Chapter 16
Mapping Conceptions of Wolf Hunting onto an Ecological Worldview Conceptual Framework—Hunting for a Worldview Theory

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> *We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters' paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.*
>
> *(Aldo Leopold, A Sand County Almanac, 1949, p. 130)*

From the prehistoric wolf paintings in France's Font-de-Gaume cave, to enduring cultural symbols of indigenous tribes such as the Arikara, Obijwe, Haida, and Nez Perce, to the "Big Bad Wolf" archetype of fairytales, wolves have long served as cultural icons evoking strong emotional responses. In the lower 48 states of the United States, a 150-year campaign to shoot, trap, and poison wolves reduced their population numbers to near extinction. However, conservation efforts since the mid-1960s have fueled wolf population recovery. Notably, in 1995–1997, 41 gray wolves captured in Canada were released into the greater Yellowstone ecosystem. By 2014, there were 11 packs totaling 104 wolves living in Yellowstone National Park (Smith et al. 2015). Protection under the Endangered Species Act of 1973, first granted to gray wolves in 1974, has been the subject of protracted and heated legal battles since 2003. In 2009, Idaho and Montana implemented the first state-managed wolf hunting seasons after gray wolves were delisted from the Endangered Species Act; other states, including Wyoming, Minnesota, and Michigan, followed soon after

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M.P. Mueller et al. (eds.), *Animals and Science Education*, Environmental Discourses in Science Education 2, DOI 10.1007/978-3-319-56375-6_16

(International Wolf Center [IWC] 2015). Legal disputes have continued. In December of 2014, for example, wolf hunts in Minnesota, Wisconsin, and Michigan were suspended when a federal judge restored wolves' Endangered Species status (McKinney and Kennedy 2014).

In Minnesota and other states, contentious questions stemming from the dilemma of whether to organize a wolf hunt have sparked spirited public debate. Have wolf populations recovered sufficiently to support a hunt? Should both hunting and trapping be included? How should harvest limits and other hunting regulations be determined? How might the elimination of an alpha male or female affect pack dynamics or impact behaviors such as depredation of livestock? How should farmers, ranchers, and other private landowners be compensated for depredation? What are the economic benefits of wolf hunting? How do economic benefits of wolf hunting compare to economic benefits of wolf-related ecotourism? How should indigenous cultural beliefs about wolves factor into local and state decision-making processes? What are some of the scientific, social, cultural, ethical, and economic dimensions of the wolf hunt dilemma, and how do they impact the key question: should there be a wolf hunt?

To study these and other thorny questions, my university biology students undertook a case study about wolf hunting (Wallace et al. 2014) that provided potent opportunities for students to reflect on their own views about wolves and to grapple with vexing questions arising at the interface of complex ecological and social systems. After a slide presentation to introduce background information and questions about wolf hunting, students engaged in a jigsaw instructional model. Through individual research, students identified a range of concerns commonly expressed by one of four community stakeholder groups: hunters and trappers, wildlife advocates, farmers and ranchers, or indigenous groups. Students who had researched like stakeholders then formed teams to discuss individual findings and plan a short presentation. Next, new teams of four were formed where each member gave a presentation about a different community stakeholder group. These mixed teams became "task forces" assigned to provide a recommendation about whether to continue, end, or modify wolf hunting in the state. After each task force presented justifications for its recommendation, the class debriefed from the experience. Last, students wrote (and sometimes mailed) individual letters expressing their personal views to a public official of their choice related to wolf management. Of note is that this was not a role-play activity where students assumed the identity of community stakeholders. Nor was it a class debate where students were assigned to argue for or against a certain position. Rather, students sought to explore a constellation of concerns commonly raised by various stances across each stakeholder group. This approach required students to avoid binary thinking and to grapple with reconciling their own emerging views with a wide variety of sometimes-conflicting perspectives.

My curiosity increased about factors that influence students' reasoning about wolf hunting and shape their perspectives on wolves. I wondered about connections between participation in the wolf hunt case study and students' ideas about human relationships with nature. Contributing to the development of this case study together with the experience of teaching it multiple times prompted me to ponder worldviews that underpin various orientations toward wolf hunting, to reflect on pertinent scholarly literature, and ultimately to construct the adapted ecological worldview conceptual framework that is introduced in this chapter.

16.1 Taxonomies of Socio-environmental Thought

Scholarly endeavors to model taxonomies of socio-environmental thought have yielded a variety of constructs that explore human relationships with the natural world. Chrisna Du Plessis (2008) proposes an integrated framework for understanding socio-environmental systems within an ecological paradigm. Her analysis of 40 research articles studying socio-environmental systems published in the journal *Ecology and Society* over a 10-year period generated four propositions that formed the basis for uniting three existing frameworks into a single, integrated construct that encompasses matter, life, and mind. While her work discusses human relationships with nature, the ultimate goal of her framework is to proffer a sophisticated model for understanding socio-environmental systems rather than a model that explores how humans think and act towards nature.

