Conservation Biology

Review

A Guide to Understanding Social Science Research for Natural Scientists

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Abstract: *Natural scientists are increasingly interested in social research because they recognize that conservation problems are commonly social problems. Interpreting social research, however, requires at least a basic understanding of the philosophical principles and theoretical assumptions of the discipline, which are embedded in the design of social research. Natural scientists who engage in social science but are unfamiliar with these principles and assumptions can misinterpret their results. We developed a guide to assist natural scientists in understanding the philosophical basis of social science to support the meaningful interpretation of social research outcomes. The 3 fundamental elements of research are ontology, what exists in the human world that researchers can acquire knowledge about; epistemology, how knowledge is created; and philosophical perspective, the philosophical orientation of the researcher that guides her or his action. Many elements of the guide also apply to the natural sciences. Natural scientists can use the guide to assist them in interpreting social science research to determine how the ontological position of the researcher can influence the nature of the research; how the epistemological position can be used to support the legitimacy of different types of knowledge; and how philosophical perspective can shape the researcher's choice of methods and affect interpretation, communication, and application of results. The use of this guide can also support and promote the effective integration of the natural and social sciences to generate more insightful and relevant conservation research outcomes.*

Keywords: epistemology, interdisciplinary research, ontology, research design, theoretical perspective, worldview

Una Guía para Entender la Investigación de Ciencias Sociales para las Ciencias Naturales Katie Moon

Resumen: *Los científicos de la Naturaleza cada vez están más interesados en la investigación social porque reconocen que los problemas de la conservación comúnmente son problemas sociales. El interpretar las investigaciones sociales, sin embargo, requiere por lo menos un entendimiento básico de los principios filosóficos y las suposiciones teóricas de la disciplina, las cuales están embebidas en el diseño de la investigación social. Los científicos de la Naturaleza que se dedican a las ciencias sociales pero que no están familiarizados con estos principios y suposiciones pueden malinterpretar estos resultados. Desarrollamos una guía para apoyar a los científicos de la Naturaleza en el entendimiento de las bases filosóficas de las ciencias sociales que respaldan la interpretación significativa de los resultados de las investigaciones sociales. Los tres elementos fundamentales de la investigación son la ontología, lo que existe en el mundo humano y del cual los investigadores pueden adquirir conocimientos; epistemología, cómo se crea el conocimiento; y la perspectiva filosófica, la orientación filosófica que guía las acciones del investigador. Muchos elementos de la guía también aplican para las ciencias naturales. Los científicos de la Naturaleza pueden usar la guía como asistencia al interpretar las investigaciones de las ciencias sociales para determinar cómo la posición ontológica del investigador puede influir en la naturaleza de la investigación; cómo la posición epistemológica puede usarse para apoyar la legitimidad de los diferentes tipos de conocimiento; y cómo la perspectiva filosófica puede formar los métodos de elección del investigador y afectar la interpretación, comunicación y la aplicación de los resultados. El uso de esta guía también puede apoyar y promover la integración efectiva de las ciencias sociales y naturales para generar más resultados profundos y relevantes de la investigación de la conservación.*

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Palabras Clave: diseño de investigación, epistemología, investigación interdisciplinaria, ontología, perspectiva teórica, visión mundial

Introduction

Biodiversity conservation research and application has changed from a strong natural science focus to a "metadiscipline" (Meffe 1998), which increasingly integrates the social sciences, including sociology, anthropology, and psychology (Daily & Ehrlich 1999; Mascia et al. 2003). This shift in conservation research and application has occurred because natural scientists recognized that social, political, economic, and institutional factors are common drivers of biodiversity decline (Balmford & Cowling 2006). Consequently, natural scientists are increasingly engaging with social research and application (Newing 2010).

Social research can be meaningfully and appropriately interpreted only when the reader has a sufficient understanding of the philosophical principles (i.e., foundations) and the theoretical assumptions of the discipline (Heberlein 1988; Mascia et al. 2003; Newing 2010). This argument is based on the observation that each discipline has principles and assumptions that are used to design, conduct, analyze, and interpret research and its outcomes. For example, natural scientists often attempt to explain patterns at the population level by extrapolating results obtained from a subset of the population. They do so by ensuring, for instance, that their sample is representative of the population of interest and that they meet the assumptions (e.g., normal distribution) of the analytical methods they will use to extrapolate the data. In contrast, an anthropologist who conducts an ethnographic study of the behavioral patterns and beliefs of one cultural group would not wish to extrapolate those findings to other cultural groups. Their assumption would be that any group of people who interact over a period of time would develop their own culture, which would not necessarily be the same as another group (Patton 2002). The results are used to generate insight into how and why a particular culture has emerged, rather than uncovering universal conditions in human populations.

