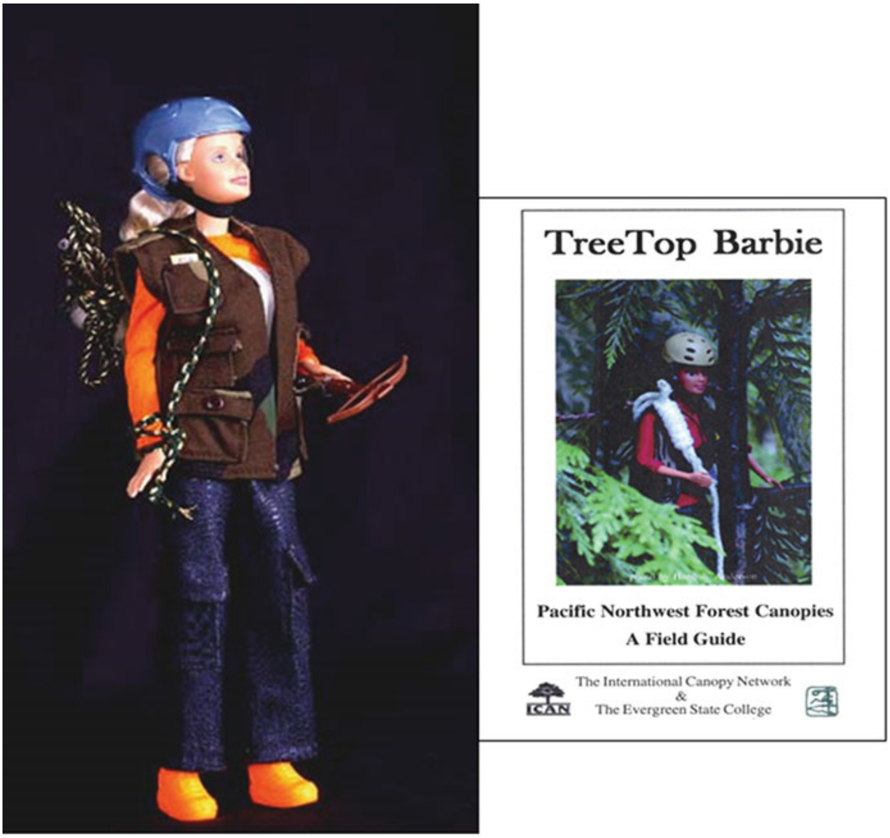

Fig. 27.4 TreeTop Barbie and the accompanying canopy science booklet, designed to engage young girls with forest canopy science and identification with an adventurous and intelligent female role model that connects to a popular icon

National Geographic Society and the TogetherGreen Program (Audubon Society and Toyota Corporation), we presented a joint ecology lecture/modern dance performance/conservation gathering in San Francisco and Seattle (www.capacitor.org).

27.4.5 Links with Urban Youth

Promoting awareness of nature can be challenging for at-risk and urban youth, groups that manifest the greatest gaps in performance in science and math achievement tests (NSB 2010). In 2006, the RAP engaged a professional rap singer to communicate the values and "coolness" of the forest canopy to 40 at-risk urban middle school youth from Tacoma, Washington. They spent five mornings on a college campus and took walks with the rapper and an ecologist to a forest, a beach, and an open field, picking up leaves, clams, and ants. In the afternoons, they used the music studios to make their own beats and rap songs about what they had encountered, and cut a CD they brought home to family and friends, thus expressing their experience in a cultural and artistic milieu that was familiar to them. (http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=114311).

27.4.6 Links with Legislators Aloft

To explore how decision-makers and scientists communicate about policy issues, the RAP invited 12 state legislators and their aides to the canopy. We installed platforms in a local park and taught the congress people to ascend. In the several hours we spent aloft, discussions included forest management issues, government funding of science, the reasons for high biodiversity in the canopy, and the importance of non-vascular plants in forest nutrient cycles. The post-session evaluation (a written questionnaire distributed at the session with an email follow-up) documented that over 90 % of the audience felt "positive" or "highly positive" about the experience, and 75 % stated that they would be willing to contact a forest ecologist in the future.

27.4.7 Prisons and Prisoners

In 2005, the RAP initiated a project to engage incarcerated men in a minimum-security prison to help with a project that involved learning how to grow mosses for the horticulture trade to reduce the unsustainable harvesting of moss for the horticulture trade. This proved to be positive for the ecologists, for the inmates, and for the prison administrators, and so other scientists were brought in to give lectures behind bars. This led to the implementation of many sustainability projects (gardening, composting, recycling, water catchment, bee-keeping), as well as conservation projects to rear endangered species (Oregon Spotted Frog, Taylor Checkerspot butterfly, prairie plants) for existing restoration projects in the bioregion. Currently this project has expanded to nine other state prisons in Washington State and to other prison systems in ten other states http//:www.sustainableprisons.org.

27.4.8 Lessons Learned

- Non-scientists are open to contact with researchers when they are in non-scientific settings;
- Non-scientists have well-developed networks based on their own interests and values, and can link a scientist into those networks;

- Networks link to other networks; i.e., an individual in one non-scientist audience would refer me to other non-scientist audiences;
- Individuals from one non-scientist group directly influenced individuals in other groups in a “leap-frog” action;
- Non-scientists are often amazed that scientists want to and are capable of communicating with them;
- Non-scientists frequently generated observations and questions that were novel and useful to me, because of their fresh perspective and new eyes;
- Non-scientists are as passionate about their own interests as scientists are about scientific interests, and if you can link the two, then there is a powerful potential for education in both directions.

27.5 Conclusions

The large scale and long-term need for academic ecologists and environmental scientists to connect their research with public audiences in significant and sustainable ways requires broad and innovative efforts to overcome the current barriers imposed by differences in culture and communications. The RAP is one pathway to provide appropriate academic rewards for scientists who link their research to an existing the interest, trade, or hobby of non-traditional public audiences in non-academic venues. The RAs garner academic rewards such as published papers, positive media attention, and a profound sense of contributing to bridging gaps between science and society, and between nature and humans. Public audiences gain rewards that include input of scientifically sound information about something they care about, intellectual stimulation, recognition of work, and a greater sense of connection to nature. This program is one way to enhance the ability of academic scientists to shift public engagement from a burden to a benefit.

Box 27.1 Non-Science Sources of Inspiration for Ecologists

An emerging trend that was revealed in working with the RAP is that many of the scientists who participated in synergistic public engagement had drawn their connection to ecology not only from scientific inspiration (papers, conferences, academic mentors), but also from more personal sources (their childhood experiences, contact with nature, curiosity). For an informal exploration of this pattern, I drew upon the ecology participants of the 2011 Cary Conference (http://www.caryinstitute.org/science-program/2011-cary-conference) by asking

(continued)

Box 27.1 (continued)

them where their own connections and motivations to choose the study of ecology as a profession. All of the 15 ecologists I queried related that they first connected to ecology and the environment in their youth, and these early connections were emotional as well as intellectual. Below is a subset of their responses and images (Fig. 27.5).

