Ecology and the Inescapability of Values

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In this short essay, I want to expand on Norton's pragmatic account of the environmental sciences and ecology specifically.

First, Norton suggests that a stereotypical "positivist" account of science accepts that claims about facts and values are conceptually distinct and that they should be given science is "value-neutral". A common but controversial view is that factual claims are either true or false whereas evaluative claims express imperatives, commendations, prescriptions, or "pro-attitudes". The two are radically distinct. This also implies that how we evaluate these claims are very different as well. The former are substantiated by empirical evidence and the latter by mere persuasion or perhaps coercion. Norton suggests that the fact-value dichotomy is not defensible. Here I will not wade into that exceedingly complex debate because even if one can distinguish between facts and values, we find them "mixed up" in the environmental sciences. More specifically, we find epistemic and moral values in these sciences.

It is said that there are *epistemic values* in science (Kuhn 1977). For example, scientists often say that a good or desirable theory is one which is simple, empirically accurate, unifying, and fruitful. These properties can only make a theory good, if there are good-making properties; i.e., values. One might argue that these properties themselves are at best instrumentally valuable – they are means to some other ends. However, that just pushes the question back to what are the intrinsic values of the sciences?[1] Presumably, the ultimate cognitive ends of science include being able to understand, anticipate, and intervene in the systems of interest. Thus, there are cognitive or epistemic values in science.

However, there are also various moral values in the sciences as well. Let me provide one example of how this occurs in conservation biology and applied ecology (Shrader-Frechette and McCoy 1992). In standard Neyman-Pearson hypothesis testing, we have a null hypothesis H_0 and an alternate H_1. Null hypotheses assert that some causal factor has no effect; the alternate says that the causal factor does have an effect. As an illustration, suppose we are considering the role of hydroelectric dams in the Pacific Northwest and how they affect salmon populations. Specifically, they prevent salmon from moving easily up and down the Columbia River to the Pacific Ocean. Let our null H_0 and alternate H_1 say,

H_0: Leaving irrigation water on will not decrease endangered salmon populations

H_1: Leaving irrigation water on will decrease endangered salmon populations.

Obviously, there are four types of decisions we can make:

- We reject the null H_0 given that it is true.
- We accept the null H_0 given that it is true.
- We reject the null H_0 given that it is false.
- We accept the null H_0 given that it is false.

A *Type I error* occurs when we reject the null given that it is true and a *Type II error* occurs when we accept the null when it is false. Given that are ecological data are samples from populations under investigation and how difficult that data can be to collect, these errors are

[1] Norton is very critical of the distinction between intrinsic versus instrumental values. However, to avoid an infinite regress of values, there must be some basic ends. These need not be metaphysically or epistemically odd and they certainly can change depending on circumstances.

always present. Customarily, scientists minimize Type I errors; they reject H_0 just in case Pr(Rejecting H_0/H_0 is true) < 0.05.[2] We could choose to minimize the risk of Type II errors, but for various reasons it is difficult to minimize both types of errors. Since both errors cannot be minimized we must choose which one to minimize and that involves which error we believe to be more important to avoid. Is losing endangered salmon populations more important than irrigation? In attempting answer which hypothesis to reject, we are necessarily involving ourselves in questions of value. Moreover, these questions of value will in part be ones of moral value. That is, how do salmon populations contribute to human well-being both economically, ecologically, and aesthetically and similarly with hydroelectric dams. Thus, in conservation biology and applied ecology, facts and moral values are often mixed even in statistical hypothesis testing.[3]

Second, Norton notes that models are ever-present in the environmental sciences and he is certainly correct since we find conceptual and mathematical models in ecology, economics, climatology, and so on. On my view, a model is an idealized representation of a system (Odenbaugh 2005). By ‘idealized’, I mean that the representation contains some false claim or other which is useful for some purpose. Models are almost always partial representations since in virtue of their idealizations they distort or ignore various factors. However, if we are to realistically represent a system and its various properties, we must use multiple models since any

[2] Of course, there is nothing sacrosanct about a significance level of 0.05. Sometimes we use 0.01 instead. However, significance levels themselves presuppose judgments about what standard of evidence is good enough and that depends on our aims and interests which can be ethical. Likewise, the quality of evidence we have in ecology rarely is this good.

