A Short Reflection on Protecting the Remaining Biodiversity of Salmonid Fishes

John J. Piccolo

Abstract Earth is faced with an anthropogenic biodiversity crisis. The Sixth Mass Extinction is the first mass extinction to be driven by a single species, *Homo sapiens*. In this brief essay, I briefly recount salmonid biodiversity, concluding that a vast portion of historic biodiversity has already been lost, mirroring global biodiversity loss in general. I then recount the concepts of instrumental and intrinsic value, anthropocentrism and ecocentrism, in relation to biodiversity conservation. I conclude that intrinsic natural value is an incontrovertible aspect of biodiversity conservation, and that ecocentrism is one key aspect of a truly sustainable transformation of the relationship among human and nonhuman beings. A sound rationale for protecting the world's remaining salmonid biodiversity must rest in part upon the recognition of, and respect for, intrinsic natural value.

Keywords Ethics · Values · Conservation · Intrinsic · Instrumental · Ecocentrism · Anthropocentrism

> So much must be done in so short a time to protect the remaining genetic diversity of these fishes that I cannot responsibly suspend judgments…in the hope that irrefutable data might one day be collected.
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> Robert J. Behnke (1992), "Native Trout of Western North America."

1 Introduction

The world's salmonid biodiversity is found in five genera in the family Salmonidae, including the salmon, trout, charr, grayling, whitefish, taimen, and lenok. The known number of species is in the range of 100–200, depending upon how these are defined—there is considerable debate over which groups should be lumped or split.

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Behnke (2007), for example, listed some 30 species of salmon, trout, and charr (excluding grayling and whitefish), which many would consider a conservative estimate. In any case, in most salmonid species, reproductive isolation due to a strong homing instinct leads to many distinct populations occurring within river drainages, i.e. great intraspecific biodiversity (Taylor 1991). The sum biodiversity of salmonid fishes, therefore, if one includes all adaptive diversity, is practically immeasurable (Behnke 2002, 2007). Hence, a project aiming to protect the world's salmonid biodiversity is indeed a daunting task, enveloping diverse ecological and social knowledge. When faced with a monumental task, it is sometimes wise to focus on a goal that might be achievable, that which Sir Peter Medawar (1967) called "the art of the soluble"; a scientist, realizing that there are more questions than one might ever hope to answer, should focus on the most difficult problem that in fact *might* be answered. Before we set out to answer the question "*How* are we to protect the world's salmonid biodiversity?", perhaps it is worthwhile to reflect upon the question "W*hy ought we* to protect salmonid biodiversity?".

1.1 The Status of the World's Salmonid Biodiversity: A Dwindling Natural Legacy

The fact that I just wrote that salmonid biodiversity is practically immeasurable makes it seem paradoxical to state that we have already lost a vast majority of salmonid biodiversity worldwide. It would be pointless to try to put a figure of the number of unique populations that have been extirpated worldwide, particularly due to river regulation, habitat destruction, and overfishing since the industrial revolution. Before we can make educated guesses based upon historic declines which we have witnessed, such as the Columbia and Sacramento River basins in western North America, where wild salmon runs have declined by some 80% since the arrival of European settlers in the 1800s (Lichatowich 2001) or the Atlantic salmon runs of eastern North America, which have declined some 95% since settlement in the 1600s (Behnke 2002). Comparing these systems to those in Alaska or the Russian far east, one can guess that in developed regions, roughly 10% or less remains today of the post-glacial biodiversity that existed some 5000–10,000 years ago; the cutthroat (*Oncorhynchus clarkii*) and rainbow (*O. mykiss*) species complexes in western North America provide a well-documented example (Behnke 1992). Across the pond, the landlocked Atlantic salmon in Lake Vänern, Sweden, a stone's throw from my office door, have suffered a decline of at least 90% since the earliest reliable catch records from the 1700s (Piccolo et al. 2012).

The drivers of salmonid biodiversity loss are well documented and need not be reviewed here—overfishing, habitat destruction, invasive species, and others, coupled with the looming effects of climate change, have been the subject of countless articles and books. My question here is why we should strive to protect the remaining salmon biodiversity. Although this may seem self-evident, the reader may find it

profitable to reflect more deeply on this question, and how the answer to this question may help to solve the problem.

