Should Ecological Science Be Ethical?

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Abstract

Both scientific and moral communities have identified that current management of the natural environment by humans is unsustainable. How society responds to environmental challenges will likely require a multi-disciplinary approach. Jenkins addresses the contributions that science, religion and ethics can make to resolving complex environmental problems and increasing successful management of ecological systems. While we agree with many of Jenkins' points, he touches upon three common ideas about science, and ecology in particular, that we argue are often misconstrued: (i) Scientific understanding of current environmental challenges is inadequate due to 'uncertainty' in scientific studies; (ii) Ecological scientists are equivalent to environmental managers; and (iii) Scientists should become more like activists and consider social values as drivers. We suggest that these ideas may be unhelpful in interpreting scientific studies and might lead to increasing misrepresentation of science. Furthermore, such perceptions may increase distrust by the general public of scientists who do not adequately separate objective scientific evidence from personal value-judgments. We agree that the scientific method should indeed be ethical, with no room for fraud or deliberate falsification of results, but that the science itself must be objective and non-moral, with scientific evidence unprejudiced by political and social agendas. We recommend that ecologists and managers, as well as ethicists and religious communities, work together in a robust defense of an evidence-based approach to the management and restoration of global ecological systems.

Introduction

The earth and its systems are undergoing a period of unprecedented rapid physical, chemical and environmental change, caused by human activities.[1] These changes have been rigorously documented by scientists and debated by many subsets of society, including moral or religious communities.[2] Science is also concerned with predicting the likelihood and consequences of future changes.[3] The

1 D.R. Easterling, G.A. Meehl, C. Parmesan, et al. "Climate extremes: Observations, modeling, and impacts," *Science* 289 (2000): 2068-2074. J.B.C. Jackson, M.X. Kirby, W.H. Berger, et al. "Historical overfishing and the recent collapse of coastal ecosystems," *Science* 293 (2001): 629-638. T.P. Hughes, A.H. Baird, D.R. Bellwood, et al. "Climate change, human impacts, and the resilience of coral reefs," *Science* 301 (2003): 929-933. E. Monnin, A. Indermuhle, A. Dallenbach, J. Fluckiger, B. Stauffer, T.F. Stocker, D. Raynaud and J-M. Barnola, "Atmospheric CO2 concentrations over the last glacial termination," *Science* 291 (2001): 112-114.

2 Hulme, M. *Why We Disagree About Climate Change Understanding Controversy, Inaction and Opportunity*. (Cambridge: Cambridge University Press, 2009).

3 L.R. Iverson and A.M. Prasad, "Predicting abundance of 80 tree species following climate change in the eastern United States," *Ecological Monographs* 68 (1998): 465-485. A. Guisan & N.E. Zimmermann, "Predictive habitat distribution models in ecology," *Ecological Modelling* 135 (2000): 147-186.

choices that humanity makes in forthcoming years will likely influence the state not only of our own species but that of many others. Given this situation, it would seem prudent to base our choices on evidence. Although science and religion draw on different forms of evidence, the interpretation of these two evidence bases has led many scientists and moral communities to conclude that the way humans currently manage the environment is unsustainable.[4]

Considering how humanity responds to the challenges that we have set ourselves, Jenkins[5] discusses how ethics and religion may be used to change behavior and motivate a sustainable response to the environmental crisis. Specifically, he asks what the relative roles of ethics, culture and science should be. In terms of ethics, he questions whether the cosmological approach that has been emphasized by ethicists should be replaced by a more pragmatic practical approach that deals with individual situations as they arise. While we are unqualified to comment on the ethical arguments that Jenkins proposes and we agree with many of his points, as ecologists we felt that the article touched on some common misconceptions concerning science, and ecological science in particular, that could be usefully addressed here. First, there is often an explicit notion that environmental issues are too complex, predictions are too uncertain, and therefore the world cannot be understood by science.[6] We argue that the scientific method is ideally suited to address such complex problems. We attempt to clarify how science quantifies uncertainty and the difference between the probability of a certain outcome and the risks involved. Furthermore, we suggest that the ecology of many environmental problems is often better understood, or at least more easily solved, than related socio-economic and political challenges. Second, Jenkins[7] treats ecological scientists and managers as largely interchangeable in his arguments. This mirrors confusion in the general public between 'ecology,' which is a scientific discipline, and 'ecological' or 'environmental' management, which is human manipulation of ecological systems to achieve specific management goals. We argue that management should be based on scientific evidence, but that it also incorporates many other facets and is inherently ethical, in that some value judgment is required concerning what outcome is 'best.' Thus, we support Jenkins' assertion that environmental *managers* should consider cultural and religious values as they work to set and achieve management goals. However, we argue that the same considerations should not necessarily apply to scientists conducting ecological research. This leads us to our third point. There is a common cry that science and scientists must become more 'interdisciplinary,' and that science must include *x* and training about

4 E. Kintisch, "Science and religion - Evangelicals, scientists reach common ground on climate change," *Science* 311 (2006): 1082-1083. S.A. Kolmes and R.A. Butkus, "Science, religion and climate change," *Science* 316 (2007): 540.