When researchers fail to understand and recognize the principles and assumptions that are embedded in their disciplines, it can compromise the integrity and validity of their research design. If they fail to understand the principles and assumptions of other disciplines, it can limit (or worse, distort) their interpretation of the research outcomes (Sievanen et al. 2012). Thus, understanding the principles of one's disciplinary base and the embedded assumptions is a prerequisite for all researchers and highly desirable when interpreting research from other disciplines. This point is particularly relevant to conservation science, which has historically been dominated by natural scientists who are typically oriented toward (post) positivism (Evely et al. 2008). Positivists believe valid knowledge can be generated only from objective empirical observation experienced through the senses and carried out according to the scientific method (Crotty 1998). When these elements are laid bare, it is easy to see why positivism is problematic in conservation biology. For example, how do we understand the values and attitudes that drive conservation behavior when they cannot be observed? The classic formulation of positivism is, therefore, inadequate for studying and understanding human-environment action; positivism cannot "fully account for the subjective nature of human reasoning and choices" (Evely et al. 2008).

Thus, in coming to understand what we can legitimately acquire knowledge about and how we acquire that knowledge, it is necessary to understand the principles and assumptions of scientific research, in other words, philosophy. Philosophical literature, however, can be immensely confusing, inconsistent, and, at times, completely impenetrable (Crotty 1998). We developed a social science research guide to assist natural scientists interested in the social dimensions of conservation science to understand the philosophical basis of the social sciences, interpret social science, and appreciate alternative approaches to scientific inquiry (Fig. 1). The purpose of the guide is to open the door to social science research and thus demonstrate that scientists can bring different and legitimate principles, assumptions, and interpretations to their research. Understanding and accepting different philosophical approaches to research could also enable more effective integration of natural and social sciences.

The multifaceted nature and interpretation of each of the concepts we present in our guide means they can be combined in a diversity of ways (see also Lincoln & Guba 2000; Schwandt 2000; Evely et al. 2008; Höijer 2008; Cunliffe 2011; Tang 2011). Therefore, our guide represents just one example of how the elements (i.e., different positions within the main branches of philosophy) of social research can apply specifically to conservation science. We recognize that by distilling and defining the elements in a simplified way we have necessarily constrained argument and debate surrounding each element. Furthermore, the guide had to have some structure. In forming this structure, we do not suggest that researchers must consider first their ontological and then their epistemological position and so on; they may well begin by exploring their philosophical perspective.

Why Philosophy Is Important to Science

Philosophy provides both the natural and social sciences with the general principles of theoretical thinking,

