Disciplinary Capture and Epistemological Obstacles to Interdisciplinary Research: Lessons from Central African Conservation Disputes. *Studies in History and Philosophy of Biological and Biomedical Sciences* 56 (2016): 82-91.

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Abstract

Complex environmental problems require well-researched policies that integrate knowledge from both the natural and social sciences. Epistemic differences can impede interdisciplinary collaboration, as shown by debates between conservation biologists and anthropologists who are working to preserve biological diversity and support economic development in Central Africa. Disciplinary differences with regard to 1) facts, 2) rigor, 3) causal explanation, and 4) research goals reinforce each other, such that early decisions about how to define concepts or which methods to adopt may tilt research design and data interpretation toward one discipline's epistemological framework. If one of the contributing fields imposes a solution to an epistemic problem, this sets the stage for what I call *disciplinary capture*. Avoiding disciplinary capture requires clear communication between collaborators, but beyond this it also requires that collaborators craft research questions and innovate research designs which are different from the inherited epistemological frameworks of contributing disciplines.

Keywords   Interdisciplinarity; Collaboration; Applied epistemology; Biodiversity; Conservation policy; Social epistemology

Highlights
- Interdisciplinary collaboration can fail due to incompatible philosophical beliefs.
- Incompatible philosophies are more resistant to change than communication problems.
- Facts, evidentiary standards, causal inferences, and research goals interrelate.
- Disciplinary capture involves a systematic default to one philosophical framework.
- Avoiding disciplinary capture requires explicit attention to philosophical decisions.

1. Epistemological commitments and the success of interdisciplinary inquiry

More funding for policy-relevant science, plus greater awareness of how environmental, biomedical and social problems require multidisciplinary solutions, have focused attention on developing methods for improving scientific collaboration and production. Interdisciplinary research is now considered essential to solving "wicked" problems, and American and European agencies which fund research directed at solving social problems (the "Grand Challenges") prioritize research that integrates the contributions of researchers from different fields.[1] Policy-relevant research involving the biological and biomedical sciences very frequently requires collaborative efforts from research teams that include members from different branches of science. For instance, engineers and biomedical researchers contribute expertise to the development of imaging technologies; epidemiologists and sociologists contribute expertise to disease prevention policies; hydrologists, marine ecologists, anthropologists, and historians contribute to policies to remediate pollution of Chesapeake Bay. Life scientists are particularly involved both in collaborations that cross fields and in collaborations that are policy relevant. These include the design of policies that affect human health and wellbeing; the economics of health care delivery systems; the integration of cognitive and psychological sciences; the development of novel organisms, whether by traditional breeding methods, genetic engineering, or synthetic biology; and the implementation of agricultural, conservation, and land and marine management policies.

Collaborative scientific work, especially for large research teams, has become increasingly common and well-rewarded in recent decades (Wray, 2002), but cross-field collaborative projects, such as those enrolling both social and natural scientists, are less common than interdisciplinary collaborations between researchers in related fields (Porter and Rafols, 2009). In order to craft

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[1] The distinction between difficult but ordinary problems of social planning and "wicked"ones is due to Rittel and Weber (1973). Wicked problems incorporate higher levels of complexity as well as incomplete knowledge, contradictory expectations for solutions among stakeholders, or interdependence with other policy problems. Examples of wicked problems include the alleviation of poverty, the global response to climate change, and the development of carbon-neutral economies.

solutions which address the specific problems faced by cross-field interdisciplinary research, it is important to understand the nature of the intellectual obstacles that interdisciplinary collaborators face.

My aim in this paper is to construct a general framework that catalogs the epistemological obstacles to creating reliable and trusted knowledge claims in contested areas of inquiry, paying specific attention to collaboration between social and life scientists. Interdisciplinary research has been plagued by what are often described as communication problems.[2] I show that in some cases, at least, these problems are not best described as misunderstandings, but rather as a result of differences in deeply held epistemological commitments. Interdisciplinary inquiry can be obstructed when researchers hold incompatible philosophical assumptions about the nature of the world and the nature of their work.

I develop a catalog of types of epistemological obstacles to interdisciplinary collaboration through the examination of a particularly vexed problem where interdisciplinary research between biologists and anthropologists is needed but has been difficult to foster: the problem of devising conservation solutions in central Africa. In order to address this environmental problem, interdisciplinary collaboration between experts in conservation biology and experts in economic and social development is crucial. Although the need for collaboration is well-recognized, successful interdisciplinary collaboration has been rare. Instead, researchers have candidly criticized each other in public venues. It is possible to give a political reading to the invective (Adams and Hutton, 2007; Dowie, 2009). However, I argue that there is ample textual evidence to demonstrate that the basis for dispute is overdetermined and that many of the criticisms voiced by researchers relate directly to mismatched epistemological commitments. Successful interdisciplinary collaboration in this case is impossible without explicit attention to disciplinary expectations regarding the nature and methods of appropriate scientific inquiry.

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[2]See, for example, O'Rourke et al. (2014).

In the next section, I examine current approaches to understanding factors that make a difference to collaborative success. Section 3 provides an overview of debates surrounding conservation policy in central Africa. In Section 4 I use the case of conservation disputes to draw out points of difference among epistemological commitments, and I examine how they are organized into stable disciplinary matrices. Finally, I evaluate strategies for addressing epistemological disputes. Although my hope is that a better understanding of the conditions that block or delay collaborative research will be a step towards developing solutions that can be generalized, I am not sanguine that these problems are easy to solve.

2. Disciplinarity, Interdisciplinarity, and Obstacles to Knowledge Production

Collaborative interdisciplinary scientific research promises to produce epistemic benefits directed toward addressing social, technological, and biomedical problems. Because interdisciplinary research is time-consuming, difficult, and risky (Ledford, 2008), it is important to investigate factors which make it more likely to succeed or fail.