Dr. Mary Power, river ecologist, University of California, Berkeley. *I was very nearsighted as a child, but my parents didn't notice until I was 8. I had a moment of blinding happiness about age 5 when I was underwater on the shore of Cape Cod, and they put a snorkeling mask on me, and I saw fish, kelp, whelks, crabs, clearly for the first time, waving or skittering around, doing their business, oblivious of me. The moments of forgetting human cares and being absorbed into non-human life are among my happiest still. This happens most often for me under water.*

James Brown, animal ecologist, University of New Mexico: *Ever since I can remember, I have always been interested in the outdoors and natural history. I grew up in the country outside Ithaca, NY. A PhD student from Cornell named Kyle Baebehuen, who was studying small mammals in the old fields near our house, spent enormous amounts of time with me, patiently answering all the questions that only a curious 11-year-old can ask. I remember him showing me how to sex mice, and explaining the facts of life as practiced by rodents. I was on the path to becoming an ecologist by age 11, and subsequent experiences and mentors reinforced this.*

Gary Lovett, forest ecologist, Cary Arboretum. *I spent a lot of time outdoors as a kid. Every summer starting from when I was 2 yrs old, my family decamped for our little shack on a lake in upstate NY. My brother and sister and I would "go feral" for the summer, swimming, fishing, climbing trees, shooting BB guns, catching crayfish, and camping out.*

Peter Vitousek, ecologist, Stanford University. *I had a childhood connection with the outdoors, much of it 'natural'; I grew up in the rainforest above Honolulu and spent time wandering there. I went to high school on the Island of Hawaii and spent lots of time there in the rainforest above my school - not studying, but certainly looking and experiencing and catching goats.*

William Reiners, ecologist, University of Wyoming: *Childhood associations with nature (my father took me hunting, I lived next to open space, I worked on a family farm in the summer) were initial causes. My Protestant upbringing imparted a lasting moral sense of stewardship of the earth. At the same time, even as a kid, I realized that population and economic growth couldn't go on indefinitely in a finite world. I gave a High School valedictory speech about population control that squelched the gaiety of that occasion.*

William Schlesinger, Jr., biogeochemist, Cary Arboretum: *My interest in ecology began early. My mother would have said it genetic, although no one else in our family possesses it. I started to pursue ecology at a weekend program of the Cleveland Museum of Natural History.*

Kathleen Weathers, ecologist, Cary Arboretum. *My profession in ecology came from a passion about montane, lake, and stream ecosystems, borne out of spending time in them and wondering how they work – basically, curiosity.*

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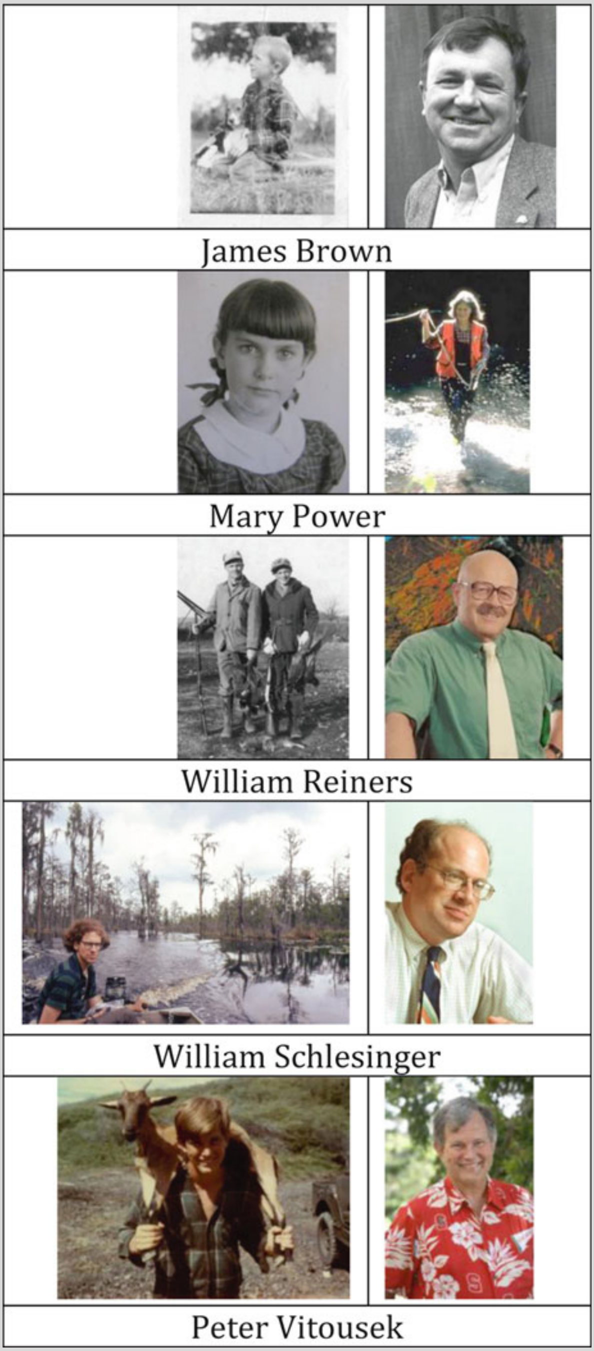

Fig. 27.5 Images of prominent ecologists as adults and as youth, when their first emotional attachment to nature and the environment prompted their professional work as ecologists

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Chapter 28
A Call for Ethics Literacy in Environmental Education

Alexandria K. Poole, Eugene C. Hargrove, Philip Day, William Forbes, Alan R. Berkowitz, Peter Feinsinger, and Ricardo Rozzi

Abstract A number of factors inhibit ethics literacy, the integration of ethics and values into environmental education. The first is belief that science can be value-free. On the contrary, science contains both epistemic values or values of knowledge and non-epistemic values (including social values). Practitioners of science, students, and citizen-participants should be able to recognize these values, articulate them, and evaluate them critically. A second factor is the so-called

A.K. Poole (✉) • E.C. Hargrove
Center for Environmental Philosophy, University of North Texas,
1155 Union Circle # 310980, Denton, TX 76203-5017, USA
e-mail: AlexPoole@my.unt.edu; hargrove@unt.edu

P. Day
Department of Philosophy and Religion Studies, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-0920, USA
e-mail: philipday@my.unt.edu

W. Forbes
Department of Social and Cultural Analysis, Stephen F. Austin State University,
Box 13047 SFA Station, Nacogdoches, TX 75962, USA
e-mail: forbesw@sfasu.edu

A.R. Berkowitz
Cary Institute of Ecosystem Studies, Box AB, Millbrook, NY 12545, USA
e-mail: berkowitza@ecostudies.org

P. Feinsinger
Wildlife Conservation Society, Bronx, NY 10460, USA

Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ 86011, USA
e-mail: Peter.Feinsinger@nau.edu

R. Rozzi
Department of Philosophy and Religion Studies, University of North Texas,
1155 Union Circle # 310920, Denton, TX 76203-0920, USA

Institute of Ecology and Biodiversity, Universidad de Magallanes, Punta Arenas, Chile
e-mail: rozzi@unt.edu

R. Rozzi et al. (eds.), *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action*, Ecology and Ethics 1, DOI 10.1007/978-94-007-7470-4_28,

Culture War, during which, since the early 1800s, ethics and value education has been systematically eliminated from schools in the United States. Efforts to introduce ethics and values into schools are typically met with charges of indoctrination and relativism. This problem can be overcome, in part, by teaching the social values that are explicitly stated in our environmental laws. A third factor is the influence of modern economics, which considers that it has become a science by focusing on what is and ignoring what ought to be. Economics undermines ethics and values by translating our non-economic or social values into economic values in terms of willingness to pay and sell (for example, translating aesthetic value of a landscape into what visitors are willing to pay to experience it). Because ethics and values are learned tacitly, not formally taught, most people lack the vocabulary to articulate their ethical views except in terms of how they feel. The absence of ethical learning is particularly problematic regarding environmental issues as management decisions must integrate ecological, social, and cultural dimensions, and a comprehension of the values underlying those decisions. This paper concludes with a short overview of six programs that illustrate a variety of ways to include ethics literacy in environmental education.

