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Stuck in Science: The Natural Scientist and Non-Objective Ways of Knowing Nature

Marianne R. Chrystalbridge
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Marianne R. Chrystalbridge entitled "Stuck in Science: The Natural Scientist and Non-Objective Ways of Knowing Nature." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Geography.

Lydia M. Pulsipher, Major Professor

We have read this thesis and recommend its acceptance:

Thomas L. Bell, David L. Feldman

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Stuck in Science: The Natural Scientist and Non-Objective Ways of Knowing Nature

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Marianne Russell Chrystalbridge
August 2004

DEDICATION

This thesis is dedicated to my children

Ramana Rose,

Sierra Jasmine,

and

Iris Emerald

Russell,

who have taught me the value of believing in oneself

through their belief in me.

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Abstract

My research investigates whether and to what extent natural scientists utilize non-objective but personally meaningful ways of knowing, that is, different modes of perceiving, interpreting, judging, and comprehending, in addition to their objective stance as scientific researcher, in constructing their understanding of nature. I investigate whether or not the norms of science restrict discussion of non-objective ways of knowing to the margins of the discourse. I pursue this topic through a review of literature on ecological sustainability that emphasizes the importance of buttressing objective knowledge with non-objective ways of experiencing and talking about nature.

In interviews with fifty natural scientists, I ask about their sense of spiritual connection to the natural world, under the assumption that this way of knowing is one that can integrate objective and non-objective understandings of nature. The results of this qualitative research demonstrate that norms in the workplace of natural science discourage integration of multiple ways of understanding nature, even when these ways reflect an ethos of ecological sustainability as it is normally described in the literature. I argue that the inclusion of more integrated ways of knowing nature in the discourse of natural science could enhance conventional scientific understanding of the human relationship with nature. This in turn could broaden the ways natural scientists communicate with the public, by making connections between objective scientific information and the spiritual or personally meaningful ways that the public might understand ecological sustainability goals. A discussion addresses ways in which these connections might be accomplished.

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Chapter One
Introduction

Hypothesis

This study focuses on the discourse of natural science, in particular on the extent to which there is space in that discourse beyond the purely objective and measurable for additional ways of understanding nature and our relationship with it. I hypothesize that certain norms dominating the natural science workplace restrict natural scientists from thinking and talking about non-objective ways of knowing nature (personally meaningful, spiritual, or emotionally based), silencing even those who value these ways of knowing nature. The norms of science elevate objectivity as the only valid way of understanding nature, and banish to the margins of that discourse—or from the discourse entirely—discussion and examination of ways of knowing that are considered non-objective, different, and hence unacceptable. These restrictive norms of scientific objectivity prevail even though literature in the preservation and conservation fields has historically included non-objective ways of knowing as important factors in supporting sustainability.

Adding to this hypothesis, I contend that these restrictions against non-objective ways of understanding nature make it difficult for natural scientists to convey scientific findings in a way that will inspire widespread, effective public commitment to sustainability. Many environmentalists maintain that sustainability requires a cultural transformation. Furthermore, they argue that this transformation must include a redefinition of boundaries between science, politics, ethics, religion, and our ideas and even myths about nature. Natural scientists exert a key influence on cultural attitudes about nature because they generate most of our knowledge about nature, and influence the way we view and value—and thus act toward—nature. Were scientists to give a spiritual context to their science studies, they would have a more effective influence on cultural attitudes about nature.

In this thesis, I investigate only certain aspects of the first part of this hypothesis: that among natural scientists there are those who value certain non-

objective as well as objective ways of knowing nature, but because norms in natural science restrict discussion of non-objective ways of knowing, scientists rarely discuss these issues with colleagues. I also consider the literature connecting certain non-objective ways of knowing to sustainability. Through interviews with fifty natural scientists, I explore whether and how natural scientists blend non-objective with objective ways of knowing in constructing their professional understanding of nature, and whether they consider certain non-objective ways of knowing to be important to sustainability.

I begin by documenting how these natural scientists describe some of the personally meaningful ways they understand nature. This is followed by a description of their views on whether certain personally meaningful ways of knowing nature can motivate sustainable behaviors. I then examine their descriptions of norms for—and restrictions against—discussing such ways of understanding with colleagues and others. Because I found a considerable amount of conservation and sustainability literature that emphasized the combination of objective with certain non-objective ways of knowing, I compared the views of those I interviewed with prevalent themes in this literature. I did not attempt to investigate whether a personally meaningful connection to nature resulted in sustainable behavior, or whether incorporation of this way of knowing into the discourse of natural science improved natural scientists' influence on social attitudes about sustainability. This research here is intended to lay the groundwork for further work on the connection—if any—between the acceptance of spiritual or personally meaningful ways of knowing nature, and activism for sustainability.

Overview of Thesis

I introduce the thesis topic in *Chapter Two* with definitions of relevant terms, and a brief description of the themes I will develop in the literature review. I then discuss the relevance of this topic to geography, including a discussion of how a feminist geographic perspective can contribute significantly to a study of natural science researchers and their ways of understanding nature. These geographic and feminist perspectives are grounded in the theoretical concepts regarding the positioning

of the observer to the observed, the construction of meaning, different ways of knowing, and the marginalization of difference. In other words, I look at ways the natural science researcher positions him- or herself in viewing or thinking about nature. I consider how the researcher brings different forms of knowledge to his or her understanding of nature, and how he or she constructs meaning about nature.

I continue this review of literature with a brief overview of background literature, and a review of studies that look at interview-based studies similar to mine. I then present an exploration of norms in natural science that regulate against, and marginalize, non-objective ways of understanding nature, that is, ways of understanding that are not considered scientific. I also present literature that contends that the role of science must change in order to be more effective in inspiring commitment to sustainability. In addition, I discuss literature that emphasizes the importance to sustainability of integrating objective knowledge with non-objective ways of understanding nature. Finally, I review literature that considers the biological basis for the construction of myth and meaning, and the relevance of this construction to sustainability. *Chapter Two* will conclude with a brief discussion about the significance of this research.

In *Chapter Three*, I explain the interview methodology that I used to gather information from a range of natural scientists. I then analyze these interviews in *Chapter Four*, extracting evidence on:

a) *The extent to which these natural scientists consider non-objective knowledge—in terms of spiritual and/or personally meaningful connection to nature—as an important element in their ways of understanding nature.* I do this by examining their responses to several questions, as well as their comments about spiritual and/or personally meaningful ways of understanding nature. I also consider the content of several lectures and other forms of communication at each research site, noting whether there was mention of spiritual or personally meaningful ways of understanding nature, particularly in regard to sustainability issues.

b) *The extent to which the interviewees considered spiritual and/or personally meaningful ways of knowing as important to sustainability goals.* I focus in particular on their responses to a specific statement about how natural science must combine a sound empirical base with opportunities for dialogue about "the spiritual impulse," if it is to be more relevant to the environmental movement. I also consider interviewees' responses to several open-ended questions about these non-objective ways of knowing.

c) *The comparison between data from my interviews and the literature expressing views about the role of non-objective ways of knowing nature in sustainability goals.* I do this by distilling opinions expressed in the literature to a limited number of summary statements. I then compare these statements to my interview data, recording similarities and differences between interview data and summary statements.

d) *The extent to which these natural scientists feel constrained—or not—by norms in the workplace of natural science that encourage or discourage discussion of non-objective ways of knowing nature.* I focus on comments by the interviewees that illuminate these norms and describe the settings—if any—for discussion about non-objective ways of understanding nature.