K. Brad Wray (2002) identifies epistemic benefits which accrue to collaborative research. Two benefits are especially likely to apply to interdisciplinary collaborative research: "collaborative research has made possible types of inquiries that would not otherwise be feasible" (156) and collaborative research is of higher quality as measured by citation rates. In the current research environment, there is an additional reason why specifically *interdisciplinary* collaboration is beneficial to researchers. Namely, the epistemic benefits, especially for work on complex problems of high social value, are actively pursued by public funding agencies by offering incentives to researchers willing to engage in interdisciplinary projects. Wray argues that competitive access to this funding drives the trend toward increased collaborative efforts (2002), and funding dedicated to support for interdisciplinary research has indeed increased in recent years.[3]

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[3] For instance, in the United States funding for a program titled "INSPIRE: Integrated NSF Support Promoting Interdisciplinary Research and Education"increased from \$29M in 2012 to over \$42M in 2014 (Scott and Smith, 2014). This program's funding is targeted toward complex science issues such

However, as many experienced researchers can attest, interdisciplinary collaboration is a risky undertaking—it promises high yields but introduces distinct difficulties as well.[4] Though many researchers are understandably reluctant to talk about failed projects, stories about difficult, tense, or failed interdisciplinary collaboration are common. Davies (2011) is a relevant account of the challenges which interdisciplinary researchers face. He participated in a broadly interdisciplinary project on the "Nature of Evidence," with participants from jurisprudence, computer science, psychology, economics, statistics, and other fields, directed by Philip Dawid and William Twining, primarily at University College London. According to Davies, one of the difficulties of the project was that when there was a disagreement about how to proceed, the usual arguments, starting from shared disciplinary expectations, got no traction: "*Aporia* arose, then, when familiar disciplinary strategies were exhausted: a statement that was expected to command unproblematic assent failed to do so, further appeals to disciplinary norms merely complicated matters as they too were challenged, and so on until we reached a complete breakdown" (59). In the end, he writes, even the criteria by which to measure the success of the interdisciplinary project were ambiguous. Although the project did produce well-received presentations and publications, the group did not achieve their original aim. Davies, therefore, raises the question of whether a shift in the achievable outcome of the project should be judged negatively or if, instead, it should be judged positively, since their complex and imprecise accounts of evidence achieved a more accurate perspective on the subject matter than an oversimplified classification.

The high reward and high risk presented by interdisciplinary collaboration, together with the difficulty of identifying criteria for success suggests numerous problems calling for philosophical investigation. Sociologists and philosophers of science are examining how epistemic cultures are produced and maintained (e.g. Knorr-Cetina, 1999) and how facts and techniques are transferred from one context to another (e.g. Howlett and Morgan, 2011). Social epistemologists are examining

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as space-weather monitoring and groundwater restoration. In the last section of this paper, I return to this idea that funding initiatives can direct the quality of interdisciplinary collaboration.
[4]For instance, the more complex a collaboration (e.g., the more institutions involved), the less likely it is to end with published articles (Cummings and Kiesler, 2007).

the criteria for collective belief (e.g. Fagan, 2010; Rolin, 2010) and the dynamics of information exchange and aggregation (e.g. Andersen and Wagenknecht, 2013). These endeavors are complemented by projects which bring awareness of epistemological issues with interdisciplinary collaboration to the attention of policymakers (e.g. Miller et al., 2011) and prospective scientific collaborators (e.g. O'Rourke et al., 2014). Additional work remains to be done in specifying the types of epistemological obstacles that tend to trip up interdisciplinary collaborations. To that end, this paper extracts some general lessons about sources of friction related to beliefs about how knowledge ought to be produced from a case study of scientists whose work relates to conservation in central Africa.

In the next section I describe the complex problems addressed by conservation policy and explain why they are best addressed through interdisciplinary collaboration. In Section 4 I argue that epistemological disputes fall into four loose, interacting categories: disagreements about

1. facts,

2. evidentiary standards or "rigor,"

3. causes, and

4. research goals.

All of these are interlinked and support one another such that commitments of one type may determine commitments of other types. For instance, differences about the kind of causal claim that is made may determine the evidentiary standards which are used, and that decision in turn may lead researchers from one discipline to question the sufficiency of empirical data which is deemed adequate by another discipline.

As Davies (2011) points out, when research collaborators from the same or similar disciplines disagree about how to proceed at a decision point during the research process, there is often some touchstone that they can use to settle the disagreement—either a common disciplinary standard or an example of prior research that all can agree is exemplary. But where common training is lacking, there is less of a basis for comparing the benefits of different approaches. Thus, while disciplines organize inquiry by defining what counts as a good research question, what counts as an acceptable

answer to a research question, and what is an acceptable path from question to answer, interdisciplinary research risks disorganization when members of a research team hold mismatched assumptions about the fundamental methods and goals of knowledge production.[5]

If epistemological disputes cannot be settled based on deliberation that arises out of shared commitments, the result can be what I call *disciplinary capture*.[6] Disciplinary capture occurs when the standards, value commitments, and methodological presuppositions of one discipline in a collaborative interdisciplinary project consistently take precedence over other disciplines', thereby playing an outsize role in how the ostensibly integrative interdisciplinary research progresses. Since elements of the epistemology of inquiry are tightly interrelated, when a crucial decision is made in a way that draws on standards or concepts from one discipline rather than another, further decisions are likely to settle in place in a way that follows from and supports the initial decision, causing team members from the neglected disciplines to feel increasingly less involved—and therefore less invested—in the outcome of research. This is because they are the objects of disciplinary capture: their short-term interest lies in finding a satisfactory means of maintaining their collaborative investment, but this short-term interest may not produce the most integrative results in the long term.