Keywords Objectivity • Value-free • Environmental education • Ethical literacy • Culture war

> *A myth is that with enough knowledge and technology we can manage planet Earth… What might be managed is us: human desires, economies, politics, and communities. But our attention is caught by those things that avoid the hard choices implied by politics, morality, ethics, and common sense. It makes far better sense to reshape ourselves to fit a finite planet than to attempt to reshape the planet to fit our infinite wants. David Orr (1990), "What is Education For?"*

28.1 Introduction

Education is not just a luxury or a specialization of focused knowledge. It is also the essential element in the maturation of thoughtful citizens capable of making well-informed decisions on their own lives and communities, and on politics at national and global scales. Education can enable us to become dynamic, critical thinkers who can creatively confront novel scenarios such as those arising from climate change. Evaluating the arguments of how best to manage and act in relation to the environment also requires a mastery of value-language, so that we are able to articulate more than mere feelings about alternative strategies of environmental management. We must be able to evaluate these alternatives with explicit reference to the values involved, with comprehension of the arguments used, and with critical consideration of the justifications provided for the actions taken.

This chapter consists of four sections. First, we offer critiques of the common perception that science must be value-free, suggesting that a measured, explicit inclusion of values in science that can actually increase its trustworthiness and transparency. Second, by exploring the history of ethics within the United States education system and of its disappearance from our curricula standards for fear of "indoctrination"—referred to by some as "the Culture War"—we argue that the excision of value discussion from education, rather than avoiding indoctrination of students, has instead inhibited their ability to critically think through complex socio-ecological problems. Third, we discuss how environmental philosophy can help validate or critique argumentation dealing with those problems, repeating the need for broad education in critical thinking skills. Finally, to explore practical applications of ethics within environmental education at various levels we present case studies of educational programs that, in very different ways, explicitly promote ethical considerations and critical thinking.

28.2 Objectivity in Science Reconsidered

In the nineteenth century, US philosopher and psychologist William James[1] described scientific theory as the "conceptual shorthand" that is used to account for nature. James's perspective recognizes that science can provide us with a representation of the world by developing useful knowledge that reflects, to the best of our ability, the nature of reality. Yet as clearly demonstrated in the politics of climate change, data alone, no matter how accurate their reflection of reality, do not guide society or the decisions that societies and individuals make. Implicitly or explicitly, decision-making also incorporates beliefs, desires, and above all values of diverse sorts. In order to choose from among alternative decisions, it is necessary not only to evaluate data obtained through scientific investigation but also to articulate the entire range of values that impinge on the choice. When conflicts arise among values and perspectives and decision-making becomes especially challenging, it is particularly urgent not only to evaluate critically the "facts" but also to articulate explicitly—and evaluate critically—the differing values involved. The methods of ethics and philosophy can help students to identify epistemological perspectives and values in arguments presented to them, express and argue alternative value-laden decisions and realize how these values interact with scientific understanding to inform environmental policy and actions at all scales.

A prevailing perspective in science education programs today is that values as a whole should have been, and are thought to have been, exorcised from science (see following section) such that the process of knowledge production is carried on solely through accumulation of facts deduced from interrogation – directly or indirectly – of the natural world. Dobson and Bell (2003) refer to this perspective as scientific determinism. Heather Douglas (2009) further criticizes the pervasive "ideal" of

[1] William James. Pragmatism: A New Name for Old Ways of Thinking (Harvard University Press, 1975). Eds. Fredson Bowers, Ignas K. Skrupskelis. p. 33.

value-free science, although she also notes that "the value-free ideal in science has meant different things in different times and places."[2] In her book *Science, Policy, and the Value-Free Ideal*, Douglas emphasizes that the "ideal" is not only harmful for the relationship between science and society but that it is also disastrous for the process of "doing science" itself. Thus, she concludes that the value-free ideal should be rejected. Douglas identifies two categories of values, epistemic values, or values of knowledge, *and* non-epistemic values, which are the values that come from society (ethical values are non-epistemic in nature, for instance). Clearly, value-free science is anything but, as it is founded on epistemic values such as objectivity. But objectivity is also a complex concept that resists reduction into a single, mechanistic definition. Evaluated conscientiously and critically as a value, specifically as a methodological value in science, objectivity provides avenues for producing reliable, reproducible, and verifiable knowledge. In essence, treating objectivity as a value instead of an unquestioned assumption not only obviates the value-free ideal in science but also enables scientists to conscientiously and consciously enhance the very same objectivity in their work and its interpretation. Douglas's distinction of epistemic and non-epistemic values enables us to recognize that values of one or another sort are intertwined with science and every other human cultural activity.

So how do we—practitioners of science, students, citizen-participants—obtain the ability to recognize values, articulate them, and evaluate them critically? How do we make explicit their presence in our intellectual research and decision-making in a productive and fruitful way, one that moves beyond simply stating how we feel about a given situation? As educators, how do we help children to develop this ability so that from an early age they might consider the implications of their value systems to their own actions in the world, and reflect on the best options when these values come into conflict with others? In the United States, the causes of our unfamiliarity with these abilities and the means of learning them are deeply entwined with the history of education in this country, in what has been commonly described as the "Culture War."

28.3 The Culture War of Ethics Learning Literacy: A Vacuum in Formal (Environmental) Education in the United States

In the United States, ethics education, including environmental ethics education, has been inhibited by two main factors. The first is the Culture War, which has been going on for about 200 years. The second is the replacement of ethical thinking with economic thinking in both policy and daily living.

[2]Heather Douglas, *Science, Policy, and the Value-Free Ideal* (Pittsburgh: University of Pittsburgh Press, 2009), p. 46. There are notable exceptions, however; see Merton's (1942) highly influential essay, "The Normative Structure of Science" where he points out that while science should mostly cling to its internal norms for guidance it ultimately has to comport with the greater social context which necessitates the inclusions of "values and norms" within science (263, 268–269). Douglas also points to the work of John Dewey, Rudolf Carnap, Otto Neurath, and Philip Frank.

The Culture War began in the first decade of the nineteenth century, when large numbers of Catholics began migrating to the United States from Europe (Hunter 1991, 2000). From the 1600s, Protestant ethics and religion were taught in colonial schools and the practice continued after the American Revolution. This came as a disagreeable surprise to many newly arriving European Catholics, who responded by founding their own schools to avoid their children's exposure to Protestant ethics and religion. Given that they were paying taxes for public schools, the Catholics asked that their tax money be redirected to fund their own schools. Their request was denied, in part with the argument that doing so would open the door to state funding for a multitude of religious-based schools and make public schools financially infeasible. The attempt to obtain public funding for parochial schools has continued year by year for two centuries, with most of the public believing that this idea is a new one and unaware of the historical origins of the debate.

To lessen the need for parochial schools, public school administrators began removing Protestant ethics and religion from state-funded schools. According to Lloyd P. Jorgenson (1987, p. 216), "by 1860, this process was largely complete." Catholics continued to watch over the public schools to ensure that inappropriate ethics and religion were not covertly reintroduced. As time went by, groups opposed to the teaching of ethics and religion in public schools formed in virtually every religious group. Such is the situation to this day.