This paper concludes with *Chapter Five*, which develops the argument that inclusion in the natural science discourse of discussions about non-objective but spiritual or personally meaningful ways of knowing—and the recognition by scientists of the sense of spiritual connection to the Earth—would be one way for scientists to more effectively influence social attitudes about sustainability. This, in turn, would deepen the relevance of natural science to the debate on how to realize sustainability goals. This chapter also will include a discussion on the potential for further research in this area.

Limitations of the Study: A Summary

Limitations of this study are discussed in depth in the concluding chapter, *Chapter Five*, where I address the following issues:

- The difficulty in collecting information on philosophical attitudes;
- The shortcomings of using indirect questions in interviews;
- The limitation of the focus of the study to the natural science workplace rather than to the broader natural science discourse;
- The limited applicability of findings primarily to developed areas.

In addition to the discussion of limitations in *Chapter Five*, I add the following caveat here regarding my use of the word *spiritual*. Although I deliberately included the word *spiritual* in the second round of my interviews, I do not assume spirituality necessarily contributes to sustainability, or results in actions for sustainability. What is called *spiritual* can focus on spiritual benefits without mentioning environmental considerations; or an overly strong theistic focus on the afterlife can ignore environmental issues in the here and now.

Chapter Two
Literature Review

Introduction

When I read the introduction to the Miller (1988) textbook on environmental science in 1990, I first encountered the idea that a personally meaningful, non-objective way of understanding sustainability issues was just as important to sustainability as scientific knowledge. I understood Miller to mean that an understanding of our relationship with Earth must go beyond objective knowledge and aesthetics to incorporate some kind of deeply meaningful sense of connection to the Earth. What is meaningful to us is reflected in what we value, which is reflected in the ways we think, feel, and act in our relationship to nature. Miller, who has written extensively on environmental science and critical thinking about the environment, further emphasizes that this integration is not only relevant to environmental issues but is crucial to our survival. Several geographers have expressed similar ideas, albeit with more emphasis on the psychological rather than the spiritual, including Rose (1992), whose research focused on the examination of critical Marxist theory, Simmons (1993), who developed fresh ideas in environmental philosophy, and Berg (2001), who writes about masculinities and space.

Others have voiced these thoughts as well, speaking from fields that, like geography, examine the connections between human society and nature, including environmental educator David Orr (1992), ecological biologist Aldo Leopold (1949), and the conservationist-naturalist John Muir (1911, 1916). Wildlife biologist Rachel Carson (1962) linked knowledge about the natural world with a sense of caring for, and personal connection to, nature. According to Takacs (1996), who researchers the role of natural science in environmental issues and society, Carson inspired the beginnings of the environmental movement—not with her attention to objective facts, although these were certainly well integrated into the book, but with her emphasis on personal connection and caring for the natural world.

In the field of environmental studies, Mitchell Thomashow (1995), emphasizes a sense of the spiritual or personally meaningful connection to nature—grounded in objective science—as an important component in environmental work. Others who have emphasized the relevance to sustainability of this spiritual connection between humans and nature include Arne Naess (1986), the philosopher whose writings sparked the deep ecology movement, as well as Stephen Kellert (2002) in social ecology, David Takacs (1996) in science studies, Paul Ehrlich (et al. 1992) in population biology, and E. O. Wilson (1993, 2000), the Pulitzer Prize-winning biologist.

I have often been asked, when discussing or presenting these ideas, if a spiritual or personally meaningful sense of connection to nature makes for better science. Ostermeier (2001), a Professor of Forestry at the University of Tennessee, suspects that the degree to which natural scientists are aware of their own subjective connection to nature makes them better able to communicate with non-scientists, because most non-scientists connect to nature in this more personal way. Thus spiritual ways of understanding nature may not make for better science, but may make for better education and communication with the public, because they provide a way to link scientific facts with something meaningful to many lay people.

Hard-to-define values

A study done by Rennie (1999), Professor Emeritus at the Department of Forestry, Wildlife and Fisheries at the University of Tennessee, supports the importance of this combination of personally meaningful and scientific understandings of nature. Rennie wrote about what he called "hard-to-define values"—the aesthetic, the intrinsic, the emotional, and especially the spiritual values of forests. Driver et al. (1996) provide an in-depth examination of these hard-to-define values in *Nature and the Human Spirit.* John Muir (1911, 1916), one of the founders of the preservation movement, highlighted the importance of these values through descriptions of his travels in natural areas in the late nineteenth century. Gifford Pinchot, one of the major contributors to the development of forestry management policies for the Forest Reserves, also voiced his appreciation for these values. In an address he made in 1920, he described the spiritual

value he gained from loving forests as "beyond counting," according to an account by Miller et al. (1999, 31), in the *Journal of Forestry*.

The Tennessee Forest Management Advisory Panel's (1998) report to the Governor and Commissioners of Agriculture and Forestry created four categories—economic, ecosystem, recreation, and quality of life—for the products, uses, and values derived from forests, with hard-to-define values falling into the "quality of life" category. Hard-to-define values are amorphous, non-objective, non-quantifiable, and personal. They are generally considered irrelevant to the public or private business of natural resource use—even when such use is valued for the profit-potential of recreation in natural areas. They are also considered irrelevant to science research on ecosystems or even on species diversity. Economic considerations and scientific research are necessarily quantifiable, although environmentalists Berry (2002) and Soule—one of Takacs' (1996) interviewees and a conservation biologist at the University of California—argue that hard-to-define, non-quantifiable values should be taken into account to some extent, especially in economic decisions. But certain hard-to-define characteristics of nature—whether experienced through natural areas, representations of nature, or nature in the abstract—for example, through existence value[1]—contribute to our quality of life and mental well-being. These characteristics are a source of spiritual, emotional, and/or aesthetic experiences. Just as we need quantifiable information for economic decisions or scientific predictability, we also need these non-quantifiable experiences, because we need meaning in our lives. A sense of kinship to all living things, to life beyond ourselves, assuages our fears of being alone. We gain a value from the abstract idea of nature as a whole through our personal and direct experiences of nature, as Rennie (1999) describes in relating the influence on his life of his childhood experiences in the forest.

[1] According to economist Moffat (2004), existence value is the value that individuals may attach to the mere knowledge of the existence of something, as opposed to having direct use of that thing. Synonymous with nonuse value. For example, knowledge of the existence of rare and diverse species and unique natural environments may have value to environmentalists who do not actually see them. The knowledge of the existence of natural areas in Federal lands (not necessarily national parks) can be reassuring to urban dwellers who may never experience such places in person.