It is important to note that disciplinary capture implies no bad faith or nefarious intent on the part of the researchers whose disciplinary standards take precedence. Disciplinary capture can arise from choices that at the time seem innocuous, noncontroversial, or merely expedient. It is only

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[5]There are also abiding fault lines within disciplines. Some sociologists, for instance, disagree with other sociologists about how to derive generalizable conclusions from qualitative or quantitative data. And there is also constant innovation within disciplines as new methods become adopted and as standards of evidence change in response to critique. Nonetheless, a shared institutional context and training provides greater commonality of assumptions about the goals and methods of inquiry within than across disciplines.

[6]Disciplinary capture is analogous to regulatory capture in that it is an undesired, emergent consequence of the structure of knowledge institutions, but it is unlike regulatory capture in that it is not closely associated with corruption (Brister, 2009). Frodeman, Briggle, and Holbrook (2012) use the term "disciplinary capture" to indicate a similar concept. Rather than apply it to describe the effect of lopsided methodological decision-making on collaborative, interdisciplinary research, they draw out the consequences for subfields which become tied exclusively to one or another disciplinary method or standard of evidence.

later, and with the benefit of hindsight, that it becomes clear that these decisions sent the research project down a particular path. Thus, while researchers working on complex, socially-relevant problems may have good intentions and even good practices when it comes to cooperative teamwork, in some cases the logic of a disciplinary framework is sufficiently rigid that epistemological decisions made early in the research process may tip the scales toward other epistemological decisions that also follow that disciplinary framework. At no point in a series of decisions is it necessary that members from one discipline foist their perspective onto the others or ignore the input of others, and each individual epistemological decision may seem sufficiently well-supported because it attains fit with—or is constrained by—earlier decisions. For instance, a choice to limit research methods to quantitative and objective measures may rule out consideration of certain research questions or the use of certain normatively-loaded metrics. Likewise, funding agencies and universities seeking to encourage interdisciplinarity may place conditions on the research—e.g., incentivizing certain kinds of results in a certain space of time—that tilt it toward the standards of one discipline or another. Under those circumstances, research can be overly sensitive to initial conditions. Decisions made early in the funding or proposal process may foreshadow decisions made later. The end result of a series of such decisions may then fail to achieve the desired integration and instead result in disciplinary capture.[7]

After establishing that environmental conservation policy in central Africa fits the criteria for being the type of grand challenge that is urgent and of high importance, requiring the intellectual contributions of both social science and natural science researchers, I will examine how decisions about which facts to believe and how to attain methodological rigor open up difficult epistemological debates which cannot be settled merely by clear communication practices.

3. Conservation policy requires interdisciplinary collaboration

[7]Giovanni de Grandis has pointed out to me that this process reflects the historical contingency and sensitivity to initial conditions known as 'path dependence,' a parallel which deserves further examination (see Page 2006).

Complex environmental problems, such as the development of effective conservation policies, will not be solved without coordinated knowledge production from disparate disciplines. For instance, effective conservation policies depend on both the specialized ecological knowledge of conservation biologists and on social scientists' specialized understanding of politics and cultures. I will demonstrate the ways that diverse epistemological commitments can derail collaborative research by looking at a particularly acrimonious dispute concerning land management in central Africa. This section outlines the problem of developing effective conservation policies, establishes the need for collaborative inquiry between natural and social scientists, and shows that this need is acknowledged by researchers. The next section analyzes individual epistemic obstacles to collaboration and the reticulated relationships between them.

Worldwide, throughout the twentieth century the dominant management method for protected areas recommended the exclusion of people, either by economic inducements or compulsion. This strategy is supported by the assumption that the conservation of natural areas requires the establishment of wilderness conditions, so that species of interest are isolated from human presence. This model of protected area management has earned the derogatory name "fortress conservation" (Brockington, 2002). Conservation policy that aims to exclude human activity has been criticized primarily on ethical grounds (Sarkar and Montoya, 2011) but also on the pragmatic grounds that the long-term success of conservation policy requires political support from nearby communities (Brechin et al., 2002). In addition, the historic cultural practices of indigenous communities may embody specialized knowledge concerning sustainable resource management (Dowie, 2009). One alternative to fortress management is the biosphere reserve model (BR) (Sarkar and Montoya, 2011), which dictates strictly controlled human activities in the protected area, for instance by permitting a limited amount of foraging inside a reserve. Another alternative that has won recent support is the community-based natural resource management model (CBNRM), in which indigenous communities are involved in determining management goals and policies (Brosius et al, 2005).

Central Africa is an area of both high biodiversity and high poverty, and it has been a focus for the creation of protected areas in order to conserve as much of the remaining forest as possible. Since the late twentieth century, both the number and total area of protected areas in Central Africa have more than doubled (Cernea and Schmidt-Soltau, 2006). The creation and management of protected areas is supported by national governments, private donors, international conservation NGOs, and international agencies such as the World Bank. Management strategies can involve a trade-off between the pursuit of conservation goals and the stability of local economies and communities, since people may lose their source of food, firewood, or fodder and may require relocation, with the associated cultural and social harms of displacement.

To take one example, Bwindi Impenetrable Forest in southwestern Uganda was set aside as a game sanctuary and forest reserve in 1932 and was loosely managed for decades. In 1991 it was upgraded to a national park in order to closely monitor and protect the dwindling number of mountain gorillas living there. Local people of pygmy ancestry had been hunting, gathering, keeping bees, and running small-scale timber operations in the forest for generations (Namara, 2006). When the forest was granted a stronger protected status, the surrounding communities lost access to their forest-based means of subsistence, and at least 1700 people were reportedly displaced from their villages without compensation for the loss of land (Dowie, 2009). Another study documents the displacement of between 5,000 and 10,000 people in creating the Mkomazi National Park in Tanzania (Brockington, 2002).