When educators attempted to introduce ethics into the curriculum, they were promptly accused of indoctrination. The basic assumption was that ethics and values were personal rather than social, and that teachers were trying to impose their personal ethics and values on the children. To solve this problem, educational psychologists took a leading role. Inheritors of Immanuel Kant, they assumed that all minds worked the same way and that, if children were properly engaged in appropriate training, they could learn ethics and values without overt instruction, thereby blunting the charge of indoctrination. Psychologists fine-tuned their techniques by developing concepts of the stages of child moral development. The most famous are perhaps Jean Piaget and Lawrence Kohlberg. The streamlined version of the psychologists' approach is called "values clarification". It is as controversial as indoctrination as proponents are accused with teaching relativism, that whatever children think is okay. The twin threat of indoctrination and relativism prevents most attempts at teaching ethics and values in elementary school.

The Culture War leaves a vacuum that economic value-reasoning easily steps in to fill. Children learn their economic values tacitly (Polanyi 1967a, b). The well-known environmental philosopher Bryan Norton (1991) begins one of his books with an anecdotal encounter with a small child who values sand dollars, skeletons of living creatures, exclusively because the local hobby shop will buy them for five cents each (pp. 3–13). At a very early age, most people come to hold the following views: "Values are subjective," "Values are personal biases," "Values are arbitrary and irrational," "Values are expressions of emotions," "Values are just how you feel," "Values are just not facts," "The only values are instrumental values," "The world is or ought to be value-free," and even "Intrinsically valuing something is stupid." The ultimate point is that only economic value is objective and worth thinking about. Conservation of nature itself has fallen victim to this viewpoint. "Valuing ecosystem services" only in terms of instrumental values and economics has been the theme of considerable argument, occupying the time and attention of numerous conservationists, NGOs, and government agencies to the point where the approach prevails in conservation policy and action at many scales.

According to the prevailing neoliberal economic model, economics is itself independent of ethics and values. As Milton Friedman (1953) put it in his influential book *Essays on Positive Economics*, "if economists ignore what ought to be and concentrate only on what is then economics becomes a science" (pp. 3–4). Many academic programs in social sciences, colleges of business, and colleges of public administration as well as many programs in conservation biology and natural resources management follow neoliberal economics in separating themselves from philosophy, ethics, and values, or they treat values in a simplified way from the perspective of utilitarianism (Hargrove 2008). Nevertheless, the intrinsic value of nature is stated in numerous conservation documents—for example, the Convention of Biological Diversity (1992) starts with the statement "Conscious of the intrinsic value of biological diversity." Still, most conservationists in governmental and non-governmental entities feel that the only way to effectively justify conservation is in terms of economic values.

Although Milton Friedman's school of economics has claimed that the discipline is independent of philosophy, one could say it is a rather naïve, simplistic mixture of three recent philosophical and ethical positions: utilitarianism, pragmatism, and logical positivism. Utilitarianism is an ethical view that defines *good* as pleasure. Aristotle had objected to this move on the grounds that because people often take pleasure in bad things, if good were defined as pleasure, then moral standards would not be possible (see Aristotle's *Nicomachean Ethics,* Book II, chap. 3). Utilitarianism set the stage for the eventual establishment of the value-free, ethics-free economics of today (see Clare Palmer's chapter in this book). Pragmatism is a philosophical position initially focused on clear thinking. A major element of the view, however, is a magnified focus on instrumental value, which in large part (as a result of a crusade by John Dewey undermining intrinsic value) is a system where nearly everything can be valued solely in terms of its use.[3] This reduction of the value system makes social ideals appear frivolous and extraneous to human experience (as if there were no other ways of valuing other than of utility, and even as if this could be framed as being of "utility" to the valuer). Finally, logical positivism is a philosophical view that tries to take a scientific approach to all problems. Positivists hold that values are expressions of emotion, values are arbitrary and irrational, and values are just how you feel or have been trained to feel (Hargrove 2008). The implication of the positivist account is that there is no cohesion to ethical systems, that by exploring ideas and values through critical thinking we will gain no more progress in our understanding of reality than if we were chasing our tails. The net

[3]For a discussion of the issues involved in the relationship of intrinsic value and pragmatism, see Ben A. Minteer, "Intrinsic Value for Pragmatists?" *Environmental Ethics* 23 (2001): 57–75.

consequence for society is a perception that ethical debate is unproductive, since there is no objective basis by which one person can argue that his or her ethical viewpoint is superior to that of others.

If, however, we consider the application of environmental law from a values perspective we quickly find that it does not always take the utilitarian, pragmatic, and positivist approach. For example, the U.S. Endangered Species Act explicitly promotes five particular values of species: aesthetic value, educational value, historical value, recreational value, and scientific value. Notably missing from the list is economic value. This omission was intentional, for the purpose of citing non-economic values was to inhibit "economic growth and development untempered by adequate concern and conservation."[4] Promoting the five values, however, is problematic because most policy makers and scientists are only marginally educated about values other than economic value within the approaches of their discipline. Following the reasoning of Milton Friedman's school of economics, if other values have no clear meaning then the only way to make them meaningful is to translate them into economic terms. For instance, the aesthetic value of a protected area is commonly translated into travel costs incurred by visitors: the cost of tickets for trains, planes, or gasoline for a car, the cost of food, the cost of lodging, and the cost of entrance fees. Such translation is inappropriate, since it reduces the value spectrum of visitors and decision-makers to an economic function, and redefines aesthetic value into something that it obviously is not. Instead, aesthetic value can be appropriately taught in terms of the factors that have created it over the centuries: poetry and prose, painting, photography, natural history (geology, biology, botany), and landscape gardening.[5] If we are not successful in clarifying these alternative values within the formal and non-formal education systems, future generations will likely come to believe that we thought the appreciation of natural beauty just meant spending money.

28.4 Addressing the Culture War: Alternatives to Economic Values

Indeed, there are many ways to value nature other than in monetary terms. In the 1980s, one of the founders of the field of environmental ethics, Holmes Rolston, III, developed an axiological model for environmental policy that includes economic value as only one part of a much broader value scenario. Rolston (1985) proposes that the fundamental value of nature is *ecosystem value*, from which all

[4] Public Law 88–577, in U.S., *Statutes at Large* 78 (3 September 1964), pp. 890–91; Public Law 91–190, in U.S., *Statutes at Large* 83 (1 January 1970), p. 852.; Public Law 93–205, in U.S., *Statutes at Large* 87 (28 December 1973), p. 884.

[5] See Eugene C. Hargrove, *Foundations of Environmental Ethics* (1996) Chap. 3; see also Eugene C. Hargrove, "Why We Think Nature is Beautiful," http://www.cep.unt.edu/show.