While the hard-to-define values of nature may be personally meaningful to us, personal values differ from "hard-to-define" values. As we come to know our own values, and learn the importance of being open to the values of others, even values that differ from ours, we learn to value difference, including different species. As noted by philosophers Ehrenfeld (1970), Naess (1986), and the radical political philosopher Blanke (1996), along with biologists Mayr (1982), Ehrlich (1992), Soule (1988), and Wilson (1993, 2000), when we learn to value that which is beyond measure, we learn to value the immeasurable idea of nature as a whole, as well as the quality of life for those we may never meet—for future generations as well as for other species.

Forestry is a discipline that is based only partially in the natural sciences; a good portion of its knowledge base lies in forest economics. Based on Rennie's considerations concerning hard-to-define values, he conducted an informal survey of the students taking his course on current issues in renewable natural resources, a course designed primarily for students new to the field of forestry. At the start of the course, Rennie asked the students why they had chosen their major. Over ninety percent indicated deep concerns and strong interests related to these hard-to-define values of forests; only two percent indicated interest in the economic values of the forest.

Forestry programs have long put an almost exclusive emphasis on the economic values of forest products. Some programs have now added discussions about ecosystem values, but there continues to be little concern for Rennie's "hard-to-define values." The strong emphasis on economic values at the University of Tennessee's Department of Forestry, Wildlife, and Fisheries had a winnowing effect on students holding a broader ecosystems perspective, causing some to leave the program, and had a narrowing effect on the views of remaining forestry graduates, concentrating their focus on economic products in the forestry profession.

Rennie's (1999) study indicated that these hard-to-define values were effectively marginalized in forestry. Rennie noted that, in forestry, norms against discussion of these values were so entrenched that he felt he had had to wait until he was retired to talk openly about them. After my discussion with him, I wanted to know if there are similar norms in other natural sciences that marginalize these hard-to-define values.

Definition and Discussion of Terms

I have used a number of abstract terms in the introduction to this review, and will clarify these terms here. The word *nature* is difficult to define because it has an almost endless variety of complex connotations and is imbued with normative values. Replacing it with supposedly value-neutral word such as *ecology* or *environment* would not offer a useful alternative because, as geographer Olwig (1996) notes, these words are just as laden with social values. Our definitions of nature reflect our passions for nature. As Botkin (1990), Cantrill et al. (1996), Cronon (1996a, 1996b), Ingerson (1994), Merchant (1980), Sagoff (1988), Hull et al. (2002) and other writers on environmental ethics and the interaction between humans and nature point out, we feel passionate about nature because it evokes God, home, and livelihood—we are deeply connected to nature spiritually, culturally, and economically. In this thesis, which focuses on considerations about ways of knowing nature that are personally meaningful, spiritual, or emotionally based, it is necessary to limit the definition of *nature* to personal ideas about, and personal ways of conceptualizing, nature.

These ideas would likely be based on one's personal experience of nature. I contend, for the purpose of this definition, that this experience differs from one individual to another. For example, an urban dweller may feel a potentially inspiring connection to nature by watching birds on their balcony in the center of an urban area. This idea of nature may be enhanced by visiting city parks and gardens, or by viewing nature programs on television. Education about the natural environment may enhance this idea further by leading the individual to conceptualize the natural systems of the Earth, and to then feel a kinship to the whole of Earthly nature. Another urbanite may not feel such a connection unless she creates opportunities for more hands-on experiences of nature. Furthermore, I do not assume that a resident of a rural area would necessarily feel a meaningful connection to nature, because again, experiences that evoke connection to nature may differ among individuals.

Nature could be defined as the interaction of all living and nonliving things on Earth, systems in which these life forms function, and all structures—including human

structures—created by these life forms. However, since we are unlikely to feel a connection to nature by contemplating a skyscraper or a heavily industrialized area, I am excluding most human-made structures from this definition. The best-selling environmental writer McKibben (1989), who considers the hidden costs of global warming and other pervasive effects of human activities, points out that humans have exerted their influence over much of the natural world on earth. With this in mind, it would not be useful to define nature in terms of some ideal, pristine state. Therefore, for this thesis, I am defining *nature* as the idea of nature held by the individual person, to the extent that this idea has the potential to evoke a sense of connection to nature in that person.

Sustainability is also a difficult concept to define, but I will use a definition created by those who have given much thought to this challenge. Definitions by biologist Mayr (1997, 268-269), The United Nations Educational, Scientific, and Cultural Organization (UNESCO) (1997), The United Nations Sustainable Development (UNSD)—Agenda 21 (1999), The World Bank (1999), and Prescott-Allen's (2001) national rankings of wellbeing, emphasize the same central ideas—that *sustainability* consists of those conditions wherein all humans live healthy and productive lives in harmony with the natural world on Earth; it is based on a sustainable environmental ethic in which we do nothing to our environment (in the widest sense of the word) which would make life more difficult for future generations.

The geographer Simmons (1993) reminds us that it is important to bear in mind that sustainability is an amorphous goal rather than a definite state to be attained through specific measures.[2] Determining desired future conditions for nature—or sustainability—is frustrating, because "nature," as discussed above, is a socially constructed and infinitely complex concept. Both of these characteristics make it difficult to define and discuss (Olwig 1995, 1996). For this thesis, I build on the definition of *sustainability* above, to include those conditions which foster the continuation of many species, as well as a relatively stable climate supporting human

[2] With this in mind, when I refer to *sustainability goals*, I refer to the small steps in a dynamic process, not to an overarching, static sustainability goal.

life. *Sustainable behaviors* are those human activities that promote these conditions. Because humans have control only over some aspects of climate, e.g., over human-induced climate change, this study focuses on aspects of the natural environment over which humans have some control. I use the term *sustainability* rather than *sustainable development* in this thesis because, as Reid et al. (1992) point out in their comprehensive report on biodiversity, and Takacs (1996) and Redford et al (1992) discuss in their books on biodiversity, the latter term is thought by some to be an oxymoron. Development, they would say, inevitably threatens sustainability by reducing biodiversity. According to conservation biologists Ehrlich and Ehrlich (1992, 225), if development continues to proceed at its current pace, "we can kiss goodbye to most of the world's biodiversity, and perhaps civilization along with it."

Many natural scientists consider the preservation of biodiversity necessary for achieving the level of sustainability defined above. There continues to be some debate about the importance of biodiversity to sustainability, as discussed for example in Burrows' (1990) text on vegetation change. Debate also continues regarding the details for achieving sustainability, such as how many and which species need to be preserved, for example. I use the term *biodiversity* interchangeably with *sustainability* for this thesis, however, because I make numerous references to the ideas and quotations of certain biologists and environmentalists, as well as to the Takacs (1996) study, which draws heavily from interview data from conservation biologists. Most of these biologists and environmentalists framed their ideas about sustainability in terms of biodiversity. I do not, however, use these terms interchangeably with *environmentalism*, *environmental ethics*, or *environmental* issues. These latter terms can include such environmental issues as lead paint contamination of young children—an issue that is quite important to sustaining the health of human children, but is not directly relevant to biodiversity. When I refer to environmental ethics and related terms in this thesis however, I am referring to concerns that are directly relevant to biodiversity—and to sustainability.