[3] Neyman-Pearson statistical hypothesis testing is a very common methodology taught in biostatistics courses and used by practicing biologists. However, some philosophers and statisticians reject it for an alternative, Bayesianism. On this view, we do not reject or accept hypotheses; rather we compare the probability of the hypothesis given some evidence Pr(H/E) against the prior probability of the hypothesis Pr(H). Whether similar problems affect other inferential frameworks is an open question.

one model may only accurately or truthfully represent a proper subset of the properties of the system. By integrating such models, we are able to understand, anticipate, and intervene the systems' full range of dynamical properties. Since no model can completely represent the behavior of a given system, we must use the models which suit our purposes and aims.[4] We must select models at least in part given the sorts of interests we have be they epistemic or moral. Norton is correct that modelers should be "self-reflexive" since interests are already at play in modeling ecological systems. By being explicit about such purposes, we can again recognize the importance of values in science.

Third, I agree with Norton the notion that science is "value-neutral" is a myth (Odenbaugh 2003). However, there are two questions we should ask. First, what values are at stake in environmental science? Second, how should they affect our scientific decision-making? To help us understand the various values at stake it useful to consider the work of Helen Longino in her *Science as Social Knowledge* (1992). Longino distinguishes between *constitutive* and *contextual values* in science. Constitutive values are those which make science the discipline that it is. For example, as we have seen values like simplicity, empirical accuracy, unification, and fruitfulness are at work in the process of theory choice. These features of theories are valuable because of the aims which they serve in scientific inquiry and they help define what science is. Contextual values are those that arise from the contexts in which science is done. More specifically, they arise from individual scientists, science as a collective enterprise, and the larger society in which science is occurs. Personal contextual values include those economic, aesthetic, and moral values that inform the projects that individuals select, the types of analysis they do, and the people that they are. Collective contextual values include the practical aims of these

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[4] The models are selectively represent the systems and hence we models we choose is done so explicitly or implicitly in light of our aims and interests of those who came before.

research programs both in terms of the implications of their research for future intellectual activities but also for other's well-being. For example, the study of biodiversity has these larger values in the sense that these objects can be bought or sold in markets, can improve our lives in non-material ways, and can valued for their own sake.

It is more controversial as to how these values should affect scientific decision-making. The controversiality depends on what the values are, who holds them, and what reasons they have for holding them. For scientific work to impact policy, the science must appear to be sound; i.e. no apparent "junk science". If one advocates values that are *unique personal contextual values*, then the work of a scientist can appear subjective and hence irresponsible. For example, if one advocates that hydroelectric dams should be banned because of the intrinsic value of salmon populations and those values are not widely shared, then one risks critics challenging the work on the basis of the aims of the scientists and not the quality of their work. If one advocates values that are *collective contextual values shared by scientists*, then the work of a scientist can appear more-or-less objective or responsible. For example, if general circulation models suggest that global mean temperature will increase significantly due to greenhouse gas emissions and this would have widespread negative impacts on human well-being, then advocating curbing emissions would appear more objective because it based on shared collective values of climatologists. If one advocates values that are *collective contextual values shared by scientists and non-scientists alike*, then the science will appear objective and responsible. For example, biodiversity provides us with essential ecosystem services like purification of water and soil, generation and renewal of soil, pollination of crops and plants; control of agricultural pests, and partial stabilization of climate. Society as a whole values these services (and should) and they should be promoted.

The major point is this. Clearly science is not value-neutral. However, this does not entail that every value should enter scientific decision-making in the same way. Scientists must be aware of whether those contextual values are personal or collective and how deeply they are shared. They risk the loss of credibility when those values appear to be idiosyncratic to ecologists or cannot be justified on the basis of considerations of the well-being of others. This is crucial because we live at time where scientific credibility is under heavy scrutiny and the opinions of scientists are challenged due to possible political biases and the clear biases of those who evaluate the science for political purposes. If the public believes that the environmental sciences should be value-free (contrary to what is the case), then scientists must engage in activism or advocacy with care.[5]

In conclusion, science generally and the environmental sciences especially are inescapably value-laden. We can see this in a variety of contexts from hypothesis testing, modeling, and how scientific results are used in political contexts. However, scientists should keenly aware of this and be mindful of the roles these values play in their work. Otherwise, they risk losing their increasingly important credibility.

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[5] It should also be noted that science education should challenge the myth of value-neutrality. One way of improving the public's view of science is by the recognition that it is in the service of the common good. How exactly this is to be done is complex of course.