2 The Values of Salmonid Biodiversity

In the early days of fishery management, the answer as to why salmonids should be protected was usually because they could be fished for either food, sport, or income. Bill Ricker (1954), for example, developed his famous stock-recruit models in part to ensure sustainable salmon populations. Of importance for this reflection, Ricker understood stock-recruit in relation to local adaptation of salmonid populations (i.e., intraspecific diversity), which plays a key role in biodiversity conservation (Behnke 2002; Piccolo 2011). Of course, for populations that are commercially valuable, for either food or sport fisheries, it is relatively easy to justify a conservation program because the financial costs may be less than the gains, or at least the costs may not greatly exceed the benefits (perverse subsidies notwithstanding). The stock-specific salmon fisheries management in Alaska, USA, provides one such example (Piccolo et al. 2009).

With the global awareness of the environmental crises in the 1960s–1970s, conservation focus began to shift away from simply economically valuable species to unique and threatened species in general—whales, pandas, and whooping cranes became icons of threatened nature, and societal values led to environmental legislation in many countries, such as the US Endangered Species Act. Species conservation could be justified because the species had a right to exist and flourish (Taylor et al. 2020); such arguments led to the birth of the Society for Conservation Biology by leading ecologists of the time, such as Jared Diamond, Paul Ehrlich, and Michael Soulé (Soulé 1985).

Times rolled on, and by the date of the release of the UN Millenium Ecosystem Assessment (2005) conservation focus began to shift to the "ecosystem services" returning to a broadly similar argument as that of early fisheries management, i.e., protection can be justified largely by "services" to people, either supporting, regulating, provisioning, or cultural. In practice, most ecosystem services assessments originally focused on economic valuations (Costanza et al. 2017). More recently, the concept of "nature's contributions to people" a concept that is also largely about benefits for people (Piccolo et al. 2022).

This back-and-forth of the justifications for conservation can be roughly termed as being based upon either instrumental (utilitarian) or intrinsic (inherent) value, i.e. should nature be protected for solely for the sake of humans to use, or also for its own sake (Chan et al. 2016; Piccolo 2017). For those salmonid populations that are of economic or subsistence value for commercial, sport, or household fisheries, protecting them for sustainable use might easily appeal to their instrumental value (Watz et al. 2022). For the many populations of salmonids that have no fisheries value, however, arguing that they should be protected for the sake of humans seems futile. Perhaps they have some cultural value, or some future option value, but these

alone hardly seem viable, and they might easily change if, for some reason peoples' opinions change. If we wish to have lasting protection for the world's salmonid biodiversity, scientists and managers should be prepared to argue for the intrinsic values of nature and the rights of fish populations to persist and flourish. In the section below, I summarize the elegant rationale for biodiversity protection known as an eco-evolutionary conservation ethic, one that should intuitively appeal to ecologists and evolutionary biologist.

2.1 Intrinsic Natural Value: "What Good Is It Anyway?"

To illustrate the practical aspects of intrinsic natural value, Piccolo et al. (2022) retell philosopher J. Baird Callicott's (2017) story of Edwin (Phil) Pister, a fish biologist for over 50 years at California Fish and Game (Pister 2010). Pister was the founder of The Desert Fishes Council (DFC 2021), and he led efforts to protect the native golden trout (*Oncorhynchus mykiss aguabonita*) of California, as well and many other desert fishes. Pister was a student of Starker Leopold (Aldo's son), from whom he seemed to have developed a land ethic (Behnke 2002). Pister's efforts culminated with a successful legal case before US Supreme Court to protect the desert pupfish (*Cyprinodon macularius*) under the Endangered Species Act. Later, he saved another pupfish species by transferring the entire population in a bucket when its desert spring habitat was being dewatered (Pister 1993). Pister got a lot criticism from fellow California Fish and Game employees during the "hook and bullet" era of game management (Callicott 2017): "*The concern and care lavished by Pister on these tiny non-game species of fish baffled his colleagues… Of each such species rising to the attention of a judge, instead of a fly, they would ask him, what good is it, anyway? For years Pister struggled to answer that question. For example, some of these fish thrived in salt-saturated brine; so maybe research on their remarkable kidneys could provide information applicable in medicine. But would such speculative option value—to put the issue in economistic terms—outweigh the value of drinking water for thirsty LA and agricultural, commercial, and residential development in western Nevada? Hardly. His quest for an effective answer to the what-good-is-it-anyway question led Pister to Environmental Ethics (the journal). And there, in the concept of intrinsic value, he found the answer that had eluded him. That answer—species of desert fish have intrinsic value—certainly satisfied Phil Pister, who now had a term and a body of academic literature to justify his own intuitive application of the concept to endangered species.. Pister finally found a rejoinder that has provided us environmental philosophers with as much insight and rhetorical leverage as we ever provided him. He answered the question, what good is it, anyway? with a question of his own: what good are you?*"