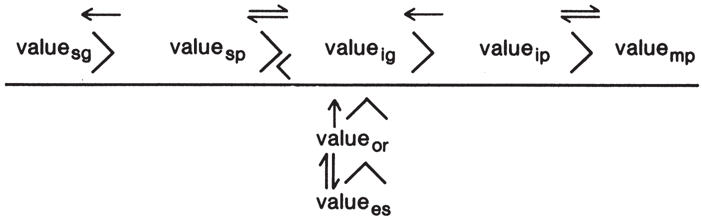

Fig. 28.1 An ordering of levels of value proposed by Holmes Rolston, III (1985): *es* ecosystem, *or* organism, *sg* social goods, *sp* social preferences, *ig* individual goods, *ip* individual preferences, *mp* market price (Reproduced with permission from *Environmental Ethics*)

other values associated with nature derive (Fig. 28.1). Next comes *organism value*, which contributes to ecosystem value along with nonliving components of ecosystems. Beyond these exists an array of social and individual values that depend ultimately on organism and ecosystem values. At one level are social good and social preference values, distinct because what is good for a society is not merely a matter of preference. In decision-making and determining policy, both what is actually good for a society and what a society prefers need to be considered. Another level consists of analogous values relevant to each individual: individual good and individual preference values. As at the societal level, these may not be the same and may indeed be in conflict. Finally, the amount of money that society and individuals place on nature in terms of willingness to pay or willingness to sell has been used to define market prices or economic values. These market prices, hence economic values, are usually arbitrary–for example, most frequently there is a failure to reach consensus on valuing ecosystem services—and rarely take into account adequately the other values. Inverting the value hierarchy—i.e., treating economic value as the primary value as we usually do—is as incorrect as planting a tree with its roots in the air.

In his book *1984*, George Orwell presents a future world in which the state imposes on society a revised language, Newspeak, whose covert purpose is to limit the ways in which the citizens could think. Applied to ethics, Newspeak reduced value language to six values—*good, plus good, double good* and *ungood, plus ungood*, and *double ungood*—or really only one value, "good", with six ranks. Today, in our current world the attempt to translate non-economic value language into economic language is most likely not consciously intentional, but the process is analogous and the result can quite appropriately be called "environmental Newspeak." (Howe 1963).

The centuries-old Culture War and today's economic Newspeak fit together in a way that is quite powerful in its ability to deprive children of the vocabulary and critical thinking processes they will need to express ethics and values as adolescents and adults (MacIntyre 2007; Rozzi 2012). The Culture War and economic Newspeak have created today a gap in the prevailing educational process. Children (and the adults they become) may still think in an ethical way but they will present their views only as "how they feel," mimicking the emotivism of positivism,[6] instead of having well-reasoned arguments on values and how these values relate to their historical, cultural, socio-ecological contexts, and their own experiences with reality and their understanding of it (Hargrove 2008; Rozzi 2012).

Due to their inordinate exposure to instrumental values and an overly reductionist account of most other values in these simplified terms, most undergraduate and graduate students will have difficulty understanding and talking about intrinsic value when they encounter an ethical theory class. How can this ethics void be filled in formal education? One means is to promote active and accurate learning of value concepts and thinking-processes in the context of the poetry and prose, painting, photography, natural history science, and landscape gardening within which they actually developed. Recently Eugene Hargrove and Kelli Moses, of the University of North Texas, led exploratory environmental ethics lessons at an elementary-level summer environmental educational camp and observed that children were regularly using intrinsic value arguments. Because they had never before discussed the concept of intrinsic value in the classroom, these children thought that they were merely talking about how they "felt." After learning first-hand the terms and concepts of intrinsic and instrumental value, however, the children immediately were able to distinguish between the concepts and correctly use the terminology to articulate why they valued their environment. Very likely, if children routinely learned how to appropriately discuss values as those values are being formed they would not need to struggle to find the language to articulate that something has value in and of itself, and recover the ability to talk about intrinsic value, as well as understand and assess the significance of this type of value.

What values, then, should children learn? One solution is to focus on the values already found in the purpose statements of our environmental laws, for example the Endangered Species Act. Referencing the values that our laws explicitly state, thus tying them to societal rather than individual values, takes the teeth out of the charge of indoctrination. Likewise, the specific definition of values in our environmental laws counters the charge of relativism. Instead of "indoctrinating" or "promoting

[6]Emotivism is an ethical view according to which only factual statements that are empirically verifiable have meaning. While there may be some factual content in ethical statements, they are basically nonsense. It is the value or emotional content that is fundamental and it is considered to be arbitrary based on accidental child upbringing. The ethical or value content is neither true nor false except at the level that it accurately reflects the emotions the speaker is feeling and expressing. Such emotion is therefore merely personal preference and cannot be the basis for rational debate and discussion. The view is most clearly and succinctly explained in chapter six, "Critique of Ethics and Theology," of Alfred Jules Ayer's *Language, Truth, and Logic* (New York: Dover Publications, 1952), pp. 102–120. The most elaborate version of the theory can be found in Charles Leslie Stevenson's *Ethics and Language* (New Haven: Yale University Press, 1944). Ethical statements are meaningless and contain no objectivity. They are subjective (personal expressions of emotion) and contain no intersubjective (social) objectivity since agreement between individuals is totally arbitrary and cannot be justified on factually verifiable grounds.

relativism", teachers will be presenting social values and a common heritage. Finally, teachers could truthfully claim that they are not actually teaching ethics (which the Culture War is intended to prevent) but rather citizenship (which will likely be regarded as noncontroversial), by preparing children to understand and promote the values in their environmental laws.

Should citing the values in environmental laws prove insufficient to avoid charges of indoctrination and relativism, it is possible to seek consensus values. In accordance with this approach, a group of community members can be convened to discuss which values are essential and/or permissible to be included in the course programs and discussions in the classroom (Hunter 2000; Nazario 1990). In such settings it often becomes apparent that the Culture War controversy is only rhetorical, acting at an abstract level. When community members actually discuss the details of just which sorts of values children can and should learn, disagreement tends to vanish, for nearly everyone has tacitly grasped the same social values.

In teaching ethics and values, the twin dangers of the charges of indoctrination and relativism need to be avoided. At the elementary school level, there will be widespread agreement within the community because of the level of generality at which the values will be taught and because controversial values (which may be in the process of evolving) will most likely not be brought up. Children will accept this instruction because it conforms to the values that they have been tacitly acquiring, the way in which children currently acquire their values today in the absence of formal instruction. Indoctrination can easily be avoided by including some multicultural or crosscultural comparative discussion of values, thereby making it clear that the children's values are social values, and that these values can differ to some degree between cultures. The evolving nature of our social values can be brought more to the fore at the secondary school level and fully at the college and university level.

28.5 The Moral and Natural Sciences for Decision-Making

Regarding higher education, it is relevant to point out that within universities the human sciences (or more generally, the humanities) and the natural sciences have not always been split. Until the seventeenth and eighteenth centuries, most areas of learning were grouped under the general title "philosophy," and what we call today natural sciences was generally referred to as natural philosophy or natural history. Later, during the eighteenth and nineteenth century British philosophers (e.g., David Hume, Adam Smith, and Stuart Mill) began to use the term *moral sciences* to refer to the sciences of human nature, while they used *natural sciences* would to refer to the sciences that aim to explain the processes of the physical world. In the nineteenth century, under the influence of Wilhelm Dilthey, the

German university also sharpened the split between moral sciences or *Geisteswissenschaften* (spirit sciences, encompassing a set of human sciences, such as philosophy, history, philology) and natural sciences or *Naturwissenschaften*.[7] Concomitantly, in England William Whewell introduced the term *scientist* in 1840 to refer to people pursuing science without philosophical training (see *The Oxford English Dictionary*).