In this thesis, *objective, scientific ways of knowing* refer to those ways of understanding that use logic and objective observation of phenomena, especially in

conjunction with the scientific method. *Non-objective ways of knowing* call on the emotions and a sense of spiritual or personal meaning, understood in both verbal and non-verbal ways. The phrase *ways of knowing* refers to the idea that there are different modes of perceiving, interpreting, judging, and comprehending the world or information about it, an idea originally developed by Belenky et al. (1986). Belenky et al. analyzed and coded 135 in-depth interviews that asked women about ways of knowing and related moral dilemmas. Morse (1995), who conducted in-depth interviews with a number of women scientists, built on Piaget's (1965) research on the child's development of language, and Kohlberg's (1981) studies on the psychology and philosophy of moral development. Morse points out that Belenky's definition is based on the assumption that individuals understand the world through different frames of reference, employing both verbal and non-verbal symbols, and ranging from the subjective and personal to the logical and objective. These different frames of reference can include the knowledge gained through (1) separation from the thing being examined, in which the individual is oriented toward abstract laws, universal principles, impersonal rules, reason, systematic analysis, and procedures such as scientific method standards and techniques—and (2) connection to the thing being examined, in which the individual is oriented toward personal understanding, intuition, interrelationships, context, emotions, and a morality of responsibility and care for the objects of study. Shepherd (1993), a biochemist and writer about more inclusive ways of knowing in science, notes that an individual can asses information for different purposes—for understanding and acceptance, or assessment; collaborative discourse, or debate; tolerance for internal contradiction, complexity, and ambiguity, or reliance on a set of objective rules (Piaget 1965; Kohlberg 1981, 1984; Belenky et al. 1986; Simmons 1993).

Most theologies define *spiritual* in terms of a belief in a universal force or deity external to—or extending beyond—ourselves, the existence of which is not provable. For this thesis, I am interested only in the aspect of spirituality concerned with the sense of there being more to life than that which can be measured, and with the sense of meaningful connection to something beyond the self. Things that inspire people to feel

such a connection are not necessarily spiritual—political ideologies do this, as do most moral philosophies. A sense of spiritual connection to something—even something as amorphous as "life" or as immeasurable as "God"—is non-economic, and non-quantifiable. It may incorporate objective observations, but combines these with non-objective ways of knowing such as a deeply felt personal meaning, awe, reverence, and even commitment and responsibility. While acknowledging that not all personally meaningful ways of knowing nature would necessarily motivate sustainable behaviors, my interest in this stems from the idea that a meaningful commitment to ecological sustainability requires a sense of connection to the Earth as a whole, beyond the self. I use the word *spiritual* interchangeably with the term *personally meaningful*, because some people—but not all—understand personally meaningful commitment to the greater good in terms of the spiritual. I also use the word *spiritual* because I hope it eliminates the more crass material or economic aspects of personally meaningful ways of understanding nature—meaningful to one's career in natural science, for example, or to one's financial prospects and prestige.

Relevance to Geography: Overview of the Literature

Human geography is virtually defined as the study of the ways humans create place and their position in that place, as the writings of Yi-Fu Tuan (1991), one of the most influential scholars in geography, make clear. Historically, geographers were concerned only with physical space, but in recent decades they have also looked at how that space is conceptualized, as described in Soja's (1997) writings on postmodern geographies. Some literature by geographers such as Tuan (1974a, 1974b; 1991, 2001), Rose (1992), Soja et al. (1993), Berg (2001), feminist geographers Bondi and Domosh (1992), and Seager (1993)—and those who have influenced human geographers, including feminist theorists such as Hartsock (1983), hooks (1990), Butler (1993), Meis et al. (1993), Haraway (1996), and others discussed in Soja (1997)—is more specific in examining the power implications of the way people position themselves in these conceptualized—or non-material—spaces.

One way people position themselves in this non-material space is to

conceptualize themselves in some position relative to nature, such as the position of powerful observer standing above nature, or the position of cooperative participant in nature. Rose (1986), in her consideration of a feminist epistemology for the sciences, along with Merchant (1980), Haraway (1986, 1991, 1996), Shepherd (1993), Takacs (1996), and Berg (2001), address ways a researcher positions himself relative to the research subject, and consider how this imaginary position is based on his way of thinking about the world. Haraway, for example, considers the hegemonic, top-down view of nature in her studies of twentieth-century primatology. From this position, the subject of research is at the disposal of the researcher, and he is freed from any responsibility for the subject.

A viewpoint in which the researcher assumes a primarily equitable position in relation to nature will result in a different—and potentially more connected, personally meaningful, equitable, and responsible—position relative to nature than that of a hegemonic, top-down position in which the researcher assumes power over—and distance from—nature. There are numerous critiques of the hegemonic position assumed by many natural scientists, including Keller's (1983) exploration of the life of award-winning geneticist Barbara McClintock, Keller's (1985) and Fee's (1986) feminist critiques of science, as well as Merchant (1980), Haraway (1986), Rose (1986), Orr (1992), Shepherd (1993), Takacs (1996), and Berg (2001). Only a portion of this literature—Keller, Haraway, Shepherd, and Takacs—examines the more equitable position in real world situations. Takacs and Shepherd maintain that this equitable view is necessary for achieving sustainability goals, and call on the natural scientist to balance her distanced, objective view of nature with a view that acknowledges her connection to the natural world. Takacs (1996, 8) describes this sense of connection as a "reverence" for fellow human beings and the natural world alike, a "feeling for life" that honors the equality between all species: "Solutions to environmental crises must be…generous and protective" to all.

Integration of different ways of knowing in geography research

A good deal of the literature in physical geography examines issues directly relevant to sustainability, but only from the objective point of view. There is very little literature in human geography that either examines the non-objective ways of knowing that natural scientists might bring to their objective observations of nature, or their views on the relevance of non-objective ways of knowing to sustainability. Rose (1992) critiques the geographer's tendency to marginalize non-objective perceptions of nature, but does not explore the relevance to sustainability of this way of knowing. I found no geographic literature examining the natural science discourse for the space given over to personally meaningful perceptions of nature. Within the discourse of *qualitative* research, however, feminist geographer Hanson (1996), Rose (1992, 1993, 1997), Bondi (1999) and Berg (2001), along with Tuan (1991), Monachan (2001)—in his overview of Tuan's work, and Widdowfield (2000)—in her discussion of the role of emotions in academic research, look at the creation of space for examining and discussing personal perceptions of the research subject.