Another notable taxonomy of socio-environmental thought can be found in the work of Julia Corbett (2006). She explores environmental beliefs systems and offers a spectrum of environmental ideologies. Corbett defines environmental ideology as "a way of thinking about the natural world that a person uses to justify actions towards it" (p.26). She situates five broad ideological positions on a spectrum from anthropocentrism to ecocentrism. Corbett's spectrum ranges from "Unrestrained

Instrumentalism," a view that posits nature exists solely to satiate human needs and wants, to "Transformative Ideologies," perspectives such as deep ecology, ecofeminism, and other ideologies that question dominant environmental ideals and call for social change. Corbett's spectrum aptly delineates values, beliefs, and power gradients that underpin human relationships with nature, but its scope does not explicitly classify epistemological and ontological components.

Another noteworthy taxonomy of socio-environmental thought originates from the field of sustainable agricultural education. As part of the Hawkesbury Critical Learning Systems model (Bawden 2000), Arjen Wals and Richard Bawden (2000) suggest a conceptual framework comprised of four "conceptual windows on the world" (p.12) that capture divergent interpretations of the meaning of sustainability within the context of agricultural food production. Each worldview is situated in a quadrant formed by the intersection of two axes, an ontological axis describing the nature of the natural world, and an epistemological axis describing how the nature of the natural world is known. Wals and Bawden's model elegantly elucidates epistemological and ontological elements of perspectives on sustainable food production, but does not explicitly address axiological value judgments. Additionally, the epistemological axis targets knowledge about conceptions of agricultural sustainability, a construct suitable for Wals and Bawden's educational purposes, but not congruent with dimensions of knowledge valued for decision-making about socio-environmental issues such as wolf hunting. Moreover, each "conceptual window" (p.12) aims to capture a separate worldview, but in practice I knew my students' worldviews contained elements that ranged across multiple epistemological and ontological positions.

16.2 An Adapted Ecological Worldview Conceptual Framework

With each iterative experience of implementing the wolf hunting case study with undergraduate biology students, my understanding of student thinking and my knowledge of community stakeholder groups' perspectives deepened. I came to recognize there were discernable patterns in the epistemological, ontological, and axiological components of various responses to wolf hunting and other complexsocio-environmental issues. I also realized that these patterns could scale up from wolf hunting to the broader construct of ecological worldview. Eventually, I sought to develop a corresponding taxonomy of socio-environmental thought that describes ecological worldviews.

The term, *worldview*, can evoke assorted meanings, but the definition that underpins the ecological worldview framework introduced in this chapter is borrowed from William Cobern, (1991, p.7): "Each person can be seen as having a fundamental, epistemological macrostructure which forms the basis for his or her view of reality. The more common term is world view." Cobern (p.19) goes on to explain,

> World view undergirds rationality. To be rational means to think and act with reason, or in other words to have an explanation or justification for thought and action. Such explanations

> and justifications ultimately rest upon one's presuppositions about the world. In other words, a world view inclines one to a particular way of thinking.

John Kok (1988, p. 19–20) distinguishes between *lived* worldviews, intuitive "world pictures" that shape our daily thoughts and actions regardless of our degree of consciousness about them, and *articulated* worldviews, "a more carefully examined and systematically formulated conceptual scheme" that is produced through processes that are "conscious, coherent, [and] unambiguous." Worldviews described in the present framework exist in a dialectical relationship between lived and articulated worldviews, and are anchored in ontological commitments about the nature of reality, epistemological commitments about the nature of knowledge, and axiological commitments that guide ethical or aesthetic value judgments.

The term *ecology* can refer to a branch of biological science that studies relationships between organisms and their environment. In this scientific sense, an ecological worldview that focuses on understanding the world on an organismal level can be distinguished from a biochemical worldview that focuses on understanding the world on a molecular level. The term *ecological*, however, can also be used metaphorically to characterize human relationships with nature, as in *ecological identity* (Thomashow 1996). For the purposes of the framework introduced in this chapter, the term *ecological* is used metaphorically to signify that an ecological worldview shapes and is shaped by our relationships with the earth.