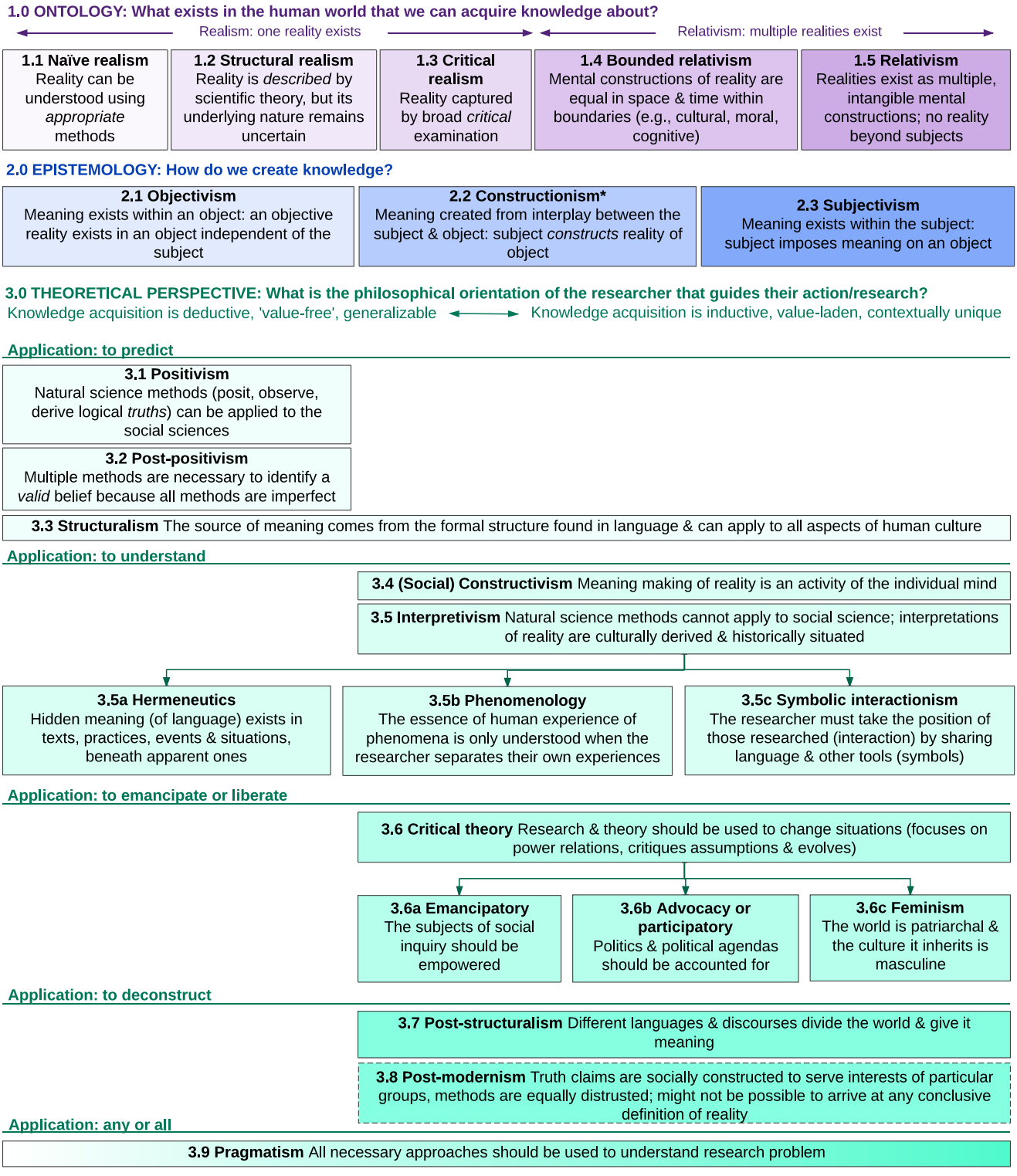

Figure 1. Social science research guide consisting of ontology, epistemology, and philosophical perspectives. When read from left to right, elements take on a more multidimensional nature (e.g., epistemology: objectivism to subjectivism). The elements within each branch are positioned according to their congruence with elements from other branches so when read from top to bottom (or bottom to top), elements from one branch align with elements from another (e.g., critical realist ontology, constructionist epistemology, and interpretivist philosophical perspectives). Subcategories of elements (i.e., 3.5a–c and 3.6a–c) are to be interpreted as positioned under the parent category (i.e., 3.5 interpretivism and 3.6 critical theory).

with a method of cognition and perspective, and with self-awareness, all of which are used to obtain knowledge of reality (Spirkin 1983). Two main branches of philosophy are important in the natural and social sciences. The first branch is ontology (i.e., the study of being): what actually exists in the world about which humans can acquire knowledge. The ancient Greek philosophers were interested in the origin and nature of the universe, what it means to *be* something, which included understanding objects and their properties and how they are similar or different from one another (Spirkin 1983). The second branch is epistemology (i.e., the study of knowledge). The philosophers distinguished a relationship between being and thinking so that ontology is concerned with what exists for people to know about and epistemology is concerned with how people create knowledge and what is possible to know. Ontology and epistemology are intimately linked with one other and, according to some, inseparable: to talk of meaning is to talk of meaningful reality (Crotty 1998). Stemming from ontology and epistemology are philosophical perspectives. A philosophical perspective is a system of generalized views of the world, which form beliefs that guide action (Spirkin 1983; Guba 1990). How researchers choose their methods demonstrates a commitment to a version of the world and how the researcher can come to know that world.

> To use a questionnaire, to use an attitude scale, to take the role of participant observer, to select a random sample, to measure rates of population growth and so on, is to be involved in conceptions of the world which allow these instruments to be used for the purposes conceived. No technique or method of investigation (and this is as true of the natural sciences as it is of the social) is self-validating: its effectiveness, i.e. its very status as a research instrument making the world tractable to investigation, is, from a philosophical point of view, ultimately dependent on epistemological justifications. (Hughes 1990:11)

Ontology

Ontology is important to conservation science because it helps researchers recognize how certain they can be about the (nature or existence of) objects they are researching. For instance, what truth claims can a researcher make about reality? Who decides the legitimacy of what is real? How do researchers deal with different and conflicting ideas of reality?

Many ontological positions exist (Feyerabend 1981; Morton 1996; Stokes 1998; Johnson & Gray 2010; Tashakkori & Teddlie 2010); however, the dichotomy between realism and relativism can be used to demonstrate clearly the importance of ontology to conservation science (Fig. 1, 1). Realist ontology holds that one single reality exists that can be studied, understood, and experienced as a "truth"; a real world exists independent of human experience (Moses & Knutsen 2012). Relativist ontology holds that reality is constructed within the human mind, such that no one true reality exists; instead, reality is relative according to each individual who experiences it at a given time and place. To illustrate the difference, Proctor (1998) asked is *wilderness* universally defined, measured, and experienced (realism) or do (groups of) individuals define, measure, and experience wilderness differently (relativism)?

The degree of confidence in one's ability to define the nature of reality is different within broad ontological positions. For example, moving from left to right across the realism spectrum (Fig. 1, 1.0), the realist ontologies become more accommodating of the notion that, although one reality exists, the nature of reality is not static; it can change as humans' capacity to understand or describe it changes. The naïve realist (Fig. 1, 1.1) claims that one true reality exists that can be understood so long as the correct methods are applied; this position is considered naïve because such realists assume a "perfect (or at least very close) correspondence between reality and the term used to describe it" exists (Bryman 2008:14). The structural realist (Fig. 1, 1.2) accepts that, although one true reality can be identified, the structures (e.g., definitions, measurements, technologies, norms) around how that reality is defined can change, at which point the nature of reality also changes. The critical realist (Fig. 1, 1.3) assumes that one reality exists but can never be understood perfectly because of "basically flawed human intellectual mechanisms and the fundamentally intractable nature of phenomena" and as such "claims about reality must be subjected to the widest possible critical examination" to help in understanding reality as closely as possible (Guba & Lincoln 1994:110).