5 W.J. Jenkins, "Ecological management, cultural reform, and religious creativity," *Union Seminary Quarterly Review* vol. 62 1&2 (2011): 1-17.

6 P.M. Vitousek, "Beyond global warming: ecology and global change," *Ecology* 75 (1994): 1861-1876.

7 Jenkins, "Ecological management".

x. Recent themes include socio-economics,[8] communication,[9] and in this case, ethics.[10] While we agree that integrating skills and ideas from other disciplines has its benefits, we think that the inclusion of ethics into science must be undertaken cautiously. Completely separating science from ethics is neither possible nor desirable. Indeed, strong scientific ethics ensures that researchers do not conduct sloppy research, report false results or violate rules concerning the treatment of research subjects.[11] However, we argue that science itself is outside the sphere of morals and care must be taken to ensure that scientific judgment and objectivity are not clouded by social or religious values. Ecology is the study of the natural world and its patterns and processes. What humanity chooses to do with the results of that knowledge is certainly related to morals and ethics, and should be debated by society at large. However, the science itself must be reported in an non-moral, unbiased framework. The notion that scientists have a political or social agenda can lead to a general mistrust of the scientific process and a discarding of scientific evidence. Furthermore, mixing science and values can provide ammunition for political groups that seek to invalidate research findings and spread misinformation for political or economic gain.[12] We expand on these points below.

Is the world too complex and are scientists too uncertain?

It does seem to be true that the "complex environmental problems" identified by Jenkins[13] in his opening sentence do "frustrate practical reasoning and scientific research." Certainly, many media outlets and political commentators make it appear so. However, the uncertainty present in many scientific models that is often misused by those opposing 'environmentally-friendly' policies as an excuse to do nothing, is actually part and parcel of science[14] (for the role of uncertainty specifically in ecology, see note[15]). The 'uncertainty' present in scientific studies does not mean that scientists are guessing; the term uncertainty has a very different meaning in science than is normally associated with it by the general public.[16] Uncertainty in science can indeed mean a lack of knowledge, but it can also mean that there is a certain probability attached either to an event or experimental result happening, or to the consequences of that event. Consider examples from every-

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8 P. Lowe, G. Whitman and J. Philipson, "Ecology and the social sciences," *Journal of Applied Ecology* 46 (2009): 297-305.

9 P.M. Groffman, et al. "Restarting the conversation: challenges at the interface between ecology and society," *Frontiers in Ecology and the Environment* 8 (2010): 284-291.

10 Jenkins, "Ecological management"..

11 National Academy of Science, National Academy of Engineering, Institute of Medicine. *On Being a Scientist: Responsible Conduct in Research*. 2nd Ed. (The National Academies Press. 1995).

12 N. Oreskes and E.M. Conway, *Merchants of Doubt - How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury, 20100).

13 Jenkins, "Ecological management". p. 1..

14 The Royal Society, *Handling uncertainty in science*. Meeting. URL: http://royalsociety.org/2010-Handling-uncertainty-in-science/

15 D. Ludwig, M. Mangel and B. Haddad, "Ecology, conservation, and public policy," *Annual Review of Ecology and Systematics* 32 (2001): 481-517.

16 G.A. Bradshaw and J. G. Borchers, "Uncertainty as information: narrowing the science-policy gap," *Conservation Ecology* 4 (2000): 7. URL: http://www.consecol.org/vol4/iss1/art7/.

day life: the probability (chance) that your house falls down is usually quite small but if it does, you are in dire straits. The probability of the house falling down is low, but the probability of a bad outcome is high if it does. People generally have some intuitive idea of such low probability high risk events, and are usually required to get insurance against them. Furthermore, the probability of a certain outcome can be rigorously quantified, given a large enough sample. This is why science is such a valuable tool. It enables us to quantify uncertainty (the probability of an event happening as well as the probability of the outcomes) in an objective manner. In terms of climate science, there is indeed a lack of knowledge of how some parts of the climate system work and what effects unknowable future human actions might have. But climate scientists can also state with >90% certainty that the net effect of human activities since 1750 has been one of warming, and that most of the observed increase in global average temperatures since the mid-20th century is due to the increase in anthropogenic greenhouse gas concentrations.[17] This is akin to saying that if you have a hat with nine red balls and one white and you randomly pull out one ball, you can say with 90% certainty that the ball you pull out will be red.