Several geographers go on to discuss the integration in geography of objective and non-objective ways of knowing. Berg (2001) points out that all knowledge has space, and the space for knowledge about a particular subject can contain different ways of understanding that subject, different forms of knowledge. Rose (1992, 343) examines the distorted understanding of landscape that occurs when the geographer's view of landscape is strictly limited to the objective. She discusses the fear that non-objective views of nature will overwhelm the clarity of the objective view, posing "a threat to the [dominance of the] scientific gaze."

The protocols of fieldwork require an analytical distance, but "space/geography" is defined not by the all-knowing objective view from above, but by "complexity" —there are many valid views. Rose (1997, 159) calls for the researcher to view the subject of research from both the "inside and outside." She says ways of knowing are "more truthful" when they are multi-layered. Bondi (1999, 13, 20) adds to these arguments by calling for "an opening up of spaces for more diverse knowledges" in academic geography, and for the freedom to move "between different positions and

perspectives." She contends that the tendency to restrict "psychical spaces" has an influence on the processes of knowledge creation, and causes "important and productive experiences [to be] lost or denied."

Simmons (1993) examines the integration of objective and non-objective ways of knowing nature in relation to sustainability, but does not examine or suggest specific ways of knowing that would be conducive to sustainability. Instead, he warns against the quest for a Utopian, prescriptive set of specific sustainability goals. It is better to act sustainably in relation to the practical needs at hand, to focus on effective "processes," he argues, than to set up "some long-term and overarching aim" (Simmons 1993, 163).

Studies of Natural Scientists and Non-objective Ways of Knowing

While literature that examines environmental perceptions and attitudes is relevant to this thesis, it is useful only as general background. See the studies of spatial behavior, cognitive mapping and environmental perceptions by Hart et al. (1973) and Kitchin (1996). Sahu's (2002) paper, presented at The Conference of Women Scientists and Technologists, examines differences in perception between males and females, while Ford et al. (2001) presents a study of environmental perceptions as they relate to economics in tourism. See also Ladd et al.'s (1995) study on attitudes about the environment in the United States, as well as studies on the psychological aspects of concern for the natural environment by Dunlap et al. (1978), Dietz et al. (1998), Gagnon-Thompson et al. (1994), and Stern et al. (1994, 1999).

More directly relevant are the following four studies in which researchers interview natural scientists and others involved professionally or politically with conservation issues. Each study investigates attitudes about the sense of personally meaningful or spiritual connection to nature. While geographers did not conduct these studies, they are in some ways similar to my research, and so offer an opportunity for comparison.

Gorman's (2002) coverage of the twenty-fifth anniversary meeting of the World Wildlife Fund in 1986 considers the spiritual and religious dimensions of conservation, as well as the role of faith in the development of a conservation ethic. He describes the

integration of personal meaning with objective knowledge, rational analysis, responsibility for the common good, and practical action. Kaiser's (2003) article for *The Nature Conservancy Magazine* features her interviews with natural scientists and other professionals in conservation, and presents their attitudes about the importance of the sense of spiritual connection to nature in their work.

The Takacs (1996) and Richert (2001) studies examine natural scientists' non-objective ways of knowing nature as well as their opinions on how these ways of knowing may contribute to sustainability. Richert (2001) asked no specific questions about spiritual or personally meaningful ways of knowing nature, but instead allowed interviewees to define environmental quality in their own terms. Only a few mentioned anything about the spiritual, and these described it in terms of awe at nature's complexity. They talked about whether there is an ultimate purpose in nature, or whether nature is a creation of God, but not about whether spiritual or personally meaningful ways of knowing nature is a factor in achieving sustainability goals. One in Richert's group was dismissive of those who considered the inherent value of nature, calling the idea "silly." His description of humans as "the top dog species" indicates a view of nature from the hegemonic position described by Haraway (1996).

Takacs (1996) limited his study to conservation biologists, asking them about the values, including spiritual values, they thought were necessary to preserve biodiversity. Some interviewees maintained that biodiversity had spiritual value for humans. They emphasized that a sense of spiritual connection to nature was important to sustainability because it can inspire people to adopt sustainable behaviors. Several expressed the idea that biodiversity is inherently sacred, and maintained that a necessary step in the process of sustainability would entail the separation of nature's intrinsic value from the needs of humans. Many of his interviewees grappled with the tension between being dispassionate observers and being passionate supporters of the very thing they must chronicle dispassionately.

Restrictions against Non-Objective Ways of Knowing in the Discourse of Natural Science

Berg (2001) notes that impartiality and disconnectedness characterize the discourse of natural science. The researcher is expected to assume a transcendent position in order to gain a supposed detached and impartial perspective. This position vis-a-vis nature is thought to constitute the desired objectivity in opposition to the disdained subjectivity. In fact, what is created is a "false objectivity"—the illusion of being the only valid way of viewing the subject. This way of looking at the world is then supported by a set of norms, expectations, and accepted beliefs.

Several geographers point out the challenges of breaking through the assumption that objective knowledge is the only valid way of knowing (Rose 1992, 1997; Bondi 1999; Berg 2001). Simmons (1993) describes how, as a professor of geography teaching Environmental Thought, he noticed that most of his students had difficulty realizing there were other aspects to an understanding of nature and environmental issues than the facts provided by the natural sciences. Widdowfield (2000, 200) examines restrictions against emotional ways of knowing, noting that "discussing one's emotions appear to be perceived as illegitimate or irrelevant to academic debate."

Regulating personally meaningful ways of knowing through norms in natural science

Implicit regulations in natural science allow little space for expression of personally meaningful, non-objective ways of knowing nature, or for examination of how to integrate non-objective and objective ways of knowing. Conservation biologist Soule, in an interview with Takacs (1996, 165) notes that sanctions begin in graduate programs, where biology students are trained to think that "feelings obscure reality." The elaborately constructed reward structure of science is designed "to reward those who play by the rules that reinforce the social authority of science in society." This structure serves to regulate against those biologists, for example, who try to combine science with environmental activism, especially when they impugn the authority of biologists who are not activists.

Norms that enforce a split between the personal and the professional go to the

core of the challenge some biologists have long wrestled with—that of presenting factual information about the natural world in such a way as to convey to the public their deeply felt concern about its future. For example, there can be severe professional sacrifices involved when scientists challenge the status quo, and break through accepted boundaries of the profession to speak out passionately for biodiversity. Some choose career safety over "rocking the boat," first establishing a position from which they might later advocate more effectively for biodiversity issues. Wilson noted that he waited until he had won prestigious awards in science before he spoke about his values regarding biodiversity. He had felt it was too risky to speak out earlier, even though, years before, he had seen "the desperate need for scientists to get involved in a more activist role." "If a scientist...becomes an activist at thirty or thirty-five, before they've built a reputation as a scientist, then they lose credibility rapidly…If you build a reputation as a scientist on into middle age, then your credibility is much less at risk" (Takacs 1996, 168). But Orians, a conservation biologist and another of Takacs' (1996, 175) interviewees, argues that while it is necessary to establish standards in balancing credibility risks with advocacy, "there's no reason that because I'm a scientist I've forfeited my right to feelings, or to advocate.