Pister's point, of course, was that these fishes had some inherent good of their own, an intrinsic value, that could justify their continued existence. The existence of such intrinsic natural value has been the subject of debate in western philosophy since the Enlightenment (Rolston 2020), but many scholars have concluded that

such value can no longer rationally be denied (see Piccolo et al. 2022). Philosopher Holmes Rolston III has delved deeply into the "origins of value in human and natural history" (Rolston 1999, 2010); he finds that, ultimately "Earth is value-able, able to create value"; that there can be no firm dividing line between life forms that hold intrinsic value and those that do not. In the simplest terms, an eco-evolutionary worldview, i.e., the belief in the descent of species through natural selection, makes it difficult to see how an arbitrary dividing line can be drawn between human and nonhuman life, wherein intrinsic value suddenly appears within humans. "*Natural selection picks out whatever traits an organism has that are valuable to it, relative to its survival. When natural selection has been at work gathering these traits into an organism, that organism is able to value on the basis of those traits. It is a valuing organism, even if the organism is not a sentient valuer, much less a vertebrate, much less a human evaluator. And those traits, though picked out by natural selection, are innate in the organism. It is difficult to dissociate the idea of value from natural selection.*"

The naïve philosophical argument that only rational beings can value has long since broken down under the weight of the evidence provided by the scientific understanding of evolution by natural selection (Callicott 2013). The recognition of the intrinsic values of nature shifts human worldviews from *anthro*pocentric to *eco*centric. Or, as American ecologist Aldo Leopold (1949) wrote: "*a land ethic changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it*."

3 Ecocentrism: The "Key-Log" for Breaking Our Anthropocentric Logjam

> The "key-log" which must be moved to release the evolutionary process for an ethic is simply this: quit thinking about decent land-use as solely an economic problem. Examine each question in terms of what is ethically and esthetically right, as well as what is economical expedient. 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.
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> Aldo Leopold (1949) "The land ethic" *in* "A Sand County Almanac"

There are many arguments as to why we should strive to protect biological diversity, in our case the biodiversity of the world's remaining salmonids. Most of these arguments will naturally rely on why the fish are valuable to people, i.e., upon their instrumental value. Like all animals, humans often care most for our own—Darwin (1872) himself recognized that ethics begin with family and tribe, before they can extend to nations; but he also recognized extending ethics to nonhumans as the noblest of moral achievements. Many argue that a conservation ethic founded *wholly* upon instrumental value, however, is ultimately doomed to failure (Taylor et al. 2020). As soon as expediency dictates that a species is no longer of instrumental valuable to anyone, it is no longer worth protecting. Much of the world's salmonid biodiversity cannot be caught, sold, or eaten (Fig. 1); if we can't recognize and

Fig. 1 A wild, endemic landlocked Atlantic salmon smolt from River Klarälven, Sweden. Nearly extirpated by overfishing, pollution, and dam-building, comprehensive conservation efforts have brought this unique population back from the brink of extinction. Today over 1000 wild spawners return annually to the river, less than 10% of historic pre-industrial levels, but a large increase from some 100 spawners in the 1960s–1970s (Piccolo et al. 2012). The wild salmon cannot currently support a fishery, so they are of little instrumental value for people. The main conservation argument for such populations is often their intrinsic value, i.e. their right to exist and flourish

respect its intrinsic value there will be little reason to protect it. Rare species are paradoxically often of least instrumental value to people. It has been argued that, in the "Anthropocene," conservation must be about peoples' needs first (Kareiva and Marvier 2012). But is such a world really the most just of which we can conceive with the great intellect which nature has endowed upon us?

If we wish to progress with protecting the remaining biodiversity of salmonid fishes, we must work toward the expression of ecocentric values, even while recognizing the legitimate instrumental values that people gain from nature. Ecologists must learn to be comfortable speaking about peoples' moral obligations to nature, in equal measure as we speak about nature's contributions to people (Piccolo et al. 2022). The eco-evolutionary worldviews of most ecologists can and ought to foster an ethic of principled responsibility for protecting biodiversity for its own sake, as well as for humans' sake.