Today, it might be argued that the contemporary model for formal education in the United States (and elsewhere) is intended to prepare students for a profession by providing them with expertise and a set of skills necessary for that profession; i.e., to train finely tuned technicians whose leading value is economic value. The traditional liberal arts education in many U.S. colleges and universities has had a broader goal, however: to provide students with a multi-faceted, thoughtful education across the curriculum so that they may take their places as full citizen-participants in society. This philosophy is articulated succinctly by the Association of American Colleges and Universities: "Liberal education is an approach to learning that empowers individuals and prepares them to deal with complexity, diversity, and change. It provides students with broad knowledge of the wider world (e.g., science, culture, and society) as well as in-depth study in a specific area of interest. A liberal education helps students develop a sense of social responsibility, as well as strong, transferable intellectual and practical skills such as communication, analytical and problem-solving skills, and a demonstrated ability to apply knowledge and skills in real-world settings" (AACU 2013). Under this broader liberal arts model incorporating ethics literacy (and the literacy of philosophy needed to evaluate ethics) into university education, curriculum should be designed to enhance the student's ability to articulate and evaluate the common social values, recognize and evaluate values inherent in all contexts (including science), and to incorporate values explicitly and responsibly when making decisions. In this way, instruction can contribute to the resolution of the conflicts in terms of evolving social values. The differences between individuals with regard to their personal values represent positions that can and should contribute to resolution of these controversies. Both the charges of indoctrination and relativism can be avoided as long as the instructor approaches each controversy fairly without insisting on a specific solution. In this context, knowledge is not just a luxury or specialization, but it is a comprehension of the complex interrelation of facts and values.

[7] German philosopher and historian Wilhelm Dilthey provided a theoretical foundation for the split of sciences by arguing that the recognition of the different methodologies used by the two distinct types of sciences would improve the outcomes of each of them. Dilthey's argument gained popularity due to its influence on German sociologist Max Weber. Consequently, in the early twentieth century the independence of the social sciences followed Dilthey – as did sociological positivism. For a critical assessment of the historical developments of the distinction between natural and social sciences see Hans-Georg Gadamer, who criticized basing the distinction on methodology rather than on the goals of the sciences (*Truth and Method*, London: Continuum, 1996).

Returning to the myth of "value-free science", we suggest that advocacy and values in ecological research (and whether or not these compromise the objectivity of science) should remain limited to evaluation and explication of embedded values, and recognitions of when value judgments are made.[8] In the educational context, this synthesis of "facts and values" simply expands the traditional liberal arts education so as to include familiarity with the ecological community, not just the human community. It is important to remember that facts, like values, sometimes change as the theories upon which they are based change (as when the Earth went from being flat to round and vacated its place at the center of the solar system)—and that they are not only theory-laden but also value-laden. While a full discussion of these issues is beyond the scope of this paper, we hope that readers will reflect on how ethical literacy (from the perspective of environmental philosophy) might enable students not only to synthesize, comprehend, and critically evaluate scientific data about reality but also to formulate an understanding of the implications in both a descriptive and ethical sense.

28.6 Case Studies of the Integration of Science Education and Ethics Education

Understanding the reasons for the frequent absence of ethics within education as a whole, and environmental education in specific, is an important step towards addressing the development of a toolkit that provides students with a thorough set of skills to both comprehend our knowledge of the environment and to formulate thought-out opinions of how to act, based upon that knowledge. We end this discussion paper by providing six boxes with contrasting programs and approaches that attempt to incorporate environmental and ethical learning. The diversity of these approaches should emphasize that there is not a single "correct way" to develop ethical and environmental skills. Just as each ecosystem and community is unique, so too are our solutions for learning and cohabiting within them.

[8] Social values, which are initially picked up tacitly, are the starting point. They form the basis for basic agreement within a society. These values, however, are subject to change and can evolve through discussion and education and in more extreme cases political disagreement. Education is not itself advocacy since its primary role is to strengthen our understanding of our existing social values. Our personal values are variations on these socially evolved values. It is these variations that sometime become the beginning of changes in our social values. If in education by talking about values, you make actually strengthen them or present problems could eventually lead to the values being changed. The teacher who is guiding in such a discussion is not necessary trying to change the values, but instead, aiding the individual in learning how to make their values clear.

Box 28.1 Broadening the Moral Community: Students and Teachers Restoring a Watershed (STRAW) Program

Ginger Potter

The Students and Teachers Restoring a Watershed (STRAW) program began in Marin County, California in a 4th grade classroom in 1992 when students asked their teacher Laurette Rogers how they could help endangered species, thus extending the boundaries of the moral community beyond humans to include the biotic community. Embracing the "think globally, act locally" precept, Ms. Rogers worked with the California State Adopt-A-Species Program on developing a project for her students and gave them a choice of which local species they would like to adopt and help. The students chose the California freshwater shrimp. The California Freshwater Shrimp Project, or the "Shrimp Club," was born.

The students in the Shrimp Club read scientific papers and gathered information on this California species of shrimp, including identifying the location of the shrimp in 15 local creeks. The students learned that the shrimp are threatened as a result of habitat destruction around these creeks, dams, and contamination from runoff from the area's ranches. They also learned that the shrimp were not the only species affected by these problems and that their habitat degradation was a whole watershed problem, thus incorporating a more systemic and holistic thinking. Eventually the Shrimp Club became the STRAW program now managed by the Point Reyes Bird Observatory (PRBO). STRAW is about hands on engagement that emphasizes the values in leadership and empathy, working with teachers, community members and restoration experts to empower students, restore the environment, and reconnect communities.

The overall purpose of the STRAW program is to protect and restore the riparian and wetland ecosystems in the San Francisco Bay watershed area in Marin, Napa, Sonoma, Solano and Alameda counties. STRAW is an inquiry and place-based learning program that increases ecological knowledge of students, teachers, and community members in the realms of restoration science and climate change, and a practice involving stewardship with explicit consideration of ethical values. It emphasizes shared decision making. Through their integrated education and community based restoration program, STRAW is also improving the environmental knowledge, skills, behavior and attitudes of the ranchers, farmers, and other private land owners whose property the students are restoring. Since 1992 over 30,000 students have participated in restoring almost 21 miles of watersheds in California.

Box 28.2 Broadening Stem's Focus: Teach North Texas (TNT) Program

Philip Day

The Teach North Texas (TNT) program at the University of North Texas (UNT) is an interdisciplinary, discovery-based education program whose goal "is to thoroughly prepare secondary math and science teachers for the Texas public school system."[9] TNT is a replication of a program that originated at the University of Texas: UTeach. The goal of UTeach, and its subsequent replication at 33 universities, is the preparation of secondary public school teachers in STEM fields.[10] Although the main goal of UTeach is to remedy a systemic problem in US education (secondary science and math test scores that are starting to lag behind the rest of the world), it also provides an educational opportunity for learning the sciences within a broader historical and philosophical conceptual framework.

TNT is a collaboration between the College of Education and the College of Arts and Sciences, so faculty representation spreads broadly across the colleges and includes professors of philosophy of science, technology and society. The course "Perspectives on the History of Science and Mathematics", UTeach replication model course original to the program, is generally taught by faculty in History and Philosophy departments.

The *goal* of Perspectives is not only to provide historical context for the development of science and mathematics but also to investigate the philosophical, social, and historical implications of scientific and mathematic progress. In this course students learn to seek the connections between disciplines in terms of knowledge, methodology, and co-dependence. We also investigate the way in which science and mathematics are first and foremost *human* endeavors that are enriched and complicated by various aspects of the human condition. We examine how culture can impact the scientific and intellectual endeavor and how closely tied most forms of human knowing have historically been. We delve into the close relationship of science with technology, mathematics with logic, and philosophy—including ethics—with all of those.