Restrictions to protect the authority of science

Regulation in natural science represses expression of passionate—emotional, non-objective—advocacy for biodiversity, in order to preserve the reputation of science as the main authority of objective observation. This reputation "is a very precious thing. And you don't want to undermine it [science] and its credibility in the public mind" (Takacs 1996, 174). Lincoln et al.'s (1985) examination of qualitative research methods notes that to maintain credibility, the scientist must maintain a balance between falling too far into advocacy—or even indoctrination—on the one side, or becoming too restrained by the norms of science on the other.

The penalties attached to espousing one's deeply felt views are also in place to maintain the elaborate structure that has proven to be very successful in attaining power, authority, and resources for the

enterprise of science, comfortable careers for its practitioners, freedom from close scrutiny from the public, and the power of being accepted as a dominant and authoritative force in society. But Longino (1990), a philosopher of science whose writings consider the social context of scientific practice, points out that what is deemed subjective or objective, relevant or irrelevant, acceptable or controversial, unprofessional, or unscientific, is not immutable, because the meaning of each of these concepts is socially constructed. In order to prevent threats to the success and power that science enjoys, restrictions must be firm. Harsh penalties must be charged against those who would act to challenge the meaning of these malleable categories and thus threaten the place of the natural scientist in society (Takacs 1996).

There is a high value placed on maintaining the status quo in natural science—as there is in many fields. Kuhn's (1962) landmark examination of scientific revolutions points out that resistance to change can be wise or myopic. Mayr (1982) notes that the occasionally overblown value for maintaining the status quo in science is sometimes maintained by intolerance for different ways of knowing that are not necessarily non-objective but rather just outside the box of accepted paradigms. This intolerance may be linked to preserving perquisites that scientists, as a class of people, enjoy.

Development of the norm of objectivity in science

Western science has long relied on objective observation as a way of understanding the natural world, although, throughout the history of humankind, subjective perceptions have influenced objective observations about the natural world. A brief historical overview seems to indicate, however, that there has been no period in Western science in which non-objective ways of understanding nature were *consciously* integrated with well-tested observations. It appears that, in general, the unconscious influence of subjective perceptions distorted scientific observations, even when these perceptions were deemed to be excised from science (Longino 1990). While the claim that science is free of subjective bias has been critiqued in depth in recent decades, a brief consideration of the historical development of norms in Western science can

contribute to an understanding of current norms in natural science, particularly in regards to the hegemony of objectivity.

As humans, we all understand our world in non-objective as well as objective ways. Early humans are thought to have invoked supernatural beings and forces in their explanations for natural phenomena, according to Glacken's (1967) and Oelschlaeger's (1991) monumental historical survey's of human's relationship—and ways of thinking about that relationship—with nature, and White's (1967) influential scholarly essay "The historical roots of our ecologic crisis." Shiel's (1968) examination of the rise of Greek rationalism maintains that within early historic times, the teachings of Socrates, Plato, and Aristotle represented a conscious attempt to break from primitive attitudes into a disciplined acquisition of knowledge. Influences from explanations based on stories of divine beings were still apparent in these pioneers of rational thought, however, in the form of the tension between Dionysian and Apollonian elements in Greek culture[3] (Oelschlaeger 1991). Although the writings of Aristotle (384-322 BC) provided a rational framework for the examination of natural phenomena, they nonetheless reflected the thinking of his time—as does science today—with its bias against the subjective and the reification of the rational. In his cosmology of observation and reason, order was seen as pervasive and hierarchical. Aristotle deemed the celestial region to be eternal and immutable because he believed he observed the absence of "corruption" in that realm. He equated the heavens with reason and purpose. He maintained that the superior should be separated from the inferior as far as possible, just as the heavens are separated from the Earth. He genderized the superior faculties of reason and deliberation, theorizing them as male—and superior to the human qualities he theorized as female, e.g., emotions, receptivity, and cooperation. He furthered this split by condemning "female qualities" (and females) to an inferior position, claiming that "the relation of male to female is naturally that of the superior to the inferior—of

[3] In ancient Greek culture, devotion to the worship of Dionysus was characterized by the ecstatic or irrational, frenzied or undisciplined. Clarity, harmony, and restraint, in contrast, characterized the cult of Apollo. In the philosophy of Nietzsche, the Dionysian refers to creative, intuitive power, and the Apollonian to critical-rational power (American Heritage Dictionary of the English Language, 2000).

the ruling to the ruled" (Shepherd 1993). Bias against these non-objective qualities continues to dominate Western thought (Merchant 1980, 1996).

During the middle ages of Europe, explanations of natural phenomena were limited to interpretations of divine word. Objective observation and rational thought were restricted to that which did not challenge the Bible, at the time considered to be the ultimate authority on all matters (Oelschlaeger 1991). The Church and aristocracy served to reinforce this authority—as a means of preserving their political power. Lovelock's (1979) influential book on new ways of conceptualizing nature describes how the Church emphasized the God-given right for humankind to dominate nature, based on Biblical teachings. In general, a sense of spiritual or personally meaningful connection to nature was not included in church teachings. While there were rare individuals, e.g., Francis of Assisi (1182-1226), who saw humankind as equals with other life-forms in a natural world imbued with "the Creator's presence," the medieval mind in general conceived of nature as an transitory earthly home over which humankind had been given dominion by a beneficent God (Oelschlaeger 1991). If a dominant idea existed, it was that Nature had to be tamed, brought into harmony with a divine order through the God-given ability to work for the purpose of bringing forth God's earthly gifts for the sole benefit of humankind. Nature existed primarily to reveal the glory of God. Salvation of the soul, however, was the ultimate goal (Glacken 1967).

The Enlightenment

Thomas Aquinas (1225-1274), although he was a follower of Aristotelian thought, began to articulate the distinction between faith and reason, and was primarily responsible for opening the way for scientific revolution. This precipitated the erosion of mystical faith in things unseen and even illogical, i.e., the entire mythology of Judeo-Christianity (Oelschlaeger 1991). Challenges to teleological orthodoxy gained momentum in the seventeenth century, even at the risk of execution. The work on heliocentrism by Nicholas Copernicus (1473-1543) was published after his death, due to the extremely repressive intellectual and political atmosphere of the time. Galileo Galilei (1564-1642), who further developed the heliocentric theory of Copernicus and eventually came to be seen as a champion of the critical spirit and the freedom of

inquiry, had to take similar precautions. Although he knew his assertions on heliocentrism were logically consistent and corroborated by physical evidence, he was forced to recant when brought before the Inquisition and threatened with excommunication for the heretical implications of his work (Oelschlaeger 1991). Cushing (1943), Blackwell (1993), Gura (2002), and Shepherd (1993) describe different aspects of the dark history that spiritual beliefs have had in restricting and repressing science; Oelschlaeger notes how this history has exerted an influence over the way science has developed since the Enlightenment

Galileo, a radical thinker for his time, continued the process of separation of science from religion initiated by Aquinas, although Galileo considered his science work to be an inseparable part of his religious beliefs, not an alternative to them. "[I]n the discussion of natural problems we ought not to begin at the authority of...Scripture," he said, "but at sensible experiments...For, from the Divine Word the Scripture and Nature did both alike proceed" (Mayr 1982, 22). As science began explaining more and more phenomena in terms of natural laws instead of divine intervention, the schism between science and theology gained momentum. Since religion required only belief, not proof, science had to break from the prevailing religious and spiritual tradition of the times in order to create scientific knowledge.