We are well underway with Earth's six mass extinction, the first of which has been driven by the unrestrained greed of a single species. In the past few hundred years, humans have driven to extinction a large fraction of the historic biodiversity

of salmonid fishes; best estimates are that only ca. 10% of historic salmonid biodiversity remains in most developed regions. If we are to protect what remains of the wonderful diversity of these fishes, *now* is the time to speak openly and loudly about their unique value and their right to continue to flourish.

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References

Behnke RJ (1992) Native trout of Western North America. American Fisheries Society Monograph 6. Bethesda

Behnke RJ (2002) Trout and salmon of North America. The Free Press, New York

Behnke RJ (2007) About trout. The Lyons Press, Guilford

Callicott JB (2013) Thinking like a planet: the land ethic and the Earth ethic. Oxford University Press, New York

Callicott JB (2017) What good is it anyway? In: Gardiner S, Thompson A (eds) The Oxford handbook of environmental ethics. Oxford University Press, Oxford, pp 113–124

Chan KM, Balvanera P, Benessaiah K et al (2016) Opinion: why protect nature? Rethinking values and the environment. Proc Natl Acad Sci U S A 113:1462–1465

Costanza R, de Groot R, Braat L et al (2017) Twenty years of ecosystem services: how far have we come and how far do we still need to go? Ecosyst Serv 28:1–16

Darwin C (1872) The descent of man, 2nd edn. Prometheus Books, New York

Kareiva P, Marvier M (2012) What is conservation science? BioSci 62:962–969

Leopold A (1949) A sand county almanac and sketches here and there. Oxford, New York

Lichatowich JA (2001) Salmon without rivers: a history of the Pacific salmon crisis. Island Press, Washington, DC

Medawar PB (1967) The art of the soluble, 1st edn. Routledge, London

Piccolo JJ, Adkison MD, Rue F (2009) Linking Alaskan salmon fisheries management with ecosystem-based escapement goals: a review and prospectus. Fisheries 34:124–134

Piccolo JJ (2011) Challenges in the conservation, rehabilitation and recovery of native stream salmonid populations: beyond the 2010 Luarca symposium. Ecol Freshw Fish 20:346–351

Piccolo JJ, Norrgård JR, Greenberg LA, Schmitz M, Bergman E (2012) Conservation of endemic landlocked salmonids in regulated rivers: a case-study from Lake Vänern, Sweden. Fish Fish 13:418–433

Piccolo JJ (2017) Intrinsic values in nature: objective good or simply half of an unhelpful dichotomy? J Nat Conserv 37:8–11

Piccolo JJ, Taylor B, Washington H, Kopnina H, Gray J, Alberro H, Orlikowska E (2022) "Nature's contributions to people" and peoples' moral obligations to nature. Biol Conserv 270:109572

Pister EP (1993) Species in a bucket. Nat Hist 102:14–14

Pister EP (2010) California golden trout: perspectives on restoration and management. Fisheries 35:550–553

Ricker WE (1954) Stock and recruitment. J Fish Board Can 11:559–623

Rolston H III (1999) Genes, genesis, and God: values and their origins in natural and human history. Cambridge University Press, Cambridge

Rolston H III (2010) Three big bangs: matter-energy, life, mind. Columbia University Press, New York

Rolston H III (2020) A new environmental ethics: the next millennium for life on Earth, 2nd edn. Routledge, New York
Soulé M (1985) What is conservation biology? BioSci 35:727–734
UN MEA (2005). Millennium ecosystem assessment. Washington, DC: New Island, 13, 520
Taylor EB (1991) A review of local adaptation in Salmonidae, with particular reference to Pacific and Atlantic salmon. Aquaculture 98:185–207
Taylor B, Chapron G, Kopnina H, Orlikowska E, Gray J, Piccolo JJ (2020) The need for ecocentrism in biodiversity conservation. Conserv Biol 34:1089–1096
Watz J, Aldvén D, Andreasson P, Aziz K, Blixt M, Calles O, Bjørnås KL, Olsson I, Österling M, Stålhammar S, Tielman J, Piccolo JJ (2022) Atlantic salmon in regulated rivers: understanding river management through the ecosystem services lens. Fish Fish 23:478–491