Such economic displacement falls within U.N. and World Bank definitions of involuntary displacement or resettlement, a violation of norms of social justice (World Bank, 2013). The research question that arises from examples such as this is whether conservation goals can be achieved simultaneously with development goals, such that biodiversity can be conserved and human rights violations can be avoided. Some land managers, conservation biologists, and representatives for conservation organizations press for management policies which exclude people from protected areas on the grounds that the rate of biodiversity loss is increasing, habitat loss caused by human activity is the leading cause of extinction, and excluding human activity from a protected area is the surest

way of stemming habitat loss (Miller et al., 2011). Whether exclusionary conservation practices are in fact more effective—and against what scale to measure their effectiveness—is a source of controversy in the field. Advocates of CBNRM hold that it is the only just management method because it, unlike fortress conservation, attends to democratic decision-making, and they also hold that it is often possible to design management policies which can achieve both development and conservation goals (Agrawal and Redford, 2009b).

It is apparent that what is needed to raise the chances of success for biodiversity preservation in central Africa is an analysis that can establish which characteristics correlate with success for community conservation areas, which conditions risk undermining community-based conservation projects, and which conservation goals can only be achieved by excluding human activity. The knowledge that is required for informed policy-making is knowledge about the interaction between people and nature in particular places and an understanding of when knowledge about local conditions can be extrapolated to make predictions about conservation and development policies for other areas. These questions can be answered neither by social scientists working alone without specialized knowledge of conservation priorities and ecological relationships, nor by biologists working alone without specialized knowledge of economies, agricultural practices, cultures, spiritual beliefs, and social structures of indigenous communities.

The need to develop research that crosses disciplinary divides between conservation biologists and anthropologists is acknowledged by both biologists and social scientists (Chapin, 2004; Curran et al., 2009). A group of conservation biologists, some of whom work for major conservation organizations such as the Wildlife Conservation Society and the World Wildlife Fund (WWF), has called for research that draws on the perspectives of both social and natural scientists (Curran et al., 2009). Resolving political blockades, they argue, "will require long-term, multi-disciplinary, focused and objective studies undertaken by technically competent teams of researchers and practitioners" (Curran et al., 2009, 30). Social scientists have expectedly been even more vocal than biologists in calling for social scientific research to be integrated into conservation management. West and

Brockington (2006) convincingly describe their view that social science research is as necessary to conservation management as biological research. They write that

> Our vision of collaboration is not one of people from different disciplines coming together because funding agencies mandate it or because after the fact there is a need for social impact analysis. Rather, we want to advocate collaborations before protected areas are made or before new projects are designed. Better discussion of interventions—whether in establishing a protected area or to mediate perceived and real threats to protected areas and the people who live in and rely on them—is critical to improving the success of conservation efforts. One of the persistent issues with regard to the social effects of protected areas is that social and natural scientists do not have sustained conversations about why deep social effects matter and how methodologies could be designed so that they take certain social beliefs and practices into account before projects are implemented (614).

The controversy between social and natural scientists working in and near central African protected areas is vitriolic. Its causes are complex, and political differences play a prominent role; however, there is abundant evidence of the effect of epistemological differences on inhibiting collaboration. One team of conservation biologists, noting that knowledge of their own discipline was insufficient to achieve conservation success, studied perceived barriers to collaboration and found that both social scientists and conservation biologists believe that integrating natural and social knowledge is important to the success of conservation activities. Both groups of scientists who participated in the study perceived that conservation activities are dominated by biological research. In addition, social scientists were more likely to perceive conservation biologists as being unreceptive to their involvement or unwilling to integrate social science into the early stages of conservation work, while conservation biologists were not as likely to perceive social scientists as unreceptive (Fox et al., 2006).

This raises the question: can we understand the breach between these researchers as more than a political turf-battle? I think we must. When parties on both sides have endorsed the desirability of collaboration, I take them at their word. So, rather than treat their disagreement as a

political dispute between sworn adversaries, I prefer to view it as an epistemic disagreement over best research practices. Making these epistemic disagreements explicit, and working toward solutions, can lead to more cooperative and productive outcomes.

4. Classifying differences in conceptual commitments that obstruct collaboration

The literature on interdisciplinarity contains many resources evaluating institutional support for collaborative projects (e.g., Frodeman et al., 2010, Section 4) and a number of practical guides for coordinating interdisciplinary research teams (e.g., Hall et al., 2012). There has been less analysis of the ways in which epistemological differences can inhibit successful interdisciplinary collaboration. In this section I classify differences concerning facts, rigor, causes, and goals and trace how they are interconnected.

4.1 "Facts" and background knowledge

At a basic level, conservation biologists and anthropologists who work in central Africa disagree about the facts of the controversy. They make use of different background theories and concepts, and some claims about empirical evidence contradict each other. Failure to agree on a knowledge base is not due to idiosyncrasies of particular researchers. That is, they are not renegades or proponents of unorthodox theories. Rather, the problem is both that background theories are discipline-specific and that, for both conservation biology and anthropology, the knowledge base is geographically localized.

Conservation biology studies how ecological relationships depend on complex, situated, local processes, and though it develops generalizations, there are no natural laws in conservation biology. For instance, management actions that have been successful for the protection of endangered bird populations in boreal forest habitats have little bearing on strategies to protect birds that dwell on Pacific islands because the first are most closely linked with winter food availability while the latter are linked with predation. The ineliminably local context of knowledge claims limits the ease and integrity with which facts in conservation biology travel. It also generates an epistemological

heuristic for the way conservation biologists treat factual claims. Since extrapolation from one site or species to another is uncertain, there is a tendency toward skepticism about generalizations except when they have been supported by extensive and diverse data.