Given that there is such overwhelming scientific consensus on the most complex environmental problem that humanity has yet faced, why is there so little agreement on what should be done about it? While there may be scientific consensus, there is often less public consensus, and even less commitment from national governments to amend policy. We suggest that solutions to wicked problems such as climate change tend to be more frustrated by practical reasoning than by scientific research. The complexity of many environmental problems lies with trade-offs between the values and priorities held by humans. Jenkins[18] considers religion and whether humans ascribe an intrinsic value to nature or believe it is provided for our benefit; however, there is also a more immediate trade-off between meeting short-term needs over the needs of future generations.

Is management a science and is ecology environmental?

Amongst the general public 'ecology' and 'environmental' are so often synonymous that it is no wonder that this confusion has drifted into academia.[19] Ecology as a science is fundamentally different to environmental management. Ecology is the scientific study of the organisms and the interactions between them and their environment that make up the living natural world.[20] This science is based on the accumulation of evidence concerned with how organisms and communities function. Ecology therefore also includes the effect of humans and their impacts on ecological communities; and does concern itself with the importance of organisms within communities and how critical they are to maintain a fully-

17 Inter-governmental Panel on Climate Change *Fourth Assessment Report*. Core Writing Team, R.K. Pachauri and A. Reisinger (Eds.) (Geneva, Switzerland: IPCC, 2007).

18 Jenkins, "Ecological management". pp. 9-16.

19 M. Westoby, "What does 'ecology' mean?" *Trends in Ecology and Evolution* 12 (1997): 166.

20 M. Begon, C.R. Townsend and J.L. Harper, *Ecology: From Individuals to Ecosystems*. 4th Ed. (Wiley-Blackwell, 2005).

functioning ecosystem.[21] But it has nothing to say about any inherent moral or ethical value of species or individuals and whether they have such value simply for existing. Environmental management, on the other hand, is concerned with the management of ecosystems, communities, or particular species, and how some management plan or goal may be realized.[22] These goals are inherently ethical and reflect human societies' ethical values – society decides what outcome is desired and what ecological community should be encouraged or preserved, whether it is the deciduous forests that covered Europe several thousand years ago, or the diversity of passerine birds that flourished in the extensive agricultural systems since then. Not only do environmental managers help set these goals, they also compromise them by including other points of view, including cultural and religious aspects. For example, rigorous studies of fisheries have demonstrated the likely negative effects of catching large numbers of certain species of fish.[23] Reconciling these predicted (and documented, in many cases) results has proven difficult with the lifestyles and livelihoods of fishermen. Much scientific work has been done on how and why people value various aspects of nature, what benefit they obtain from it, and what the conflicts are.[24] As we stated above, most people value their own food and energy security above that of future generations (or, in situations of dire poverty, must meet their short-term needs to ensure the survival of themselves and their immediate offspring).

But how do we know if our management is successful? Much like the revolution in evidence-based medicine, conservation and management has undergone dramatic changes in how it is conducted.[25] Evidence-based management should be the norm, and this should also include how to manage people. Understanding how to address the key nodes in a network of a human population such that they respond positively to evidence-based management, as in the Chesapeake Bay example identified by Jenkins,[26] is important research to undertake. In this respect, we wholeheartedly agree with Jenkins[27] argument that ecological *managers* should become "adept participants in moral culture."

Multi-disciplinarity and scientists as activists

Ecology is among the most collaborative of disciplines, using diverse tools such as molecular genetics, isotope ratios, advanced statistics and even theoretical

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21 F.S. Chapin III, B.H. Walker, R.J. Hobbs, D.U. Hooper, J.H. Lawton, O.E. Sala and D. Tilman, "Biotic control over the functioning of ecosystems," *Science* 277 (1997): 500-504.

22 J.P. Harkins, "Thou canst not stir a flower/," *Environmental Management* 1 (1977): 4-5.

23 J.B.C. Jackson, M.X. Kirby, W.H. Berger, et al., "Historical overfishing and the recent collapse of coastal ecosystems," *Science* 293 (2001): 629-638.