Galileo led the way into the scientific revolution through his use of a scientific instrument, the telescope. Instrumentation is now essential to research and the acquisition of scientific knowledge (Oelschlaeger 1991), but the use of such instruments both amplify and reduce the senses, placing the user in the position of objective observer outside nature. Nature began to be seen as a theoretical object of inquiry, not as a sweep of stars across the sky (Oelschlaeger 1991). The attitude that humans were meant to have dominion over nature still held; the sense of moral responsibility for nature, or spiritual connection with nature, was yet to develop.

Bias against such subjective attitudes toward the natural world dominated scientific views from the beginning of the Scientific Revolution. Henry Oldenburg, one of the chief promoters of the Royal Society of London, which was formed in 1662 as one of the first scientific societies in Europe, maintained that truth does not have a chance

when “the Affections wear the breeches and the Female rules.” The ideal scientist was unemotional and detached. The business of the society was “to raise a Masculine Philosophy...whereby the Mind of Man may be ennobled with the knowledge of solid Truths,” as Oldenburg wrote in the Society’s first professional journal (Shepherd, 1993).

The enormous changes in science brought about by seventeenth century scientists replaced the medieval view of an organic, living, and spiritual universe with the reductionist view, which conceptualized nature as a vast mechanism with individual, separate, and moveable parts. This way of thinking guided all scientific observation and the formulation of all theories of natural phenomena until twentieth-century physics brought about radical change (Shepherd 1993).

Mumford (1970)—internationally renowned writer on technology, philosophy, utopias, and modern life—and Orr (1992) discuss how the reductionist view was accompanied and assisted by the urge to dominate nature, the position of separate observer detached from the machine of nature (Mumford 1970; Orr 1992). This sharp demarcation comes out of the mind/body distinction of Cartesian thought, in which Descartes separated the knower—the active scientist—from the known, that is, the passive object being researched. Berg (1994), along with social theorist Seidler (1994), feminist theorist Bordo (1986), and feminist geographer Longhurst (1995), maintain that this philosophy served as the basis for perceiving the Body as part of nature, to be completely transcended by the Mind, the detached observer of nature. In the discourse of objectivity, both space and the objects of knowledge—and hence the natural world—are to be transcended (Keller 1985). This view, as put forth by the founders of modern science—Bacon, Galileo, Newton, and Descartes—excluded the significance of nature, and thus contributed to the demise of the medieval world view of nature as organically and spiritually interconnected.

Although the experimental approach liberated science from many of the unfounded assumptions and doctrines of Aristotle and those based on faith or superstition, science continued to reflect the ideal of objective, rational, logical, linear thinking. The perception of the world as mechanism, held by those in positions to

influence the way we understand nature, traded the "totality of human experience…for that minute portion which can be observed within a limited time span and interpreted in terms of mass and motion" (Mumford 1970, 57; Orr 1992, 12).

Early nineteenth-century British biology

Rehbock (1983), a specialist in history of science at the University of Hawaii, has examined the roots, development, peak, and central figures of a significant movement in philosophical natural history in the period from 1800 to 1860. He notes that by the early nineteenth century in Britain, biologists were beginning to turn from a teleological explanation of life, in which all of life was explained in terms of "God's creation," to the more physical perspective of genetic explanations. This major intellectual shift in focus transformed the life sciences from the practice of identifying, describing, and classifying species, into the search for a unifying body of theory.

Natural scientists in this formative period were interested only in classification of species and theory formation. Rehbock (1983, 9) makes no mention of spiritual or personally meaningful connection to the subject matter. His account describes only the conquering hero of intellect, setting out confidently to discover "the laws of life itself," without consideration as to how this process might involve the emotions, morality, or a sense of responsibility to nature.

Also during this formative period, natural scientists began looking for "ideal patterns" manifested in the morphology and distribution of organisms (Rehbock, 9). This seems to be a way of co-opting the "God" mode, playing the "god trick" of claiming to know the answers to life (Haraway 1996). The spiritual was no longer in the form of a male god, separate from nature, but instead took the form of the transcendent ideal, the intellectual explanation. It did not take the form of spiritual or personally meaningful connection between humans and the rest of physical life.

While natural scientists respected the vast complexity and intellectual challenge of life, they did so with the removed gaze of the objective observer, not the personally involved gaze of an equal partner (Haraway 1996). Natural scientists did not consider creating a legitimate place for both the subjective and objective perspectives. They did

not discuss ways to look at the world from "within," from a perspective in which they could see themselves as connected, physically and emotionally, to the natural world.

Darwin and the end of supernatural explanations of nature

When Darwin's *Origin of Species* was published in 1859, it refuted natural theology with Darwin's explanations of natural phenomena in terms of competition, adaptation, and co-evolution. Simultaneously, Darwin's theory of natural selection implicitly refuted a teleological view of nature—the new scientific view of nature did not follow that of the natural theologian's view of a world controlled by God and governed by God's laws (Mayr 1997). When these advances in biological theory led to the loss of a belief in God, it left an existential vacuum along with unanswered questions regarding the meaning of life.

From Darwin's time to the present, much of the literature on the relation between ethics and evolution has been devoted to a search for a 'naturalistic ethics' to replace a supernatural explanation of human morality with a naturalistic one. This is an extension of views from the Enlightenment to the present, in which leading thinkers felt strongly that natural science—biology in particular—"should not be merely a destroyer of traditional values but also the creator of new value systems" (Mayr 1997, 250). Some biologists contend that all biologists hold a deep value for life that is akin to religious reverence, albeit a "religion without revelation," as described by biologists and science writers Huxley (1927) and Mayr (1997, 80). In Worster's (1985, 338) *History of Ecologic Ideas,* he calls for an "ecological ethic of interdependence," a "marriage" of ethics and ecological science that grows naturally out of the way that biodiversity "embodies and generates moral principles."