This chapter presents a promising ecological worldview conceptual framework that can elucidate valuable aspects of ontological, epistemological, and axiological assumptions that underpin perspectives on wolf hunting and other thorny socio-environmental issues. The framework is adapted from Wals and Bawden's conceptual framework for worldviews related to sustainable agricultural food production (2000), part of the Hawkesbury Critical Learning Systems model (Bawden 2000). The framework's axiological component resonates with Corbett's (2006) definitions of anthropocentrism and biocentrism. Depicted in Fig. 16.1, the adapted framework includes four dimensions: egocentrism (Us vs. Nature), technocentrism (Us over Nature), ecocentrism (Us in Nature), and resiliocentrism (Us within Nature). These dimensions are situated within the context of three components: an ontological axis, ranging from reductionism to holism; an epistemological axis, ranging from pragmatism to idealism; and an axiological continuum, ranging from anthropocentrism to biocentrism. Each dimension resonates with a fundamentally different relationship between humans and nature, but all dimensions can be present in a single person's ecological worldview.

16.2.1 Ontological Axis

The ontological axis distinguishes reductionism from holism and focuses on perceptions of nature as a system. Reductionist ontology represents a core belief that systems are essentially comprised of collections of parts. Inputs are constituents taken up by the system and outputs are products generated by the system. To

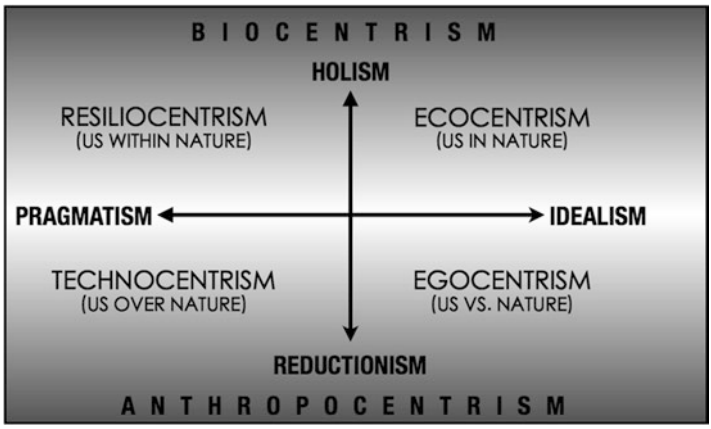

Fig. 16.1 An ecological worldview conceptual framework

understand a system from this perspective, the parts should be isolated and studied individually. If an unanticipated output or property emerges from a system, a reductionist perspective concludes that the system has not yet been studied in sufficient detail. Uncertainty regarding the system's functions, then, can be resolved by parsing the system into still smaller parts for closer inspection. When a system is conceived as a collection of parts, it follows that a system's nature and behaviors can be known by reducing it to its constituent elements.

When applied to nature, perspectives grounded in a reductionist ontology view natural systems as a complicated collection of parts that works together to perform various functions such as water purification and soil production. Indeed, ecosystem goods and services on which humans depend such as forestry products and pollination are regarded as system outputs. Reductionist ontology is grounded in a core belief that nature functions essentially like a machine where inputs can be controlled and managed to optimize outputs.

In contrast, a holistic ontology is grounded in a belief that systems are not simply collections of parts, but rather whole entities from which emergent properties arise when parts interact (Meadows 2008). The essence of a holistic ontology can be captured by the well-known adage commonly attributed to Aristotle, "The whole is greater than the sum of its parts." Rather than focusing on the parts, this perspective focuses primarily on interactions between the parts. Perspectives anchored in holistic ontology also acknowledge the impact of scale, the notion that structural and temporal boundaries of systems can shift when sub-systems become nested within each other or when they form internal feedback loops. The output of one subsystem can become the input of another, as when a thermostat regulates room temperature (an output) by responding to room temperature (an input). Another important characteristic of systems grounded in a holistic ontology is the role of thresholds. Systems can usually exist in more than one stable state and may shift to a different stable state when certain thresholds are exceeded; these shifts may take place

abruptly and sometimes cannot be reversed (Allen et al. 2014). When committed to an ontological view that focuses on dynamic interactions between parts, it follows that the system's nature and behaviors can only be known by studying the system holistically.

When viewed from a holistic perspective, nature is regarded as a complex adaptive system where myriad interactions within and between biotic and abiotic components result in a dynamic stability that is subject to disruption when certain thresholds are exceeded. For example, Brian Walker and David Salk (2006) explain that when spruce and fir forests are young, the density of needles on trees is low and predators such as birds and insects can easily locate and prey on the larvae of spruce budworms. As the forest matures, the needle density increases and it becomes harder for predators to locate their prey. Eventually, the efficiency of the predators drops below a certain threshold and the spruce budworm larva population breaks free from predator control. The result is an explosion of spruce budworms that consume so much tree foliage that the mature forest declines and returns to a new forest state. Nature is more than a collection of living and nonliving parts; natural ecosystems are rife with dynamic interactions occurring at several levels of scale simultaneously, and sometimes producing emergent outcomes that are difficult to foresee.