Indeed, a significant point of difference between the biologists in this case study, who often work for conservation organizations, and the social scientists, who are critical of exclusionary conservation policy, has to do with identifying the answer to two empirical questions: *Can conservation objectives be accomplished without eliminating human activities in protected areas? If so, then under what conditions*? There has not been systematic evaluation of the degree of long-term success across a range of conservation projects, and empirical data are equivocal about whether it is always possible to achieve both conservation and development goals (Newmark and Hough, 2000). Thus, there is a dearth of data about whether conservation projects are successful and under what conditions (Chapin, 2004).

In addition to lacking data on conservation projects' success, there is also a lack of data about the impact of protected areas on nearby residents and on the empirical question of the number of people who have been displaced by conservation projects (Agrawal and Redford, 2009a). Charges against conservation organizations by social scientists and indigenous groups have been serious—accusing them of elitism (Schmidt-Soltau, 2009), colonialism (West and Brockington, 2006), racism (Tapela et al., 2007), and being aligned with parties responsible for a variety of abuses ranging from violation of due process to extra-judicial killings (Alcorn and Royo, 2007). Some anthropologists claim to have documented large-scale displacement of thousands of indigenous Africans at dozens of sites, while conservation biologists dismiss the reliability of the data collected by social scientists on which these claims are based: "We contend that not a single individual has been physically removed from any of the protected areas created in central Africa over the past decade, despite claims to the contrary" (Curran et al., 2009, 30).

A lack of mutually accepted empirical evidence on these matters may be contributing to various forms of cognitive bias which further inhibit the production of consensus and collaboration. For instance, confirmation bias is the tendency to selectively privilege claims that support

preconceived assumptions (Bazerman and Tenbrusel, 2011). In the case of conservation in central Africa, conservation managers often view local people as hostile to conservation projects. While this may have been the case in the past, Newmark and Hough (2000) analyze a number of regional studies to show that this is no longer true in the majority of cases (588). A paucity of agreed-upon empirical facts thus protract the very conditions under which it is difficult to generate a reliable body of knowledge.

One reason that it has been difficult to consolidate factual information about the effect of conservation projects on development is that there are multiple conceptions of displacement in use. These tend to divide along disciplinary lines, with anthropologists using the concept of displacement adopted by the United Nations and the World Bank that includes loss of access to livelihood opportunities and disruption of social structures, while supporters of conservation projects typically define displacement more strictly, as relocation, or sometimes only as involuntary, uncompensated relocation (Agrawal and Redford, 2009a). This sort of disagreement about the meaning of concepts leads to disagreements about factual claims.[8] In addition, it is related to disagreements about rigor or evidentiary standards (which are discussed next) because it may appear to conservation biologists who use a more narrowly defined category of displacement than anthropologists that the latter illegitimately inflate their findings. This highlights the role that assumptions about rigor or evidentiary standards play in the persistence of disciplinary disagreements about facts.

4.2 "Rigor" and evidentiary standards

A consistent theme in the conservation policy debate has been the accusation that studies lack rigor or that evidence fails to meet appropriate standards. Progress on building a shared knowledge base has been slow because anthropologists and conservation biologists set different

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[8]See Efstathiou (this issue) for an examination of how 'founded' concepts can help to bridge everyday ideas and operationalized scientific metrics. At the same time, concepts which have followed independent founding processes in different research communities may introduce misunderstandings and equivocation on seemingly factual matters if each community feels they alone own the concept in question.

requirements on how evidence can be collected, how much data is required to support a claim, when evidence is considered relevant support for a particular claim, and the type of evidence that can be used to support generalizations—specifically, whether data is qualitative or quantitative.Thus, when the dispute erupts openly in peer-reviewed journals, as it has in *Conservation Biology,Conservation and Society*, and *Environmental Management*, the rhetoric dismisses individual claims made by adversaries on the grounds that they are weak, while also leveling general accusations of ignorance about appropriate evidentiary standards. Allegations target rigor and standards of scientific conduct. To take an example, Curran et al. (2009) state that

> Until there is a better-researched and arguably, more objective, review of the possible
> impacts of protected areas on human welfare, based on substantiated (and substantial) site-
> by-site field visits and thorough data collection, the basis for the claims made by Schmidt-
> Soltau (2003) [and others] should be viewed with some skepticism (41).

Curran et al. (2009) criticize Schmidt-Soltau (2003) for utilizing ethnographic, qualitative methods rather than quantitative methods and for extrapolating from limited data sets. They argue that long-term controlled trials with large sample sizes are required in order to establish that the cause of social change is conservation policy rather than other sources of disruption, such as poverty. Schmidt-Soltau (2009) responds to this directly: "As my critics are natural scientists, it is no big surprise that they consider natural science methodologies to be the one and only approach to obtain 'scientific' data" (47). He goes on to critique their suggested methodology as unethical since, as proposed, it exposes human subjects to a situation which can be expected to cause economic and social harm.[9]

Such disagreements on defining appropriate evidentiary standards are part of a broader debate about whether and when qualitative evidence is useful, and it is compounded by the conservative heuristic adopted by conservation biologists which sets high skeptical standards for

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[9] Schmidt-Soltau (2009) evaluates the proposed research design, saying "It needs to be highlighted that such a setting, which exposes people to unmitigated harm just to see how they cope with it and which is undertaken without their free, prior and informed consent, is considered by social sciences an unacceptable methodology and stands in stark contrast to established research ethics…"(47).

extrapolating from data collected in one biogeographical area to another. Conservation biologists have repeatedly called for controlled trials, a methodology which is widely considered ethically inappropriate for studying economic development and cultural preservation. Anthropologists have also pointed out that in addition to the ethical questions raised by controlling economic opportunity for entire communities, an emphasis on controlled trials is counter to the methodological commitments of many anthropologists: "dependence on quantitative surveys, for example, may yield skewed results and rarely captures the nuanced complexity of social issues impacting conservation" (Peterson et al. 2010, 13).