Relativists argue that reality exists in the mind, with each individual creating his or her own version. Figure 1 demonstrates the changing nature of reality across the relativism spectrum. A bounded relativist (Fig. 1, 1.4) argues that one shared reality exists within a bounded group (e.g., cultural, moral), but across groups different realities exist. For instance, in some cultures, healing properties have been ascribed to certain (parts of) animals to justify their continued harvest, even when these animals are endangered (e.g., Graham-Rowe 2011). In other cultures, healing properties are considered of insufficient value to warrant harvesting animals with purported healing properties, especially when harvest poses a risk to the survival of the species (e.g., Biggs et al. 2013). Similarly, one reality can exist according to a particular moral position (e.g., anthropocentrism: human-centered values), but this reality can be different when considered from an alternative moral position (e.g., ecocentrism: nature-centered values). A relativist (Fig. 1, 1.5) assumes that types of reality (i.e., bounded relativism) do not exist; rather, each individual mentally constructs his or her own

unique reality. Realities are thought to change because they are "historically and culturally effected interpretations rather than eternal truths of some kind [. . .] and that at different times and in different places there have been and are very divergent interpretations of the same phenomena" (Crotty 1998:64).

Using a hypothetical example of logging in virgin forests, we illustrate the importance of ontological positions in social research. Realists would presume they could identify and define the people who log and, through the application of defined methods, discover the reasons why they log. They would assume that decision-making processes around logging represent universal "truths" that can be established through applying scientific methods. In an effort to predict patterns of logging behavior, they would likely disaggregate the system in an attempt to identify the generalizable properties or characteristics of people and the system to infer causal relationships between people and drivers of resource management. In contrast, relativists ascribe a greater role to emotions, cultural background, social norms, and experience and presume individuals make decisions in complex, contextually dependent and potentially unpredictable ways (Evely et al. 2008). They would, for instance, conduct a more detailed investigation of context, exploring who logs, the nature of their relationship to the forest they log, and the economic, political, and social context that has shaped the nature of the logging activities. Anticipating multiple interpretations of logging that cannot be (easily) separated into discrete components, they embrace the complexity of the system rather than attempting to disaggregate it.

Realists would expect that policy makers or community groups could use their data to target interventions that would have predictable outcomes on identified causal relationships. Realists, however, would expect that logging is concerned with human decision making and behavior, not causal relationships (Balmford & Cowling 2006; Evely et al. 2008), and they would instead seek to capture the diversity and depth of experiences and behaviors contributing to, or impeding, conservation efforts. Despite the apparent polarity of these ontological positions, they can complement one another. To illustrate the benefits of reduced-impact logging, interventions have been repeatedly demonstrated to loggers in the tropics; yet, these interventions have not succeeded in halting poor logging practices. Putz et al. (2000) recognize that many of the recommended practices are not in the self-interest of the loggers and that a cultural change, not interventions, is necessary to shift the view of logging from one of timber mining to forest management. In this instance, realist research played a role in the development and implementation of interventions, while relativist research helped explain which interventions were unsuccessful and why. Considering both ontological positions in research design could increase the likelihood of successful interventions and change.

Examples of both realist and relativist research exist in the conservation literature. Realists often apply models such as the theory of planned behavior or reasoned action to identify, for example, social-psychological influences on farmers' conservation behavior (Beedell & Rehman 2000) or normative influences on boaters' behavior to conserve manatees (Aipanjiguly et al. 2003). Relativist research is typically person-centered (Brown 2003) and includes research that elicits mental models to reveal individuals' knowledge, values, and beliefs that frame how they view the world to enable effective consultation and participation (Kolkman et al. 2007).

Epistemology

Epistemology is concerned with all aspects of the validity, scope, and methods of acquiring knowledge, such as, with what constitutes a knowledge claim; how knowledge can be produced or acquired; and how the extent of its applicability can be determined. Epistemology is important to conservation science because it influences how researchers frame their research in their attempt to discover knowledge. For example, is human knowledge something that exists for researchers to identify in an objective way with certainty, or is knowledge value laden? How scientists answer this question will have a profound influence on how they conduct and interpret their research (Crotty 1998). To explain epistemological positions, we used a continuum provided by Crotty (1998) that focuses on the relationship between the subject and the object (Fig. 1, 3.0; see Cunliffe [2011] for a discussion on intersubjectivity).