16.2.2 Epistemological Axis

The epistemological axis of the framework distinguishes pragmatism from idealism and focuses on the nature of knowledge most highly valued for seeking solutions to controversial socio-environmental issues. Within the scope of the framework, pragmatist epistemology constitutes a conviction that the value of knowledge claims is most effectively evaluated based on success in practical application. Describing Dewey's philosophical pragmatism, Gert Biesta and Nicholas Burbules (2003 p.12) state,

> It is only when we actually do respond that we can know whether the suggested line of action was appropriate. While the use of symbols can make our decision making more intelligent, the ultimate proof is to be found in the field of action. We must act in order to find out whether a suggested response is indeed appropriate for the situation in which we are engaged.

Pragmatic epistemological stances reject the need to unveil and resolve the interface between the immaterial mind and the material world, and might even be described as "anti-epistemology" (Biesta and Burbules 2003, p. 10), because practical application is regarded as more valuable than any type of knowledge. At the pragmatic end of the conceptual framework's epistemological axis, knowledge claims are considered valid and legitimate based on ability to achieve intended outcomes in practical application.

When applied to problem-solving in the context of controversial socio-environmental issues, pragmatic epistemological stances are more likely to favor

practical solutions supported by knowledge gained through application and experience. For example, a natural resource manager whose evaluation of socio-environmental knowledge claims is underpinned by a pragmatic epistemology is more likely to rely on quantitative data to justify practical outcomes such as optimized resource production or increased ecosystem resilience, rather than to rely on contemplation or reflection to justify outcomes such as preservation of beautiful vistas in natural places. When exploring potential solutions to controversial socio-environmental issues, many knotty questions center on the debate about what constitutes an "improvement" to any particular socio-environmental system. For example, pragmatic solutions anchored in ontologically reductive views of nature typically seek to maximize an ecosystem's outputs, whereas pragmatic solutions anchored in ontologically holistic views of nature usually aims to maximize an ecosystem's resilience. No matter the location on the ontological axis, however, perspectives grounded in a pragmatic epistemology invariably privilege knowledge claims that can be supported with evidence grounded in practical application of solutions to socio-environmental problems.

In contrast, idealist epistemology is grounded in the belief that knowledge claims are best evaluated on the extent to which they resonate with a particular vision for "how things should be" in the world, an ideal held in the mind's eye. Broadly, *Idealism* is a school of thought within the field of philosophy that is underpinned with a fundamental belief that reality and truth are immaterial, mental constructs (Maritain 2005). Similarly, idealist epistemological perspectives within the scope of the framework hold that a mentally constructed ideal rather than evidence from practical application should function as the principal evaluative criterion for identifying knowledge that is reasonable, credible and plausible.

When directed toward problem solving for controversial socio-environmental issues, idealist epistemological stances seek solutions that resonate with a particular mental construct of what is ideal given particular ontological conceptions of nature. Viewing nature reductively as a machine and viewing nature holistically as a super-organism (e.g., *The Gaia Hypothesis*; Lovelock 1987) represent contrasting commitments along the ontological axis, and thus will invariably resonate with different mental constructs of what constitutes appropriate responses and ideal solutions for socio-environmental issues. For example, a reductive ontological stance might underpin a belief that a certain forest should ideally be clear-cut to produce the maximum quantity of forest products possible, while a holistic ontological stance might underpin a belief that the forest in question should ideally be left to function in the wild with little to no human intervention. Regardless of the character of the "ideal" response to a controversial socio-environmental issue and the ontological conception of nature in which it is anchored, perspectives situated on the idealist side of the epistemological axis can be contrasted with ones on the pragmatic side. A mental construct of some type is held as an ideal for the purpose of evaluating the validity and legitimacy of knowledge claims, rather than evidence gleaned from practical application.

16.2.3 Axiological Continuum

The axiological continuum distinguishes between contrasting value judgments about nature's ethical and aesthetic worth. The range from anthropocentrism to biocentrism resonates with the endpoints of Corbett's (2006) spectrum of environmental ideologies. Anthropocentrism is a human-centered orientation toward nature that regards humans as separate and superior to non-human life. Corbett (2006) writes, "If a shape represented anthropocentrism, it would be a pyramid with humans at the top and the rest of the natural world beneath" (p.27). Nature is essentially a repository of natural resources that exists to serve human needs and wants. Conversely, biocentrism is a stance that recognizes inherent value in all forms of life, human and other-than-human. Corbett (2006, p.27) states, "The ecocentric (sometimes called biocentric) end of the spectrum can be represented by a circle, a nonhierarchical mix of interdependent relationships or a web of all life."