4.3 Causal explanation

Another methodological divide centers on the role of case studies in providing evidence for causal generalizations about the effectiveness of conservation policies. The evidence that conservation practices have caused displacement, worsened impoverishment, and, in some cases, exacerbated the loss of indigenous cultures and languages is based primarily on case studies. However, anthropologists admit that "any attempt to [build a picture of the magnitude of conservation-related displacements] will flounder upon the shoals of spotty and unreliable generalizations inevitable in case-based studies" (Agrawal and Redford, 2009a, 4). Even within social science disciplines, the role of case-based evidence is debated (Crasnow, 2010): can case studies provide inductive evidence that supports causal claims, and when are the contextual features of one case analogous to the contextual features of another case? This is not a trivial methodological debate, and it is not one that could be resolved by improved communication within an interdisciplinary team. Rather, determining the scope of application for case-study research is a matter of current scientific and philosophical debate. Crasnow (2010) argues that when case studies are put to the use of evaluating risk in decision-making, as they are in the case for establishing conservation policy (i.e., risk of irreparable ecological loss and risk of harm to humans are often both present), evidence that falls short of warranting a general causal claim may nonetheless be useful for evaluating and justifying particular policy actions.

Anthropologists sometimes offer different kinds of explanations for the failure of conservation policy than the explanations given by land managers. For instance, when residents offer support to poachers, one possible explanation is that human activity is causally responsible for destruction of biodiversity (thus confirming the assumption that people and parks are incompatible). An alternative explanation, however, interprets the residents' actions as a political response to disenfranchisement or perceived imperialism. Thus, when anthropologists criticize conservation programs, they identify one cause for failed conservation efforts to be the political environment created by governments or by conservation organizations. A key element of the social scientists' contribution to this debate has been to develop a richer understanding of the social causes of conservation failures by, for example, emphasizing how each group of residents has diverse and changing political views and commitments, complex cultural beliefs, and both long- and short-term economic interests (Peterson et al., 2010; Tumusiime and Svarstad, 2011).

The types of causal explanations preferred by natural and social scientists is linked, in part, to how they conceive of the goal of their research. Some anthropologists describe the goal of their research not in terms of identifying causal explanations for phenomena but as aiming at intercultural understanding, and especially at appreciating complex interactions as well as ambivalence and ambiguity (e.g., Tumusiime and Svarstad, 2011). For these anthropologists, conservation biology endorses methodologies which, because they fail to try to understand comprehensive social systems, are overly narrow or reductionist: "Productive engagement [between social and natural scientists]…places a demand on the conservation community to recognize that, although conservation biology is an important tool, alone it cannot provide answers to the challenges facing contemporary conservation because the questions it asks are too limited" (Brosius, 2006). Thus, there is disagreement both over the appropriate types of explanatory causes and over the goals of the research: explanation, or explanation and understanding. But the existence of this disagreement is not, by itself, sufficient reason either to dismiss the importance of causal explanation or to reassert one's disciplinary creed. As I point out later, these responses can easily lead to disciplinary capture. Instead, as Andrew Vayda (himself both an ecologist and an

anthropologist) argues, good collaborative interdisciplinary research has the potential for working out new views of causal relations, views which are different from those in the contributing disciplines, and views which are then more likely to point to useful policy innovations (2006).

4.4 Research goals and values

Finally, conservation biologists and social scientists encounter disciplinary differences concerning the goals of their research activities. In both cases, the motivation for scientific research is its policy relevance. Conservation biologists study ecological factors that promote or obstruct conservation. In the context of conservation policy, social scientists study, among other things, the effects of conservation policy on the welfare of local communities. In deciding what to study and how to study it, both scientists and funding organizations make judgments about whether a research question is policy relevant. In order to do that, they apply value judgments to assign priorities—research questions that are most relevant to policy are dubbed interesting or worthwhile. In this way, value judgments regularly determine the direction of scientific research and thus affect which areas of knowledge grow and which are left stagnant.[10]

Value judgments also influence the development of scientific knowledge—and, thus, have an epistemological function—in a way that is internal to research design. Namely, when scientific evidence provides relevant justification for a value judgment, there is then an opportunity for researchers who hold that value judgment to overlook how the design and interpretation of their research may reinforce their presumed values (Anderson, 2004). However, when a value judgment is contested or otherwise made explicit, it can lead to a fresh perspective on an object of study. In Anderson's example, an innovation in social science research on the consequences of divorce stemmed from doubts that divorce was typically bad for families. In that case, reorienting the value judgment that informed the research question led to a novel methodology (study of long-term rather

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[10]That value judgments have profound epistemic effects via determining the direction of research is not a radical thesis and is compatible with the claim that the justification of scientific claims should be value-neutral (Lacey 1999).

than short-term consequences), an atypical dataset (subjective as well as objective measures, positive as well as negative ascriptions of consequences), and an analysis along new conceptual lines. Thus, it is a common and not necessarily avoidable or negative feature of policy-relevant research that cultural and ethical values influence how the object of study is conceived, how concepts are defined, which data are relevant, how data is interpreted, and the amount and type of evidence required to support a claim.