Objectivist epistemology (Fig. 1, 2.1) assumes that reality exists independent, or outside, of the individual mind. For instance, a "tree in the forest is a tree, regardless of whether anyone is aware of its existence or not [. . .] When human beings recognize it as a tree, they are simply discovering a meaning that has been lying there in wait for them all along" (Crotty 1998:8). Objectivists contend they can discover an objective "truth" that is empirically verifiable, valid, generalizable, and independent of social thought and social conditions (Crotty 1998). Objectivist researchers can remain detached from their subjects, and researchers' interests, values, or interpretation do not bias the generation of knowledge (Pratt 1998). Objectivists seek methods to test reality by collecting and analyzing evidence to explore assertions, corroborate claims, and provide correspondence with the real world (Patton 2002). Ultimately, objectivists posit that "people can rationally come to know the world as it really is; the facts of the world are essentially there for study" (Pratt 1998:23).

Constructionist epistemology (Fig. 1, 2.2) rejects the idea that objective "truth" is waiting to be discovered. Instead, "truth," or meaning, comes into existence in and out of our engagement with the realities in our world; no real world preexists that is independent of human activity or symbolic language: "what we call the world is a product of some mind" (Bruner 1986:95). For constructionists, human beings construct knowledge as they engage with and interpret the world (Crotty 1998). That is, "knowledge is not passive—a simple imprinting of sense data on the mind—but active; mind does something with these impressions, at the very least, form abstractions or concepts" (Schwandt 1994:125). This epistemological position assumes that different individuals construct meaning of the same object or phenomenon in different ways; how an individual engages with and understands their world is based on their cultural, historical, and social perspectives and thus meaning arises through an interaction with a human community (Crotty 1998; Creswell 2009).

Subjectivist epistemology (Fig. 1, 2.3) holds that what constitutes knowledge depends on how people perceive and understand reality. Thus, reality is pluralistic (i.e., reality can be expressed in a range of symbol and language systems) and plastic (i.e., reality is stretched and shaped to fit the purposes of individuals) (Schwandt 1994; Pratt 1998; Powell 2001). People impose meaning and value on the world and interpret it in a way that makes sense to them (Crotty 1998; Pratt 1998). Whereas the motto of objectivism might be *seeing is believing*, the motto of subjectivism might be *believing determines what is seen* (Pratt 1998).

To illustrate, a shadow in the water could be interpreted differently by a person scuba diving according to whether they were waiting for a boat (the boat), were alerted to a shark in the area (the shark), or were expecting a change in the weather (clouds). For subjectivists then, "we see the world as we are; that which we have inside, we see outside" (Pratt 1998:24). Subjectivism focuses on correspondence with the inner, rather than the outer, world and attempts to understand the knowledge, interests, purposes, and values of individuals; the meanings that constitute an action are as important as the action itself (Schwandt 2000). Subjectivists reject the idea that subject and object, observer and observed, or mind and world can be separated, assuming instead that each individual observes the world from a specific place of purpose and interest.

In our logging example, researchers who hold different epistemological positions would seek to acquire knowledge about why people log in different ways. For instance, an objectivist would focus on objective reality by studying the behavior of individuals and reducing the causes of logging behavior into a discrete set of (testable) ideas. A constructionist would focus on how the interaction between people (subject) and their logging activities (object) gives rise to meaning and knowledge within a defined social context. The subjectivist would focus on interpretation and seek to understand what logging means to different people and determine how believable and widely held those meanings are and how they correspond between people with different levels of experience.

There is value in accommodating a plurality of epistemologies in conservation science. The value of objectivist research is in its external validity (applicability of the results to other contexts) and reliability (consistency of results obtained) (Evely et al. 2008). Objectivist research can be used, for instance, to help reduce fishing in depleted fisheries by identifying the socioeconomic factors that affect fishers' decisions. These factors could then be used to direct national investment in employment opportunities toward those fishers who would be deemed most likely to continue fishing (Cinner et al. 2009). Successful interventions could be transferable to communities that are socioeconomically similar.

The value of constructionist research is in generating contextual understandings of a defined conservation topic or problem. For example, scientists can learn about the willingness of resource-dependent communities to accept or adopt different scientific management prescriptions by applying constructionist methodologies. Weeks and Packard (1997), for example, found that scientists constructed their reality of scientific management according to the scientific enterprise (context) and valued factors associated with scientific integrity, such as methodological rigor. In contrast, resource-dependent communities (e.g., ranchers, fishers) constructed their reality of scientific management according to their own context: historical relationship with the management agency, the match between scientific explanations and local experience (knowledge), and the conceptual fit between managers' and communities' views on resource management. Constructionist research can enable governments and stakeholders to design contextually relevant responses to conservation problems, which have been demonstrated to have a higher likelihood of success (e.g., Waylen et al. 2010).