Within the context of problem-solving for controversial socio-environmental issues, perspectives imbued with anthropocentric values reside near the bottom of the framework, and are generally congruent with reductionist ontological stances. The more nature is reduced to a machine that produces consumable resources for humans, the more rational it seems that humans can learn to manage nature to optimize natural resource production and efficiency. A deep belief that it is possible for humans to control nature logically resonates with a desire to do so, and ultimately generates a tendency to do so (Vitek and Jackson 2008). On the framework, an increasingly reductionist ontological view of nature correlates with an increasingly anthropocentric axiological value judgments about humans' dominance over nature.

Conversely, perspectives instilled with biocentric values toward nature reside near the top of the framework, and these perspectives resonate with holistic ontological perspectives. The more nature is regarded as a complex adaptive system from which emergent properties can arise unexpectedly, the more it seems reasonable that humans are but a part of a much larger and vastly complex system. A steadfast belief that humans and social systems are inherently and inextricably intertwined with natural systems is congruent with a curiosity to understand socio-environmental system structures and behaviors, and ultimately a cautious or even humble recognition of humanity's place within nature's immense complexity (Vitek and Jackson 2008). On the framework, increasingly holistic ontological views of nature correlate with increasingly biocentric axiological value judgments about human relationships with nature.

16.3 Dimensions of Ecological Worldviews

Egocentrism, technocentrism, ecocentrism, and resiliocentrism are ecological worldview dimensions represented on the framework that resonate with fundamentally different relationships between humans and nature, and point toward

divergent beliefs and actions in response to controversial environmental issues such as wolf hunting. To further elucidate the framework, Fig. 16.2 maps juxtaposed responses to the dilemma of wolf hunting onto the framework. Further, each dimension is assigned a brief caption that distills the human and nature relationship to its essence. Two of the captions, "Us vs. Nature" and "Us in Nature," are borrowed from the three-category classification scheme for dimensions of ecological interconnectedness devised by Benjamin Herman, Mark Newton, and Dana Zeidler to describe "how one perceives inter-connectedness between human beings and ecological systems" (2015, p.22). The other two captions, "Us over Nature" and "Us within Nature," are novel categories that follow a similar pattern but resonate with other dimensions of the framework.

As with any conceptual model, the framework strives to capture an essential distillation of core components, but cannot fully replicate the richness of the subject being modeled. Each quadrant is comprised of a constellation of beliefs clustered around a particular range of ontological, epistemological, and axiological commitments, but for simplicity, each orientation is sometimes described in the singular rather than the plural. Further, the various responses to wolf hunting associated with each quadrant, explained later in this chapter, are described broadly and thus do not capture the full depth and complexity of the complete range of perspectives in each quadrant.

16.3.1 Egocentric Dimension

Egocentrism, located in the bottom right quadrant of Fig. 16.2, is characterized by a reductionist ontological orientation, an idealist epistemological orientation, and an anthropocentric orientation toward nature. This perspective pits humans against

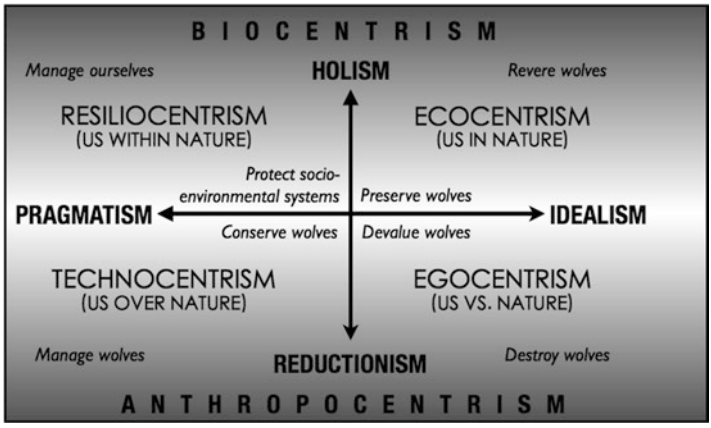

Fig. 16.2 Various responses to wolf hunting

nature, aspiring for the struggle to result in human dominance. “Us vs. Nature,” a term used by Herman et al. (2015, p. 22), aptly captures the framework’s dimension of egocentrism because a win/lose dichotomy represents human-nature relationships. Ideal solutions for socio-environmental problems, then, are ones where fulfillment of human needs and wants is squarely prioritized whereas the needs of other-than-human life are discounted or disdained.