24 e.g. G.C. Daily, T. Söderqvist, S. Aniyar, K. Arrow, P. Dasgupta, P.R. Ehrlich, C. Folke, A.M. Jansson, B-O. Jansson, N. Kautsky, S. Levin, J. Lubchenco, K-G. Mäler, D. Simpson, D. Starrett, D. Tilman and B. Walker, "The value of nature and the nature of value," *Science* 289 (2000): 395-396.

25 A.S. Pullin and T.M. Knight, "Doing more good than harm - Building an evidence-base for conservation and environmental management," *Biological Conservation* 142 (2009): 931-934.

26 Jenkins, "Ecological management".p. 12.

27 Jenkins, "Ecological management". pp. 2, 10.

physics in order to address ecological questions.[28] A problem can arise, however, in cases where quantitative science meets qualitative science, when trying to make predictions.[29] It is difficult to include an in-depth interview with a local fisherman in a quantitative model that predicts how many fish one can remove from the sea. Nonetheless, recent years have seen an increase in applied ecological research that incorporates data and methods from social sciences.[30] Quantifying human behavior has been unpopular in the field of ecology since EO Wilson determined to synthesize sociology and biology,[31] but research by sociologists and psychologists may be essential in order to understand how to encourage human behavior that is less self-destructive. Thus, we agree with Jenkins[32] that understanding and resolving environmental and ecological problems will require a multi-disciplinary approach, involving experts from various fields. As the prominent ecologist Simon Levin recently wrote: "Scientists will also need to work with humanists and ethicists, as we deal with the core problems of intergenerational and intragenerational equity, and the powerful role of social norms in shaping individual behaviors."[33]

Jenkins[34] goes further, though, and argues that "Like activists, they [scientists] should agitate those [moral/religious] communities to … support new responsibilities..." We argue, however, that scientists take a risk when they adopt the role of activists. Whether ecologists should be involved in advocacy has been actively debated in the literature.[35] For example, Haupt[36] argued that "appropriate, change-inducing activism is going to require a blurring of the lines between the scientist as scientist and the scientist as activist." However, others have argued that scientists who do blur those lines run the risk of creating a perception of bias and, as a result, losing their credibility in sociopolitical processes.[37] Lackey[38] la-

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28 e.g. P.D. Quay, B. Tilbrook and C.S. Wong, "Oceanic uptake of fossil-fuel CO2 - C-13 evidence," *Science* 256 (1992): 74-79. J.E. Richardson, R.T. Pennington, T.D. Pennington and P.M. Hollingsworth, "Rapid diversification of a species-rich genus of neotropical rain forest trees," *Science* 293 (2001): 2242-2245. B. Shapiro, A.J. Drummond, A. Rambaut, et al. "Rise and fall of the Beringian steppe bison," *Science* 306 (2004): 1561-1565. I. Volkov, J.R. Banavar, S.P. Hubbell, and A. Maritan, "Patterns of relative species abundance in rainforests and coral reefs," *Nature* 450 (2007): 45-49.

29 I.R. Cooke, S.A. Queenborough, et al. "Integrating socio-economics and ecology: a review of applications and approaches," *Journal of Applied Ecology* 46 (2009): 269-277.

30 G.A. Bradshaw and M. Bekoff, "Ecology and social responsibility: the re-embodiment of science," *Trends in Ecology and Evolution* 16 (2001): 460-465.

31 E.O. Wilson, *On Human Nature*. (Cambridge: Harvard University Press, 1979). M.D. Sahlins, *The Use and Abuse of Biology*. (Michigan: University of Michigan Press, 1976).

32 Jenkins, "Ecological management". pp. 8-9.

33 S. Levin, "The evolution of ecology," *The Chronicle of Higher Education* 8 August 2010. URL: http://chronicle.com/article/The-Evolution-of-Ecology/123762/

34 Jenkins, "Ecological management".p. 11.

35 J.M. Scott, J.L. Rachlow, R.T. Lackey, A.B. Pidgorna, J.L. Aycrigg, G.R. Feldman, L.K. Svancara, D.A. Rupp, D.I. Stanish and R.K. Steinhorst, "Policy advocacy in science: prevalence, perspectives, and implications for conservation biologists," *Conservation Biology* 21 (2007): 29-35.

36 L.L. Haupt, "Scientists in conservation activism," *Conservation Biology* 9 (1995): 691-693.

37 L.F. Ruggiero, "Scientific independence and credibility in sociopolitical process," *Journal of Wildlife Management* 74 (2010): 1179-1182.