The value of subjectivist research is in revealing how an individual's experience shapes their perception of the world. A lot of risk perception research adopts subjectivist epistemology because people tend to perceive risk on the basis of very personal experiences (Burgman 2005). While a constructionist approach would examine perceptions of climate change risk on the basis of people's direct experience with climatic events (e.g., flooding) (Whitmarsh 2008), a subjectivist approach would be less closely aligned with the climate system and more likely to explore emotion, values, worldviews, trust, effect, and imagery (Slovic 2000). Subjectivist research, therefore, provides important insight into the factors that contribute to individual conservation behavior (Fishbein & Ajzen 1975).

Philosophical Perspective

The basic, albeit abstract, question of philosophy is what is the relationship of thinking to being; how an individual answers this question reveals their general theoretical worldview, or philosophical perspective. Philosophical perspectives represent a system of values to which people adhere (Evely et al. 2008). They are important to conservation science because, when made explicit, they reveal the assumptions that researchers bring to their research, and these assumptions lead to choice of methods (Crotty 1998). Philosophical perspectives, also called paradigms (Guba & Lincoln 1994; Morgan 2007), perspectives (Patton 2002), and worldviews (Creswell 2009), can be defined as "a basic set of beliefs that guide action" (Guba 1990:17). So where epistemology is about beliefs around knowledge, philosophical perspectives can be considered a set of assumptions that structure the approach to research. A philosophical perspective is something personal that drives the way research is conducted; it is underpinned by ontological and epistemological leanings and influences how a researcher creates knowledge and derives meaning from their data. For example, the mere choice of what to study in the sciences imposes values on one's subject (Ruse 1988). Philosophical perspectives are shaped by the discipline of the researcher, their beliefs, and past experiences (Creswell 2009), and are applied to the purpose, design, methodology, and methods of the research (see Newman et al. [2003] for a typology of research purposes), as well as to data analysis and interpretation (Slife & Williams 1995).

Each perspective is characterized by an often wide-ranging pluralism, which reflects the complex evolution of philosophy and the varied contributions of philosophers through time (Crotty 1998). All ontologies, epistemologies, and philosophical perspectives are characterized by this pluralism, including the prevailing (post) positivist approach of the natural sciences. It is common for more than one philosophical perspective to resonate with researchers and for researchers to change their perspective (and thus epistemological and ontological positions) toward their research over time (Moses & Knutsen 2012). Thus, scientists do not necessarily commit to one philosophical perspective and all associated characteristics (Bietsa 2010).

Many generalized philosophical perspectives have been defined, some of which can also be viewed as, and interchanged with, epistemological or ontological positions (Tashakkori & Teddlie 2010; Denzin & Lincoln 2011). We included in Fig. 1 those perspectives we considered most relevant to conservation science and others that are not commonly used in conservation science but can play an important role in expanding and extending approaches to scientific inquiry. For instance, whereas postmodernism is, to some, a rather esoteric perspective, it has had an influence on the nature of scientific inquiry because it challenges established knowledge: postmodernism questions causality, objectivity, egalitarianism, rationality, and "truth." At an extreme level postmodernism dismisses science, whereas at a more moderate level it stimulates innovation (see Rosenau [1991] for a detailed discussion of the role of postmodernism in the social sciences). We elaborate on 5 common perspectives below and present 10 additional perspectives in Table 1 (see also Fig. 1, 3.0).

Positivism is objectivist, it is based on a conviction that only knowledge gained through the scientific method through unprejudiced use of the senses is accurate and true (Crotty 1998) (Fig. 1, 3.1). Postpositivism is also objectivist, but it is based on the premise that humans can never know reality perfectly. It replaces the verifiability notion (i.e., that researchers can verify that a proposition is true) and inductive methodologies (e.g., Romesburg 1981) with Popper's logic of "falsification." That is, scientists should seek to falsify, rather than verify, their theories or laws, whereby a genuine counter-instance would act to falsify the theory (Crotty 1998). We used our logging example to provide a simple distinction between these 2 perspectives. A post-positivist would test both a null hypothesis (providing landholders with a financial payment to stop logging will have no effect on logging activities) and an alternative hypothesis (providing landholders with a financial payment to stop logging will result in a net reduction in logging activities).

Interpretivism emerged in "contradistinction to positivism attempts to understand and explain human and social reality" (Schwandt 1994; Crotty 1998:66–67) (Fig. 1, 3.5). The subject matter of the social sciences (people and institutions) is considered by interpretivists to be fundamentally different from the natural sciences, who adopt a "different logic of research procedure, one that reflects the distinctiveness of humans as against the natural order" (Bryman 2008:15). Instead of seeking to identify regularities or establish laws that explain human behavior, interpretivists seek to understand by looking at individual cases to trace the development of phenomena (typically qualitatively) (Crotty 1998). Interpretivist approaches make explicit scientists' biases and perspectives that influence data collection and analysis (Patton 2002). People who read research on, for example, participation in a conservation program (i.e., phenomenology), the cultural context of conservation behavior (i.e., hermeneutics), or shared meanings of a concept such as ecosystem services or adaptation (i.e., symbolic interactionism) are engaging in interpretivist research (Fig. 1). For the logging example, an interpretivist might ask: How does culture explain why this community logs? Interpretivist research outcomes emerge from the scientists' interaction with the participants, and all of the (different) interpretations are considered contextually dependent on the history and culture that influences how each individual interprets and makes meaning of their world.