When applied to the dilemma of wolf hunting, egocentric responses generally result in devaluing or destroying wolves for human gain. Historically, early European settlers feared and despised wolves, baiting and trapping them for sport and for livestock protection (Schullery 2003). Bounty systems intended to systematically wipe out wolves were begun as early as 1630 (e.g., Massachusetts Bay Colony) and became commonplace as laws were passed in various states (e.g., Michigan in 1838, Minnesota in 1849, Iowa in 1858, Wyoming in 1875, Montana in 1884) (IWC 2015). The heyday for “Wolfers,” professional and civilian hunters committed to wolf destruction, occurred from approximately 1850 to 1880, with estimates exceeding 100,000 wolves killed annually between 1870 and 1877 (IWC 2015). In 1906, the U.S. Forest Service together with the U.S. Bureau of Biological Survey undertook a wolf-extermination campaign with intent to maximize protection for cattle ranges. For the next six decades, wolves were shot, baited with poisoned carcasses, trapped, hunted with dogs, hunted from airplanes, and dug from their dens (Schullery 2003). By the 1960s, wolves occupied less than 1% of their original range in the lower 48 U.S. states, and the few remaining populations in Minnesota and Michigan were near extinction (IWC 2015).

The Endangered Species Act, passed by the U.S. Congress in 1973, marked an important milestone in the large-scale shift in government policy and public perception, from wolf extermination to wolf conservation. However, egocentric orientations are still ensconced in current policy debates, public discussion, and individual practices regarding human-wolf interactions. Egocentric perspectives are evident, for example, when private landowners attempt to kill wolves that trespass onto their land, by poachers who disregard hunting and trapping regulations, and by the Facebook group named "The Only Good Wolf is a Dead Wolf" (c.f., Bordon 2015 for more information). Egocentrism also may compel some to advocate for hunting and trapping regulations that relax restrictions in order to optimize chances for a wolf kill, provide minimal protection for wolves, or permit particularly non-humane lethal practices such as neck snares and leg-hold traps.

16.3.2 Technocentric Dimension

Technocentrism, the ecological worldview dimension represented in the bottom left quadrant of Fig. 16.2, is characterized by a reductionist ontological stance, a pragmatic epistemological stance, and an anthropocentric orientation toward nature. Technocentric perspectives value nature for its instrumental uses, and regard natural resources as utilitarian building blocks for technological endeavors that alter the natural world to meet human needs and wants. Human ingenuity has produced numerous technological artifacts, including products such as pesticides, plastic, antibiotics, cell phones, and vehicles for space exploration. The raw materials used to produce technological artifacts, as well as those needed for production and distribution processes, ultimately can be traced back to natural resources. Further, humans use technology to manage natural systems to optimize the efficiency of ecosystem outputs (e.g., irrigation water, forest products, seafood), or maximize the ability of ecosystems to absorb disruptive inputs (e.g., water pollution, toxic waste, carbon dioxide).

From a technocentric perspective, humans hold the power and responsibility to manage natural systems to ensure that sufficient natural resources are produced and conserved to meet current and future human demands. An "Us over Nature" orientation describes technocentrism, because a power differential places human in a position separate from and superior to other-than-human life. These perspectives do not pit humans in a battle against nature, but are still steeped in an anthropocentric belief that human ingenuity can outwit nature by developing technological solutions to environmental problems faster than new problems arise. A quote from Bill Vitek and Wes Jackson (2008) aptly captures the essence of a technocentric approach: "The recipe for success is simple: unleash human ingenuity; utilize it to harness and commodify nature's immense and complex forces; enjoy the new and improved

world that results; repeat" (p. 8). Within the continuum of perspectives that range across the technocentric quadrant, some beliefs regard technology as tools of environmental stewardship for managing nature to meet human needs and wants, while other beliefs are more "fundamentalist" in character (Orr 2002), reflecting an unexamined optimism that science and engineering will generate solutions to control and propagate natural resources sufficiently to avoid the need for humans to curb high-impact consumptive lifestyle habits.

Technocentric responses to the wolf-hunting dilemma revolve around the use of science and technology for wolf management, conserving sufficient wolf populations to fulfill various human needs and wants. Wolves are valued because of their utilitarian and economic worth in terms of hunting, wildlife viewing and ecotourism. While egocentrist responses stem from a vision for humans to vanquish the wolf, technocentric responses are more pragmatic and can include ecosystem management practices that accord functional value to the wolf's ecological role as top predator. Paul Schullery (2003, p. xii) captures the essence of the broad, historical shift in the U.S. from egocentrism to technocentrism when he states, "For a long time after they [wolves] had shed much of their demonic image, they were still respected only begrudgingly, as necessary evils placed on earth to serve as balance wheels in some intricate and clock-like natural machine." In contemporary American society, technocentric perspectives undergird the scientific and technological ecosystem management practices of state and national government agencies, and the corresponding legal and policy mandates that drive them. Such practices include setting harvest limits and regulations for wolf hunting based on quantitative data analysis.