38 R.T. Lackey, "Science, scientists, and policy advocacy," *Conservation Biology* 21 (2007): 12-17.

ments: "I am concerned that we scientists in conservation biology, ecology, natural resources, environmental science, and similar disciplines are collectively slipping into a morass that risks marginalizing the contribution of science to public policy." There is great public confusion apparent in many environmental problems, such as the 'debate' in the media around the causes and effects of climate change,[39] despite overwhelming scientific evidence and a consensus in the scientific community.[40] The recent "climategate" scandal provides an example of the problems that can arise when scientists appear to have an agenda: hacked e-mail messages from climate scientists were used to cast doubt on the integrity of the scientists and the science itself,[41] despite the fact that all scientists were cleared of any dishonesty.[42] Thus, it is vitally important for scientists to maintain adequate distance between non-moral objective science and the value-laden (ethical) policy outcomes that are, ideally, supported by unbiased scientific evidence. While scientists can and should participate in management and policy decisions by providing sound scientific information, we must "be sensitive to the boundary between scientific or technical issues and value judgments."[43]

Conclusion

Science in the media is frequently misinterpreted or poorly explained.[44] Society is increasingly scientifically illiterate, with few policy-makers having any form of scientific training.[45] Nonetheless, the debate about whether science works was settled centuries ago. The rigorous collation of data supporting or disproving

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39 C.P. Borick, and B.G. Rabe, "A reason to believe: Examining the factors that determine individual views on global warming," *Social Science Quarterly* 91 (2010): 777-800. F. Newport, "Americans' global warming concerns continue to drop," *Gallop Poll* 11 March 2010: URL: http://www.gallup.com/poll/126560/Americans-Global-Warming-Concerns-Continue-Drop.aspx?version#1.

40 N. Oreskes, "The scientific consensus on climate change," *Science* 306 (2004): 1686.

41 A.C. Revkin, "Hacked email is new fodder for climate dispute," 21 November 2009 *The New York Times*. URL: http://www.nytimes.com/2009/11/21/science/earth/21climate.html?_r=2.

42 House of Commons Science and Technology Committee Report 2010. *The disclosure of climate data from the Climate Research Unit at the University of East Anglia*. http://www.publications.parliament.uk/pa/cm200910/cmselect/cmsctech/387/387i.pdf. Lord Oxburgh Scientific Assessment Panel 2010. *Report of the International Panel set up by the University of East Anglia to examine the research of the Climatic Research Unit*. http://www.uea.ac.uk/mac/comm/media/press/CRUstatements/SAP. M. Russell, G. Boulton, P. Clarke, D. Eyton, and J. Norton, 2010. *The independent Climate Change Emails Review*. http://www.cce-review.org/pdf/FINAL%20REPORT.pdf.

43 R.T. Lackey, "Science, scientists, and policy advocacy," *Conservation Biology* 21 (2007): 12-17.

44 L. Antilla, "Climate of scepticism: US newspaper coverage of the science of climate change,"
Global Environmental Change-Human and Policy Dimensions 15 (2005): 338-352. B. Goldacre, *Bad Science*. (Harper Perennial, 2009).

45 C. Dean, "Physicists in Congress calculate their influence," *The New York Times* 10 June 2008 URL: http://www.nytimes.com/2008/06/10/science/10phys.html?_r=1. J.E. Manning, Membership of the 111th Congress: A Profile. *Congressional Report for Congress*. 2010 URL: http://sharp.sefora.org/issues/111th-congress-degrees-by-type/#science. N. Morris, "Only scientist in Commons 'alarmed' at MP's ignorance," *The Independent* 3 August 2010. URL: http://www.independent.co.uk/news/uk/politics/only-scientist-in-commons-alarmed-at-mps-ignorance-2041677.html.

hypotheses that constitutes the scientific method is a valuable tool for describing the natural world and the problems that we have created in it.[46] However, science cannot tell us what the moral or ethical response to these problems is. Given the evidence that the world is indeed warming rapidly, caused by the huge increase in CO_2 and other gases produced by human activities, there is a legitimate debate to be had about what the best response to this, and other such environmental challenges, is. Science can define the problem and predict the probability and risks of various alternative solutions. But ethicists, moral communities and others must all help decide which solution to adopt. Many people do see value in the natural world (both intrinsic and economic) and understand the recklessness in adopting activities with high-probability, high-risk outcomes; this vision is shared by both science and religion.[47] Thus, it behooves ecologists and managers as well as ethicists and religious communities to work together in a robust defense of an evidence-based approach to the management and restoration of global ecological systems.

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46 J. Ziman, *Real Science What it is, and what it means*. (Cambridge: Cambridge University Press, 2000).

47 Wilson, E.O. 2006 *The Creation: An Appeal to Save Life on Earth*. W. W. Norton & Company, Inc.