Critical theory (Fig. 1, 3.6) aims to challenge, reveal conflict and oppression, and bring about change (Crotty

Table 1. Examples of research questions and their associated assumptions as they apply to the case of logging of virgin forests that illustrate the research approach that could be taken according to different philosophical perspectives of the system being studied.

Philosophical perspective[a]	*Example research question*	*Researcher's assumption*
3.3 Structuralism	What is the purpose of the (social) structural relationships in this community (e.g., social classes, governments) and how do they influence logging practices here and elsewhere?	Once I can understand the systematic structure (through understanding objects, concepts, ideas, and words as they relate to one another) of social classes and relationships, I can generalize the knowledge and apply it to all aspects of human culture (in space and time).
3.4 Constructivism[b]	What currently motivates individuals in this community to log?	I know that each individual defines and frames problems in their own way, and these differences must be understood to evaluate the system.
3.5a Hermeneutics	Why do individuals not stop logging when they said they would?	I can interpret the (hidden) meanings of a text or event from the perspective of the author or participant within its social and historical context.
3.5b Phenomenology	Why do people log?	I believe researchers can put their own systems of meaning (of reality) aside and interpret the immediate personal experience of a phenomenon and thus give rise to a new, refreshed, or richer meaning of the phenomenon.
3.5c Symbolic interactionism	How do different individuals' descriptions, definitions, and metaphors of the trees affect logging outcomes in this community (e.g., are the trees considered part of a forest or are they considered a resource?)?	I believe that the meaning of objects arises out of social interaction (language) between people and that people interact with and interpret objects on the basis of the meanings those objects have. People are conscious of their role in interaction (thought) and can change their behavior.
3.6a Emancipatory	How can we ensure that the community shares in the benefits of logging or alternatives to logging?	I want to create a mutual interdependence between the research participants and to transform structures that exploit people.
3.6b Advocacy or participatory	How can we garner support and develop effective governance structures to enable sustainable livelihoods in this community?	I want to collaborate with the people in the system, rather than conduct research on them, to create an agenda for active change or political reform.
3.6c Feminism	Does examining logging from a feminist perspective offer alternative understandings of the dynamics and power relations among and between the stakeholders?	I believe logging is a masculine activity and reflects a patriarchal world and culture. Exploring logging solely from a traditional scientific (i.e., nonfeminist) perspective limits opportunities to understand behavior and create change.
3.7 Poststructuralism	What are the narrative structures within this system that describe how a logging debate has arisen in this historical context?	I need to understand not only what the system appears to be, but also how it emerges from the history and culture of the people that comprise the system. In understanding the history and culture, I can come to understand whether or not what I have learned about this system can be applied to other systems.
3.8 Postmodernism[c]	Why is it assumed that logging is a problem?	I am skeptical of approaches to generating knowledge and want to scrutinize, contest, deconstruct, and make visible the (invisible) origins, assumptions, and effects of meaning.

[a] *Numbers correspond to philosophical perspectives in Fig. 1 (Giddens & Turner 1987; Crotty 1998; Cheek & Gough 2005; Kincheloe & McLaren 2005; Bryman 2008; Creswell 2009; Wellard & Ordin 2011).*
[b] *Patton (2002) summarizes the debate on the distinction between constructivism and constructionism: "Constructivists study the multiple realities constructed by people and the implications of those constructions for their lives and interactions with others" (Patton 2002:96). Constructivism focuses on unique individual experiences, whereas constructionism focuses on "the collective generation [and transmission] of meaning" and places an emphasis on the influence of culture (Crotty 1998). Constructionism is not necessarily relativist though, "[t]o say that meaningful reality is socially constructed is not to say that it is not real" (Crotty 1998:63).*
[c] *Bryman (2008:680) suggests that "[p]ostmodernism is a deeply disruptive stance on social research, in that it problematizes and questions our capacity ever to know anything." Further, postmodernism privileges nonidentity and so may not necessarily be subjectivist or constructionist (Crotty 1998).*

1998; Evely et al. 2008). Some authors argue that critical theory forms the very core of conservation biology: "Conservation biology is science in advocacy for certain normative agendas [because] characterizing habitat loss and reduction of biodiversity as crises, asserting the intrinsic value of biodiversity, and acknowledging our responsibilities to effect positive change or prevent harm" represent normative and value positions that influence how conservation science is conducted (Roebuck & Phifer 1999:444). Researchers who adopt a critical theory

