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Choosing an ecological ideal: The ethics of ecosystem services modeling

The flooding of the Hetch Hetchy Valley has become an article of American folklore. In 1908, the city of San Francisco received permission to convert Hetch Hetchy into a reservoir, inciting outrage among environmentalist groups (Keel 2020). The resulting battle is typically portrayed as a duel between Gifford Pinchot, the chief of the United States Forest Service, and John Muir, the founder of the Sierra Club. Pinchot, a conservationist who believed natural resources should be used for human benefit, saw the construction of the reservoir as a means of securing the San Francisco water supply. Muir saw the construction as a tragedy, a desecration of natural beauty. His furious opposition to the reservoir has lingered in the popular imagination, turning Hetch Hetchy into a lost Eden. The issue was effectively closed after a 1913 federal law greenlighted the building of a reservoir in the Hetch Hetchy Valley (Keel 2020). However, the basic elements of the Hetch Hetchy controversy remain relevant today: in debates over environmental management, from climate mitigation to land development to drilling rights, those who wish to preserve natural resources are pitted against those who wish to put them to practical use.

The growing field of ecosystem services research attempts to reconcile the two sides of this conflict, connecting the environmental value of preservation to the economics of resource use. The central premise of the ecosystem services framework is that human society depends on natural ecosystems to provide certain life-supporting services—for instance, clean air, clean water, and food crops (Daily et al. 1997). A typical study assigns indicator variables to a selected set of ecosystem services, then measures the indicators within a study area. Computational modeling technology allows a single analysis to cover a large study area, producing landscape-scale results valuable to land managers and policymakers.

However, the implementation of the ecosystem services framework brings several ethical issues to the fore. In any evaluation of ecosystem services, the implication is that some outcomes are “better” than others. A study that tests different strategies for increasing crop yield and reducing soil loss is making a tacit statement that crop yield should be raise and erosion should be curbed. Followed to its logical extreme, this ecosystem services evaluation structure suggests that there is some optimal or ideal

state—the purest water, the most fertile soil, the maximum crop production—that ecosystems can attain (Calow 1992). Some type of ecological ideal is implied in every ecosystem services modeling study. These ideals are an expression of the modelers' personal values. In order to preserve the objectivity of ecosystem services modeling, the normative judgments behind the choice of an ecological ideal must be made explicit. To that end, this essay will identify four ecological ideals that appear frequently in the literature and discuss the ethical issues associated with each.

The most common ecological ideal in ecosystem services research is the idea that ecosystems should be productive. Theoretically, every ecosystem service can be assigned a monetary value. However, some services overlap when considered from a strictly financial viewpoint. For instance, it is difficult to separate the value of soil nutrient cycling from the cash value of crops. In order to avoid counting the same service more than once, the definition of ecosystem services must be restricted to include only the ecosystem processes and function that provide direct benefits to humans (Boyd & Banzhaf 2007). The productivity ideal emphasizes marketable outputs. It allows ecological value to be translated easily into economic value, which makes ecosystem services more competitive in conventional markets (Lant et al. 2008). However, studies organized according to the productivity ideal are biased in favor of the few ecosystem services that can easily be commodified and sold (Kull et al. 2015). Productivity-oriented studies also overlook other types of value. For instance, the productivity ideal works on the assumption that the value of nature is purely utilitarian—contingent on its usefulness to humans. If, however, nature has intrinsic value, then the buying and selling of ecosystem services becomes an ethical violation (Jax et al. 2013). For this reason, although the productivity ideal is the conventional approach to ecosystem services research, it is widely critiqued in the literature.

Another common ecological ideal is the idea of nature as a pristine wilderness, free of human influence. This wilderness ideal dictates that ecosystems should be returned to a "natural", undisturbed state, as they were in pre-Columbian or pre-settlement times (Anderson 1991). The wilderness ideal is implied whenever a study assumes without justification that, for instance, present levels of soil loss should be reduced, current biodiversity should be increased, or the species composition of the biotic

community should be restored to some historical standard. The wilderness ideal is intuitive to both laypeople and specialists. It has a powerful emotional appeal—firstly because beautiful areas like the Hetch Hetchy Valley have been mythologized in American culture, and secondly because people often have a sentimental attachment to the landscapes where they live or where they grew up. However, what constitutes unspoiled wilderness tends to differ from person to person and from culture to culture. There is no objective definition that can satisfy all stakeholders. Some theorists have attempted to formalize the wilderness ideal by tying it to a pre-human reference landscape (Suter II 1992). If a sample of undisturbed nature could be identified and studied, it might be possible to remove the subjectivity from the term "wilderness". But this approach can also be misleading, because most supposedly untouched landscapes have historically been managed by indigenous peoples (Redman 1999). Thus the wilderness ideal, though compelling, is not a sound basis for scientific research.

Some land managers have made stability their ecological ideal. In ecologies that are subject to periodic disturbance, the idea of an ecosystem that behaves in a predictable, controllable manner can be attractive. The stability ideal is associated with management strategies that aim to prevent or mitigate natural disasters such as floods and forest fires. Two notable examples from American history are the fire suppression policy implemented by the U.S. Forest Service until the 1960s (van Wagtendonk 2007), and the levee system built to control floods on the Mississippi River. In the short term, stability-oriented management can provide increased security to people living under the threat of ecological disturbance. However, ecosystems rarely attain states of equilibrium (Barkmann et al. 2001); they undergo both periodic disruptions and incremental changes. Attempting to buffer or end these cycles can backfire spectacularly. Forest fire suppression, for instance, has been shown to cause a buildup of flammable material that ultimately leads to more severe fires (Harris et al. 2021).

River engineering, rather than reducing flooding along the Mississippi, has contributed substantially to a long-term increase in the magnitude of Mississippi River floods (Munoz et al. 2018). Though important historically, the stability ideal is not a viable organizing principle for ecosystem services research.

The sustainability ideal has emerged as a compromise among the different value systems that influence ecosystem services research. Sustainability, in the literal sense of the word, entails land management practices that can be applied continuously without long-term harm. As described by the UN Sustainable Development Goals, the term "sustainability" incorporates multiple objectives: biodiversity, income security, and public health, among others (UN 2015). Seen in this light, ecosystem services research is not a monolith but a collection of diverse studies with sometimes competing motivations. The sustainability ideal is inclusive in that it accounts for the needs of stakeholders with opposing ecological ideals. However, the sustainability ideal requires modelers to cope with a broad range of variables and perspectives. An ecosystem services evaluation based on the principle of sustainability may be beyond the scope of any one study. Furthermore, sustainability remains an ambiguous concept. Of the four ecological ideals discussed here, sustainability is the most defensible, but modelers must define the term carefully if they choose to use it; otherwise, they risk inviting another source of controversy into ecosystem services research.

Ecosystem services modeling is closely intertwined with environmental ethics. In choosing an ecological ideal, researchers are consciously or unconsciously taking a political stance. As a result, some legitimate science may be discounted by parties who do not share its underlying values. One researcher may, in a peer-reviewed publication, call another researcher's views "revolting" (Norgaard 2010). This does not mean ecosystem services modeling research should cease. However, modelers must state their ideals and objectives clearly in order to avoid imposing their personal values on other stakeholders. Furthermore, research must take place in tandem with a larger public debate about ecological goals and priorities. Science can clarify, but ultimately cannot resolve, the value-laden questions at the core of ecosystem services research.

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