16.3.3 Ecocentric Dimension

Ecocentrism, the ecological worldview dimension represented by the top right quadrant of Fig. 16.2, is grounded in a holistic ontological stance, an idealist epistemological stance, and a biocentric disposition toward nature. An "Us in Nature" orientation (Herman et al. 2015) describes ecocentrism because humans are regarded as an integral part of nature, participating in the diversity of life rather than reigning over it. In terms of axiological commitments, ecocentric orientations are imbued with humility toward humans' place in the natural world, empathy for living organisms regardless of their utilitarian or instrumental value, and respect or even reverence for all parts of ecosystems, both living and nonliving. People holding these perspectives seek solutions to socio-environmental problems that are congruent with an ideal that recognizes fundamental, inherent value in all living things and respects the dynamic integrity of natural systems.

Within the context of the wolf-hunting dilemma, ecocentric responses center on efforts to preserve wolves and wolf habitat with minimal human disruption to wolf-pack dynamics and natural ecosystem processes. While humans dominate and subdue wolves in an ideal held by egocentrists, humans protect and revere wolves in an ideal held by ecocentrists. Because wolves are respected sentient beings that interact within complex social hierarchies, lethal practices such as hunting and trapping are rejected, sometimes vehemently. Axiological commitments of reverence, humility, and profound respect for wolves can been found within the traditional creation story and sacred beliefs of the Anishinaabe (Chippewa, Ojibwe) peoples of Minnesota (Benton-Banai 2010). Robert Desjarlait, a member of the Red Lake Ojibwe-Anishinaabe Nation who is a member of the University of Minnesota Council of Elders said, "If you take the fur of ma'iingan [traditional name for the gray wolf], you take the flesh off my back" (Nienaber 2012, para. 1). The constellation of perspectives located within the ecocentric quadrant of the framework includes not only many traditional Native American perspectives, but also those who work within and outside of the law to advocate for preserving wolves and wolf habitat. In particular, many wildlife advocates monitor legislative actions carefully and lobby politicians to vote for wolf protection. Others deploy strategies of direct action, going so far as to disable corporate assets through vandalism to save wolves.

16.3.4 Resiliocentric Dimension

Represented in the top left quadrant (Fig. 16.2), the resiliocentric dimension is characterized by a holistic ontological stance, a pragmatic epistemological stance, and a biocentric orientation toward nature. Within this perspective, system resilience is

not defined as expediency of returning to an initial state after a disturbance, but rather as the capacity for a complex adaptive system to absorb disturbances and continue functioning without exceeding thresholds vital to keeping the system in a particular state (Allen et al. 2014). For example, how much carbon dioxide can the atmosphere absorb before global warming results in unstoppable cascades of environmental and social changes on a global scale? Rather than managing ecosystems to optimize outputs for human use, resiliocentrism aims to assure nature's resilience is protected by seeking to understand and monitor ecosystems, identifying crucial ecological thresholds, and encouraging adaptive and flexible human responses. Resiliocentrism pragmatically considers humans' nascent capacities for identifying and estimating pivotal thresholds in natural systems, and embraces the crucial role of diverse human orientations to social, economic, and cultural values in resolving thorny socio-environmental issues. "Us within Nature" captures the essence of resiliocentrism because while human and natural systems are regarded as inextricably intertwined, the immense magnitude of human impacts to natural systems on a global scale ineluctably necessitates system management decisions by humans. Such management decisions, however, need not be directed entirely toward nature; managing ourselves with intent to reduce the risk of key system components transgressing critical thresholds is an important aspect of resiliocentrism.

The precautionary principle (UNCED 1992), part of a resiliocentric axiology, acknowledges that the Earth's biogeochemical systems are finite and interconnected in complex ways that humans do not fully understand. Thus, human actions toward nature should reflect a degree of humility, uncertainty, and precaution. Resiliocentrism is infused in the Panarchy framework developed by the Resilience Alliance, a worldwide network of ecologists, economists, and social scientists researching resilience in social, ecological, and socio-ecological systems as pathways to sustainability. Panarchy "provides a framework to understand the cycles of change in complex systems, and to gauge if, when, and how they can be influenced" (Wuethrich 2002, p. vii). Resiliocentrism also underpins the work of the Center for Socio-Environmental Synthesis, an organization funded by the National Science Foundation and "dedicated to accelerating scientific discovery at the interface of human and ecological systems...and support[ing] new interdisciplinary collaborations that pursue data-driven solutions to pressing socio-environmental problems" (SESYNC 2015, para. 1).