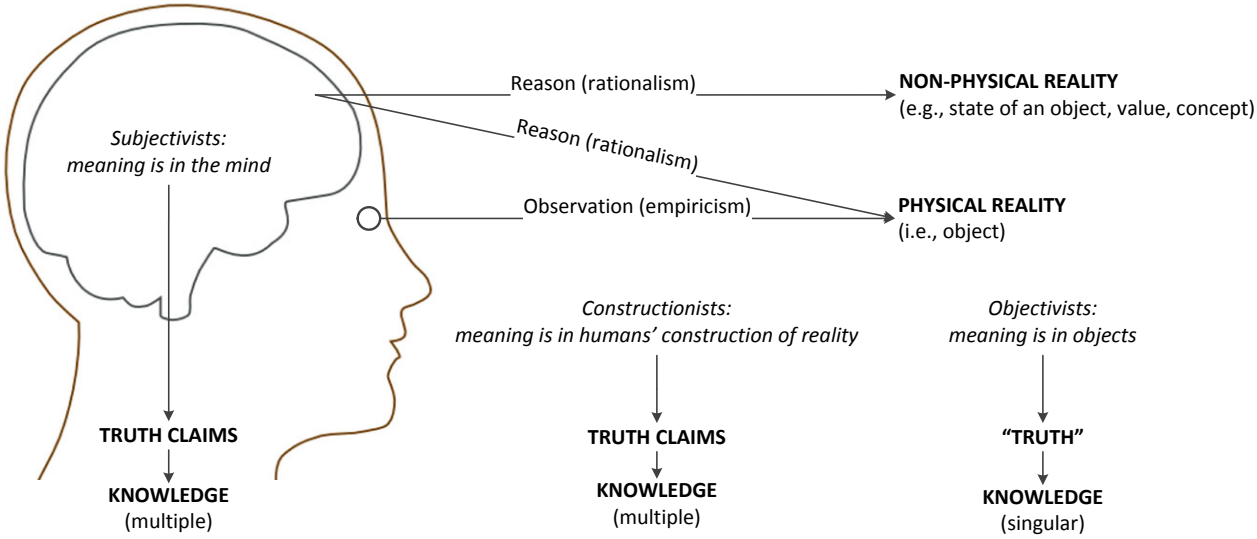

Figure 2. The relationship between reality and meaning and how they correspond with truth claims and knowledge according to subjectivist, constructionist, and objectivist epistemologies.

approach begin with an explicit ideological perspective (e.g., deep or radical ecology, feminism) that dictates how a chosen theoretical framework will direct data collection and interpretation (Patton 2002). A critical theorist might ask: Are conservation scientists who consider logging to be environmentally detrimental impoverishing countries with large rainforests? An actual example of this kind of research is Chan et al.'s (2007) study that examines how thought (including mainstream research practice) is mediated by power relations within a system and contributes to oppression. They sought to understand these power relations and expose areas of control and injustice to raise awareness and create an opportunity for change. Similarly, research that examines the role of women as natural resource users and promotes their inclusion in projects that improve sustainable resource use and human welfare reflects a critical theory perspective (e.g., Hunter et al. 1990). Critical theory has an important role to play in conservation science, particularly in bringing about positive change for minority or oppressed groups.

Pragmatism seeks a compromise between empiricism (knowledge is derived from sensory experience) and rationalism (knowledge is derived from logical and deductive reason) (see Fig. 1, 3.9 & Fig. 2). The value of knowledge is judged with respect to how well it serves human purpose (e.g., the Mercator projection, which has no truth as a representation of the planet yet is the map best suited for ocean navigation). As a technique, pragmatism is used to clarify concepts and hypotheses of inquiry by considering their practical considerations in an effort to dissolve ontological disputes (James 1907; Hookway 2010). For pragmatists, truth claims, cultural values, and ideas are explored in terms of consequences and application or use value (Crotty 1998; Scott & Marshall 2009). Pragmatists agree that research should be contextually situated without being committed to any one philosophical position, instead using a diversity of methods to understand a given problem (Creswell 2009). The pragmatist might ask: How can I understand what is really happening at this point in time so that the different needs of the community, NGOs, and other stakeholders can be balanced to reduce the negative effects of logging? The contribution of pragmatist research to conservation science is the delivery of practical outcomes, including research that focuses on managing moral conflicts (Maris & Bechet 2010), engaging private landholders in biodiversity conservation programs (Moon & Cocklin 2011), and informing conservation policy (Dombeck et al. 2004).

Improving the Value of Social Science to Conservation Biology

Understanding the philosophical basis of social science is critical to ensuring that social research outcomes are appropriately and meaningfully interpreted. With an increase in interdisciplinary research, an examination of the points of difference and intersection between the philosophical approaches adopted in social sciences with that of the natural sciences can generate critical reflection and debate about what we can know, what we can learn, and how this knowledge can affect the way conservation science is conducted and the decisions and actions that result from its practice. A deeper understanding of the philosophical basis of both natural and social sciences also has the potential to produce transformational knowledge. We recommend that both natural and social scientists consider the philosophical basis of their discipline

and, where necessary, that of others when conducting and interpreting research outcomes to ensure that conservation science is clear, well-articulated as a coherent research design, and defensible in terms of the knowledge developed.

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