At TNT, we also conduct cross-cultural analyses of the origins of epistemological systems in Western science, devoting, for example, an entire week to studying the Islamic Golden Age, a period of five centuries when mathematics and science flourished. The modern world owes algebra, modern

[9]"More About TNT." http://teachnorthtexas.unt.edu/about-us/more-about-tnt. Accessed March 28, 2013. Dr. Robert Figueroa is the founding professor and program coordinator for TNT's replication of "Perspectives in Mathematics and Science" at UNT. Both he and philosophy PhD students regularly teach the course. For more information please email: figueroa.unt@edu.

[10]"Replicating UTeach." http://uteach-institute.org/replicating-uteach. Accessed March 28, 2013.

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Box 28.2 (continued)

optics, and the development of laboratory science to thinkers of this period (White 1962, 1978).

The goal of Perspectives is to provide a framework through which the class as a whole can investigate the roots of math and science as a historically negotiated, culturally mediated, human practice. The interdisciplinary approach of UNT as a whole contributes to TNT's goal to retain as many well-trained mathematics and science majors for secondary teaching as possible by providing them with an innovative, challenging, and sometimes unorthodox teaching preparation, infusing the prevailing STEM focus on learning science with a broader historical and philosophical conceptual framework and practice.

Box 28.3 Environmental Ethics Literacy: Introductory College Courses

William Forbes

Introductory courses in environmental ethics or environmental philosophy generally aim to provide students with a lifelong framework for applying value-thinking to ecology and the environment. In a growing number of US universities, such courses often use anthology textbooks to cover a range of values and case studies that are also reflected in the syllabi.[11] Several single-authored texts also serve this purpose,[12] as do course-specific readings compiled by individual instructors.[13]

Value sets covered in an introductory course typically range from strong anthropocentrism (human-centered) to eco-centrism (prioritizing ecological systems) to biocentrism (most concerned with individual organisms). Case studies tend to illustrate conflicts between strictly anthropocentric values and eco-centric or bio-centric concerns. Examples analyzed in these texts might

[11] For example textbooks see: Pojman and Pojman, eds., 2011; Keller, ed. 2010; Armstrong and Botzler, eds., 2003; Light and Rolston, eds., 2002; Benson, ed. 2001; Gruen and Jamieson, eds., 1994.

[12] Rolston, 2011; Derr and McNamara, 2003; Attfield, 2003.

[13] Various syllabi for introductory courses, as well as advanced courses on the philosophy of ecology, are available on the International Society for Environmental Ethics website (http://enviroethics.org/syllabi/).

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Box 28.3 (continued)

include the control of wildfire or river systems, previously managed with respect to anthropocentric values, paired with a critique of how these management practices led to dense, flammable forests and channeled rivers that exacerbate downstream flooding and deprive floodplains of sediment. Texts may explore how management strategies with different priorities (for example ecosystem health, the eco-centric view), may have guided manipulation of the environment in different directions.

In recent times the field of environmental philosophy and environmental ethics has expanded to articulate new theoretical frameworks that better address the concerns and moral implications of human interaction in a world whose multifaceted, multilevel biological diversity includes the co-evolutionary relationship of humans, the environment and non-human entities;–in other words, a multicultural, multi-lingual, and multi-being world. Such expansion has incorporated post-colonial and feminist critiques to address disenfranchised groups on the one hand, and on the other has expanded arguments for the "morally considerable" to include non-human entities.

Some of the more challenging case studies set up conflicts between eco-centric and bio-centric approaches, such as killing individual trees or animals in the process of restoring fire to increase forest health. The prioritization of community ecology and rare species over individual animals was a hallmark of Aldo Leopold's oft-cited land ethic. The more bio-centric approach is represented by Paul Taylor's writings, whereas Rachel Carson would combine the two approaches to call for protection of both individual creatures and their ecosystems from chemicals. Introductory texts often address the more popular notion of ecology through key readings on "ecological crises", including historical perspectives by Lynn White, Jr. and J. Donald Hughes[14] and contemporary case studies, such as those mentioned above (Pojman and Pojman 2011).

The classroom study of environmental ethics literacy should ideally be complemented by first-hand educational experiences both indoors and outdoors. Text hermeneutics, analysis of vocabulary and values, and discussion of case studies are enriched by visits to places where these or other cases actually exist, eventually leading students to design and conduct in situ research.

[14] see Armstrong and Botzler 2003.

Box 28.4 An Integration of the Arts, Sciences, and Humanities: The "Great Books Program" at St. John's College

Alexandria K. Poole

St. John's College (sjca.edu), more commonly known through its "Great Books Program," is a small liberal arts college with two campuses: Santa Fe, New Mexico and Annapolis, Maryland. Education at St. John's is designed to "liberate minds with a book and a balance." Its philosophical position is that education's role is to prepare the student to become a complete citizen-participant of society through learning experiences based on the integration of the arts, sciences, and humanities. In order to become an integral participant in society, the student must be able to engage the various aspects of that society through exploring its political history, cultural values, language and the implications of translation, debates on moral systems and other topics through the "Great Books" of western civilization. These "Great Books" provide the foundation for a specific pedagogical structure, promoting a "coeducational community, free of religious affiliation" and taking the approach that new ideas can be created at any moment, that new interpretations of texts can arise in any conversation and any context no matter how old the book, or how often it is read. There are no textbooks in the college curricula (though guides or supplements are used); instead, students are asked to reach their own conclusions about the works they read through the practice of critical thinking and exploratory conversation.

The pedagogical practice of the courses at St. John's follows three general rules. (1) There is no authority or expert voice in the conversation. Each student must argue for her or his interpretation of the text and pose a question based upon the text under discussion. (2) Students then take on the task of answering this question or evaluating the solution proposed by the author, based only upon their reading of the text and their ability to reason through it. (3) Only materials are referenced which the group has read together.

Students learn to participate in the history of ideas that comprise Western society within a collaborative environment. Upon graduating, many students move on to a diversity of professions, such as biology, physics, philosophy, and filmmaking. One quality all graduates share is a broad intellectual basis and resilience that enables them to work with others, develop new ideas, and synthesize different aspects of society. Nevertheless, it is critical to emphasize that the integration of theory and the everyday praxis in research, educational, political, and business institutions is complex, and often conflictive. The integration of science and ethics in the real world remains an ongoing praxis for these students beyond this education.

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Box 28.5 Schoolyard Ecology in Latin America

Peter Feinsinger and Iralys Ventosa Rodríguez

"Schoolyard Ecology" began in 1985 as an effort to provide schoolchildren and teachers with information on the plants, animals, and ecological processes in their immediate surroundings and to encourage the use of the schoolyard as an open laboratory for investigating these (Feinsinger 1987). Initially "schoolyard ecology" followed in the steps of Anna Botsford Comstock (Comstock 1939), linking children with local natural history during school hours and providing ideas for hands-on investigations but intentionally providing neither a rigorous research methodology nor an explicit call for articulating values based on those first-hand experiences. The first applications of schoolyard ecology to science education based on "local natural history" involved three spatial scales: north-central Florida (Feinsinger and Minno 1990), the United States (through committees established in the Ecological Society of America that later led to the SYEFEST program, Berkowitz et al. 1995), and selected points in Latin America.