When used to examine the wolf-hunting dilemma, resiliocentric responses first seek to situate the role of the wolf in multiple natural and social systems, and to understand how those various systems are structured, nested, and interconnected. After wolves were reintroduced to Yellowstone National Park in 1995, for example, ecologists were astonished at the trophic cascades that transformed the ecosystem and ultimately the very physical geography of the park (National Park Service 2011). Wolf predation lowered the number of elk and changed grazing patterns, reducing grazing pressure on vegetation. Regenerating forests and increased vegetation cover along streams resulted in the return of beaver populations; beaver dams altered the park's hydrology producing increased habitat for otters, muskrat, fish,

reptiles and other animals, which in turn triggered additional trophic cascades. Increased vegetation cover stabilized riverbanks and mountainsides, resulting in less soil erosion and altered river flow patterns. These extensive and interconnected changes were traced back to the introduction of a small number of wolves.

Resiliocentric responses, however, go further and contextualize wolves in social, economic, historical, and cultural systems as well, samples of which have been briefly described in other parts of this chapter. Rather than managing wolves to optimize the fulfillment of human demands, resiliocentrism focuses on managing the impacts of human actions on interconnected natural and human systems centered on the wolf, ultimately monitoring and protecting the resilience of intertwined natural and human systems. An "Us within Nature" perspective requires many ecological, social, economic, and cultural voices be given careful consideration across different scales of time and impacts; indeed, such thinking necessitates a solid understanding of a diversity of perspectives that ranges widely across the framework.

Community-based discussions on how upper and lower thresholds of wolf populations influence the resilience of particular natural and human systems are vital for deciding how to coordinate a collective response to the wolf-hunting dilemma. For example, how do wolf hunting regulations and harvest limits alter trophic cascades in ecosystems? What are the social, economic, and cultural impacts of those trophic cascades on various stakeholders in wolf-human systems, including rural communities and indigenous groups? In what ways do increased or decreased wolf numbers impact changes in trophic cascades due to other causes such as natural resource development, wilderness protection, or climate change? These are challenging and complex questions, but resiliocentrism can offer a powerful approach to understanding and ultimately managing personal and collective responses to wolf hunting.

16.4 Next Steps

The value of the framework presented in this chapter resides in its potential to underpin methodological tools to investigate student learning and pedagogical tools to support student learning and curriculum evaluation. Three directions for next steps are being explored. First, a mixed methods pre-and-post research design would be suitable for gauging potential shifts in students' ecological worldviews that may occur in relationship with learning experiences. A survey comprised of Likert items could be designed to measure constructs for the ontological, epistemological, and axiological components of the framework. An interview protocol could yield findings that capture some of the multiple layers of meaning that permeate individual worldviews.

Second, the framework could be adapted into a reflection tool for use by secondary or post-secondary students engaged in instruction about wolf hunting or other socio-environmental issues. For example, students participating in the wolf hunt case study described previously could use such a reflection tool to evaluate the

extent to which their task force recommendations engage with the four ecological worldview dimensions.

Third, the framework could be adapted into a curriculum evaluation tool to gauge the breadth of the ontological, epistemological, and axiological continuums represented or not represented in science curriculum materials. For example, discourse analysis methods (Fairclough, 2003) could be deployed to examine the extent to which other-than-human life is portrayed anthropocentrically as having instrumental value to humans, and/or biocentrically as having inherent value regardless of economic significance. Such an analysis would unveil an array of ontological, epistemological, and axiological assumptions about other-than-human life that are implicitly normalized in various kinds of science curriculum materials.

16.5 A Promising Conceptual Framework for Ecological Worldviews

The adapted framework introduced in this chapter provides a means for exploring ontological, epistemological, and axiological commitments that underpin ecological worldviews. Each of the four dimensions: egocentrism (Us vs. Nature), technocentrism (Us over Nature), ecocentrism (Us in Nature), and resiliocentrism (Us within Nature), draws upon divergent presuppositions about the world in order to justify certain beliefs and actions that contribute toward solutions for complex socio-environmental issues such as the dilemma of wolf hunting. This nascent conceptual framework offers rich potential for developing an instrument for research purposes, and a pedagogical tool to support instruction and evaluate curricula. On a planet that is moving toward an increasingly uncertain future, the promising framework presented in this chapter may help equip students to recognize and navigate the complex interfaces within and between human and natural systems, ultimately contributing to a more ecologically sustainable and socially just world.

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