For this reason, it is epistemically relevant that the policy-relevant research of conservation biologists and anthropologists is guided by disparate value judgments. Conservation biologists explicitly acknowledge that they value the preservation of rare species and the conservation of intact ecosystems (Soulé, 1985). Some anthropologists have also explicitly acknowledged the role that values play in their choice of research design and methodologies when they take on advocacy roles for their research subjects on ethical and epistemic grounds. Kottak (1999) claims that anthropologists have a moral responsibility to speak out when witnessing threats to their subjects because they develop a duty to do so by entering into a knowledge-making relationship with them. Although there is a rather large amount of diversity among anthropologists of indigenous peoples, many conceive of their research subjects as active participants in the co-production of knowledge claims (Tapela et al., 2007).

In fact, it is common in the conservation debate for normative and descriptive claims to be conflated (Miller et al., 2011). This is likely to occur when a term used to describe a phenomenon also has a normative valence (Norton, 2005). Another pathway by which the interpretation of research findings is influenced by values is in assessing risks—including the projected costs and benefits of taking a particular policy action, the costs and benefits of failing to take any action, and the risk that the scientific research findings which direct a policy action are false or misapplied (i.e., inductive risk) (Douglas, 2009). In this debate these two uses of value judgments commingle in such contested terms as 'displacement'and 'community conservation'and in judgments about conservation success. According to political ecologists Adams and Hulme (2001):

Any debate about whether community approaches to conservation 'work' depends on the frame of reference used. To a preservationist [one who prioritizes preservation of biodiversity exclusively], they would only work if they made biodiversity preservation objectives achievable, or more likely to be achievable, or achievable more quickly, cheaply or permanently. There is a temptation to see the aim of such community conservation as to keep a truculent populace quiet so the serious business of science-based ecosystem management can proceed unhindered (197).

Thus, projects with different levels of community involvement in decision-making may go by the name 'community conservation,'and may use different criteria to evaluate project success: "Unless the criteria for judging the success of community conservation approaches are made clear (and perhaps standardized), then judgment will be both contentious and of limited value"(Adams and Hulme, 2001). This is an appropriate caution to make the role of values in conservation research explicit and to explicitly consider how value-based assumptions shape epistemic assumptions about the nature of the object of study and the relevance of various types of data.

Since conservation biology and anthropology manifest different basic ethical commitments (to biodiversity conservation vs. to cultural self-determination), and since those ethical commitments play a constitutive role in policy-directed sciences by determining the purposes for which knowledge may be used, there is at least the possibility that participants in this debate will be skeptical about the effectiveness of each others'research strategies for producing the knowledge needed to shape public policy (Elliott and McKaughan, 2014). At worst, incompatible ethical goals may engender suspicions of moral corruption and false witness.

To summarize, disciplinary differences related to facts, judgments of rigor, causal explanations, and value-based assumptions stand as significant obstacles to interdisciplinary collaboration—in part because they can lead to miscommunication—but primarily because they are attached to significant methodological controversies. Moreover, each type of difference reinforces others in interesting ways. Namely, differing evidentiary standards may block the adoption of a shared knowledge base. When no knowledge base is shared, the consequent lack of data increases

the weight put on the use of values in decision-making (Steel, 2010). The absence of data increases the weight that is put on questions of how to handle uncertainty, which aspect of a research project has priority, how quickly results must be delivered to policy-makers, and the costs of incorrect or incomplete findings.

In the conservation case, the potential costs of failure are beyond measure—on one side they could mean the ultimate extinction of a unique species of great worth, such as the mountain gorilla, and on the other side could contribute to the displacement, suffering, and death of human beings and the fragmentation of unique cultural identities. In some circumstances, a continuing lack of consensus may serve the short-term interests of some advocates by confounding scientific questions with political ones. On the side of conservation organizations, the absence of hard, independent data evaluating the success of CBNRM model serves to perpetuate the status quo, which up until the most recent decade has meant tacit institutional support for fortress conservation. On the side of social scientists working near protected areas, the attention paid to claims of human rights abuses have created global political support without, in many cases, also demonstrating that changes to conservation policy will better serve humanitarian interests.

Epistemological frameworks have developed out of methodological debates internal to disciplines. Thus, anthropologists define displacement in a way that is informed by placing a high value on human communities, and their understanding of the best research methods is constrained by the relationship they develop with the communities they study. Similarly, conservation biologists are skeptical of claims based on small datasets and subjective measures, consistent with the origins of their discipline in quantitative methods. In sum, effective interdisciplinary collaboration on this research question will require identifying a shared knowledge base, negotiating many individual instances of evidentiary standards, developing interdisciplinary causal explanations, and finding consensus on the normative issues related to conceptualizing research questions and interpreting research results.

5. Strategies for removing obstacles to collaboration

I have examined the ways in which disciplinary frameworks track disputes concerning facts, rigor, causes, and goals in interdisciplinary research. One phenomenon which deserves recognition is what I call "disciplinary capture." Disagreements about facts, evidentiary standards, the nature of causal claims, and the role of values are often exacerbated through the research process because they form integrated bundles of self-reinforcing epistemological commitments and beliefs. For instance, conceptualizing local residents as political actors who value self-determination may influence how data is collected and interpreted and how concepts such as displacement are defined. The risk posed by disciplinary capture is that if a research team makes early decisions without input from all interdisciplinary collaborators, or if early decisions are dictated by funding agencies or other external partners, then decisions which follow later in the course of a research project are more likely to cascade in a pattern that conforms to the epistemological commitments of a single disciplinary framework.