The dramatic evolution that schoolyard ecology has experienced since the early 1990s (Arango et al. 2009, 2013; Feinsinger et al. 2010a, b) has all taken place in Latin America, where in 1993 the approach assumed the name of "la enseñanza de ecología en el patio de la escuela" or simply "la EEPE" (Feinsinger et al. 1997). In 1994 EEPE incorporated the "Inquiry Cycle" of three steps: (1) formulating the Research Question, (2) designing the study to answer it and then carrying it out, and (3) reflecting cautiously, creatively, and humbly on the results. The Inquiry Cycle has offered pre-university educators a robust, rigorous, and accessible alternative to the frequently misunderstood and misused hypothetic-deductive scientific method as the research methodology for students (Feinsinger et al. 2010a). Later, the ethics of investigating living beings became an explicit consideration of step 2 (Action). The ethics of the language used to interpret and apply study results became an explicit part of step 3 (Reflection), where consideration of values also came to play an explicit and omnipresent role (Arango et al. 2009; 2013, see also Feinsinger 2012).

Today, in 14 Latin American nations at least some middle schools, elementary schools, and kindergartens practice EEPE, and in five of those countries EEPE is widespread. Fewer high schools incorporate EEPE per se, but instead many apply the Inquiry Cycle to the social sciences or in courses on research methodology. At least in elementary and middle schools, EEPE can be fully integrated into the curriculum, and vice versa. A single schoolyard inquiry, from its genesis to its presentation in oral and written form, can include many required curriculum elements in not only

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Box 28.5 (continued)

biology and other natural sciences but also mathematics, social sciences, language, literature, art, physical education, and ethics (Arango et al. 2009, 2013). In marked contrast to the United States, national curriculum standards in many (though not all) Latin American public education systems explicitly include ethics in the curriculum, and ethics education is especially prevalent in Catholic schools of certain orders.

In short, EEPE ("schoolyard ecology"), and analogous approaches to graduate and undergraduate training in research design of ecological field studies (Feinsinger 2004; 2010a, b), can provide powerful tools to break the dichotomy between "Science" and ethics. Schoolchildren engaged in EEPE not only learn local natural (and social) history and careful, creative science but also critical thinking and decision-making skills that involve, in the third step of Reflection, explicit consideration and comparison of the values involved. Young adults who engaged in EEPE a decade ago, whether or not they have chosen environmental fields as careers, are now fully engaged citizens making conscientious, value-informed decisions with respect to their ecological and social surroundings.

Box 28.6 Field Environmental Philosophy: Integrating Ecological Sciences and Ethics into Biocultural Education, Research, and Conservation

Ricardo Rozzi, Francisca Massardo, Jaime Ojeda, Kelli Moses, Tamara Contador, and J. Tomás Ibarra

To foster an ethics rooted in specific places or habitats, and to develop a methodological approach that broadens the social component considered in socio-ecological research and education programs – which prevailingly focuses on economic values (Parr et al. 2002; Redman et al. 2004; Ohl et al. 2007; Haberl et al. 2009) – a group of scientists, artists, philosophers, and other professionals, both Chilean and foreign, initiated a program of biocultural conservation in 1999 that led to the creation of the Omora Ethnobotanical Park in Cape Horn at the southern tip of South America (55°S, south of Tierra del Fuego).

The park was created in 2000 to provide a "biophysical, conceptual, and institutional space" for long-term biocultural research, education, and conservation (Rozzi et al. 2006). As a *biophysical space*, Omora Park aims to protect the unique and fragile biodiversity of the Magellanic sub-Antarctic region, from the Andean highlands to deciduous and evergreen forests, peatlands and coastal ecosystems. It includes a biological reserve that protects the watershed of the

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Box 28.6 (continued)

Róbalo River, the source of drinking water for Puerto Williams, the world's southernmost town and capital of the Chilean Antarctic province on Navarino Island (Contador et al. 2012). As a *conceptual space*, it fosters education experiences and methodologies to integrate ecological sciences and environmental ethics into biocultural education and conservation (Rozzi et al. 2010). It includes a natural laboratory, an outdoor classroom, and a training center, whose functions involve three broad domains of action: (1) interdisciplinary research; (2) formal and non-formal education through pre-school, school, university, and training courses; and (3) biocultural conservation linked with environmental decision-making and sustainable tourism. As an *institutional space*, it articulates local, regional, national, and international scales in long-term socio-ecological research, education, and conservation, and functions as the:

1. Interdisciplinary Sub-Antarctic Research, Education, and Conservation Center of the Cape Horn Biosphere Reserve (UNESCO);
2. Southernmost study site of the Chilean Long-Term Socio-Ecological Research network;
3. Field Site of the Sub-Antarctic Biocultural Conservation program, coordinated by the University of Magallanes (UMAG), the Omora Foundation, the Institute of Ecology and Biodiversity in Chile (IEB) and, in the United States, by the University of North Texas (UNT) and its Center for Environmental Philosophy (www.chile.unt.edu).

The integration of these biophysical, conceptual, and institutional dimensions enabled in 2000 the design of a Field Environmental Philosophy (FEP) methodology for graduate curricula, which has been successfully implemented by UMAG, IEB, and UNT (Rozzi et al. 2006, 2008, 2012). Although developed in the remote Cape Horn region, the FEP methodological approach can be practiced in urban and rural areas worldwide. To incorporate FEP into graduate programs, we designed an interrelated four-step cycle, which we briefly summarize below.

Step 1: Interdisciplinary ecological and philosophical research. Students conduct ecological, ethnoecological, historical, and philosophical research, including research on the diversity of values and perceptions about biocultural diversity held by participants from different disciplines, institutions, and sociocultural groups, who speak different languages and hold different forms of ecological knowledge and practices.

Step 2: Composition of metaphors and narratives. Graduate students conduct this poetic work in order to: (i) integrate the ecological and philosophical findings (step 1) through analogical thinking that leads to a conceptual synthesis of facts, values, and action in biocultural education or conservation;

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Box 28.6 (continued)

(ii) better understand the dialectic relationships between inventions and discoveries involved in research and conservation work; (iii) establish an engaging dialogue with the general public.

Step 3: Design of field activities guided with an ecological and ethical orientation. For participants in FEP, the experience of face-to-face encounters with living beings in their habitats has been essential for understanding biocultural diversity not only as a concept but as an awareness of co-inhabiting with diverse human and other-than-human beings. Students translate these face-to-face experiences into innovative educational and ecotourism field activities guided with an ecological and ethical orientation. In this way, the understanding gained through "steps 1 and 2" about biocultural diversity and its values is broadened, and enjoyed by participants directly involved in the FEP, as well as by local, regional, national, and international visitors.

Step 4: Implementation of *in situ* conservation spaces. FEP methodology requires students to participate in the implementation of interpretive trails and other *in situ* conservation sites to: (i) protect native habitats, species, their ecological interactions, and cultural significance; (ii) enable visitors to know and enjoy these habitats and biocultural interactions; (iii) foster a sense of empathy and responsibility in the students, as citizens, who are ecologically and ethically educated and who proactively participate in the care of the diversity of habitats and their various forms of life.

In summary, FEP offers a methodological approach to integrate ecological sciences and environmental ethics into biocultural conservation and biocultural ethic, which are ecologically and culturally contextualized. The FEP four-step cycle helps students to gain not only an understanding about scientific and traditional ecological knowledge but foremost an *in situ* ethical practice, which leads to a better awareness of ecological and cultural interactions, the interrelated habits and habitats of the communities of co-inhabitants, their ecological, economics, aesthetic, ethical and biocultural values. Based on this theoretical and practical understanding of biocultural diversity, the FEP cycle fosters research and conservation habits for respectful forms of co-inhabitation within the diverse communities of human and non-human co-inhabitants.

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