Disciplinary capture may occur even if efforts at collaboration are genuine and even if all team members are consulted on methodological decisions. What matters is not the intent or attitude of lead researchers but rather the uptake of cross-disciplinary criticism. Disciplinary capture is not the same as scientific imperialism (Mäki, 2013), though scientific imperialism may drive some cases. When a scientific discipline acts imperialistically, it applies its own methods to study the domain of some other discipline such that it challenges or aims to replace that discipline. There is an element of arrogant disrespect for other disciplinary approaches, as when economics reduces complex human social behavior to simple models of self-interested agents motivated solely by short-term economic gain. In the conservation arena, social scientists have charged biologists with this sort of trivialization of social scientific approaches, as when social scientists are invited to contribute to conservation-relevant research only in projects' late stages or only when a management strategy has failed (Fox et al., 2006). However, even when there is an open-minded awareness of disciplinary differences, disciplinary capture can result when a single discipline's constellation of epistemological commitments dominates methodological decisions.

There are two general types of strategies that assist interdisciplinary collaboration: a global, top-down strategy of institutional support for undertaking challenging collaborative research, and a local, bottom-up strategy to facilitate interdisciplinary communication and novel transdisciplinary solutions to epistemological disputes. Both strategies are important, and both should pay special attention to the risk of disciplinary capture.

Institutions, such as universities, funding agencies (e.g., NSF and ERC), and private foundations aim to prod interdisciplinary collaboration by providing funding. When funding is earmarked specifically for interdisciplinary projects, incentives may contribute to disciplinary capture if they add pressure for quick results rather than encouraging the difficult and time-consuming dialogue required to truly integrate disciplinary methodological frameworks from the natural and social sciences. Some funding is earmarked for research, such as the "Science of Team Science" which analyzes interdisciplinarity at a higher level and which aims to create general, multipurpose tools to produce better (or quicker) interdisciplinary results. This work has produced some useful organizational strategies; however, it is as unlikely to discover general, theoretical solutions to methodological disputes as philosophers of science have been.

A parallel local, bottom-up approach is taken by individual research teams who address the risk of disciplinary capture by engaging in deliberate methodological reflection about their differences. This is a process that philosophers may play a role in supporting, and the "Toolbox Project" aims to do exactly this (O'Rourke and Crowley, 2013). In Toolbox Project workshops, members of interdisciplinary research teams are presented with a series of statements about the kinds of epistemological commitments discussed above, and they respond using a Likert scale instrument. A facilitator (typically someone with philosophical training) guides team discussions about their epistemic commitments as reflected in the scored instrument. This technique focuses attention on precisely the kinds of misunderstandings and disagreements that can derail interdisciplinary collaboration, and one of its virtues is that the facilitator provides the opportunity for teams to engage in philosophical discussion without appropriating their intellectual autonomy. Awareness of epistemic commitments is effective at counteracting disciplinary capture because it

directs attention to epistemological differences at early stages of interdisciplinary work, helps researchers focus on the content of disputes rather than treating disagreements as personal or political clashes, and supports long-term planning to anticipate methodological decisions rather than dealing with them ad hoc (Looney et al., 2014). However, the local nature of the intervention that makes the Toolbox Project uniquely effective may also be a limitation when the problems that plague interdisciplinary collaboration are less like communication or translation problems and more like the sticking points described in the conservation policy case study. The solution to those problems requires improved communication and mutual respect, but it also requires difficult innovation. The significant interlocking bundles of epistemological differences which lead to disciplinary capture may need to be addressed by a wider constituency and by more probing deliberation than what can be accomplished by individual research teams. O'Rourke, Crowley, and Gonnerman (2015) suggest that researchers might be explicit and deliberate about anticipating the degree, scale, and comprehensiveness of integration that is the goal of particular projects. The local approach provides an entry into raising researchers' awareness of relevant methodological debates and the value of attending to them.

Another way in which philosophers support a local approach to addressing interdisciplinary epistemological obstacles is by participating as members of scientific research teams and by contributing methodological analyses in philosophical, scientific, policy-oriented, and interdisciplinary journals. Miller et al. (2011), for instance, use philosophical concept analysis to identify mismatched assumptions about the veracity of empirical claims and the necessity of normative claims between anthropologists and conservation biologists in the debate about the effectiveness of CBNRM. Love and Lugar (2013) is another example of how philosophers may contribute a fine-grained analysis of differences among concepts and epistemological assumptions to interdisciplinary research involving biological scientists. Love and Lugar demonstrate how diverse concepts hindered data integration among the disciplines contributing to explanations of evolutionary novelty and how varying expectations for causal explanation also hindered methodological integration in that area.

In cognitive science, evolutionary theory, biomedicine, and other fields, philosophers of science commonly become engaged in methodological debates directly with scientists, contributing to the clarity of concepts and consistency of their application. This role has recently been expanded to work at the interface between natural and social scientists and policy-makers. Tuana (2013) argues that funding agencies such as the NSF should formally recognize the value of embedding philosophers with general methodological expertise in complex interdisciplinary projects. The work that philosophers have already performed in such roles has been productive and should be provided additional explicit support.

My analysis of epistemological obstacles to interdisciplinary collaboration highlights the tension that exists between, on the one hand, the diverse, local nature of interdisciplinary projects and, on the other hand, the desire to identify integrated and unified methodological guidelines. The localization effort is commendable and reflects the current nature of innovative and *ad hoc* interdisciplinary research, and yet there is an inherent and unresolved tension in aspiring to identify simple, streamlined, transferable methods of resolving deep epistemological issues without being able to refer to more general, systematic, extradisciplinary beliefs about science and ethics. My pessimistic conclusion is that obstacles to interdisciplinary scientific collaboration are deeply rooted. The degree of difference between conservation biologists and anthropologists leaves me, for the time being, skeptical that collaboration will develop spontaneously. Nonetheless, it is possible to identify certain distinct sources of disagreement among researchers coming from different disciplinary backgrounds. Being able to diagnose the source of disagreement will help researchers engaged in environmental problem-solving identify the specific causes of—and potential solutions to—those obstacles, so that they may more effectively address a range of critically important environmental problems.

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