Twentieth century science

After centuries of dominating science—and especially after the refutation of teleological explanations of nature—the mechanistic way of knowing nature has come to thoroughly define the culture, philosophy, and rules of the science profession (Shepherd 1993). While science serves as a specific way of looking at the world and its inhabitants—a systematized method to understand the complexities of nature—Fee (1986) and Morse (1995), along with feminist philosophers Harding (1991) and Tiles

(1996), argue that this presumably neutral way of looking at nature has been cloaked in the qualities valued by those who have dominated science. The scientific-technological revolution of the twentieth century came to embody the hegemonic perspective of the detached observer, as described by biochemist and philosopher Chargaff (1980), as well as Keller (1985) and Berg (2001). Although this view of nature is being challenged by the theories of quantum physics, Heisenberg's uncertainty principle, and others, scientific knowledge continues to be restricted to the rational, linear, logical, and objective (Berg 2001). While some critiques of science in recent decades have resulted in a general acknowledgment among scientists that scientific knowledge is not free from bias, the acknowledgment has so far been quite limited in its application. Ways of understanding nature through the personally meaningful, the emotional, or the spiritual, are still assumed to have no place in science or intellectual thought (Shepherd 1993).

Changing the Role of Scientists to Promote Social Change for Sustainability

Wilson and other natural scientists contend that the role of science—and the role of the scientist—need to change.[4] Science is central to the production of knowledge about the Earth; this knowledge is a key influence over the way we know and value the Earth. How we think about and value the Earth is in turn a key influence over the societal changes necessary for sustainability. Because the perceived boundaries of science are constantly redrawn by individual biologists involved in the ongoing "negotiations about what science is or should be…What scientists actually do is...what scientists actually do" (Takacs 1996, 171). The work of a conservation biologist can include such common activities as writing for the popular press, lobbying legislators, or managing nature reserves—activities beyond their central role of generating and testing hypotheses.

Takacs (1996, 9) maintains that many conservation biologists are already working to redefine the traditional "boundaries of science and politics, ethics and

[4] Wilson clarified that it is the role of science—*not* the scientific method—that needs to change, or "expand" (Takacs 1996, 164).

religion, nature and our ideas about it"—and values for it—when they integrate their objective and non-objective ways of understanding nature to advocate for biodiversity. Rasmussen's (1996) award-winning book on environmental ethics presents a similar argument. Advocating combines the conservation biologist's personally meaningful sense of connection to nature, passion for biodiversity, and dispassionate, objective knowledge. By reaching people on multiple levels, conservation biologists aim to gain enough of people's affection and allegiance to motivate them to make effective changes to conserve biodiversity.

When scientists redefine their role, they renegotiate the position of science in society. This renegotiated position must be based on a clear identification of what works in an expanded role of science (Takacs 1996). One crucial step would involve making space for the examination of better communication techniques with the lay public, techniques that more effectively educate the public about scientific findings and how these findings support, or not, a stance of activism on behalf of biodiversity. Soule, Noss, and Ehrlich, in their interviews with Takacs (1996), maintain that scientists are in an excellent position to inspire people to adopt sustainable behaviors by appealing to their sense of spiritual connection to nature, a sense of connection that they observe is widespread. Ehrlich (Takacs 1996, 269) suggests creating a "quasi-religion" based on the conservation of biodiversity, to bring public attitudes beyond the rather ineffective sentiment described by Ladd et al. (1995), to a deeper, more authentic, and more effective level of commitment to sustainability.

Although some natural scientists are not at all religious, do not accept popular interpretations of *spirituality*, and may even consider many religious beliefs preposterous, some of these scientists nonetheless acknowledge the validity of the unexplainable, and are confident that spiritual beliefs are useful tools. Sustainability, says Ehrlich (in Takacs 1996, 258), is interwoven with "our basic feelings towards each other and towards the planet, and that's not something that falls within the realm of science. I can't convince you scientifically that it would be a good thing for your soul to enjoy nature and feel responsible for it and so on." Ehrlich (1985) asserts that the

task of biologists is in part to encourage the feeling of spiritual connection, to provide the sense of wonder that religion provides for many.

Another approach to the interweaving of the spiritual with biodiversity is the incorporation of the value of biodiversity into traditional religions. Natural scientists who are proponents of biodiversity "lend the imprimatur of science to spiritual arguments that have a history of resonating with the public" (Takacs 1996, 256). This brings the phenomenon of spiritual connection to nature full circle, from its pre-science origins to its current process, wherein scientific knowledge is being integrated into something larger than science, something more fully human.

Peter Brussard, one of Takacs interviewees and a conservation biologist at the University of Nevada, maintains that creating changes in people's attitudes towards nature requires a multifaceted approach, and recommends indulging many people's need for spiritual or religious values by helping people experience biodiversity in a religious or spiritual way (Takacs 1996). Ehrenfeld (1986, 43) calls for "fallible scientists" to open their minds to the validity of different ways of knowing nature, and to no longer "despise" religion and emotion. "Within the purview of religion," he says, "are several very different ways to celebrate diversity—some invoking God and some not."

Encouraging the formation of effective conservation ethics in society need not be limited to expanding the boundaries of science. Noss calls for greater transparency about the content within current boundaries. Most biologists experience a sense of "spiritual or…nonrational connection to nature," Noss contends, but professional and social norms of science discourage acknowledgment of this way of experiencing nature (Takacs 1996). Many natural scientists admit to privately held views of nature that would be considered unscientific, biocentric, and even devotional. Most will not admit this publicly, however, particularly those who are concerned about their status as objective observers.

Takacs (1996, 11) notes that because these non-objective values and feelings are not sanctioned by the norms of science, scientists present another set of values to the public, values that are based on "more anthropocentric, utilitarian, scientifically

respectable rationales." This does little to evoke personally meaningful values for biodiversity in the public. Most of his interviewees described deep feelings they could not explain, but that imbued their lives with meaning, inspired them in their professional activities, and made them passionate conservationists. Some of these biologists labeled such feelings *spiritual,* or noted that these feelings fall outside the boundaries of science. Others contended that such feelings are an embedded feature of science, and indeed provide the motivation that drives science.

Noss, Takacs, Wilson, and Soule all call for the role of scientists to expand beyond facts, predictions, and policy prescriptions, to encompass the moral aspects of conserving biodiversity (Takacs 1996). Their message has earned credibility because each had a lengthy history of providing objective knowledge, hence their message resonates with the general public in non-objective but deeply meaningful ways. Norton (1995, 1998), a writer in philosophy, biology, ecology, economics, and ethics, and Worster (1985, 1990) point out that while society has long given scientists the cognitive authority to supply us with our objective knowledge of nature, we also look specifically to ecologists to provide what could even be called moral guidance, to take us beyond immediate concerns such as avoiding bad weather, to more overarching concerns such as determining the behavior changes needed to insure the survival of future generations.

Simmons (1993), Takacs (1996), and Mayr (1997) contend that the ethical norms of both the general public and the scientific community need to be flexible enough to effectively address environmental problems as they appear, while maintaining a foundation of values that hold the community of life—humans as well as other lifeforms—in higher regard. Often such ethical norms are difficult to activate because they involve changing deeply rooted but short term and selfish values. Yet most religions and other ethical codes have long avoided the concept that humankind has a responsibility toward nature as a whole. Implementation of environmental ethics will require a long period of education for everyone, accompanied by an enormous shift in values (Mayr 1997).

Drawbacks of an exclusive reliance on objective knowledge

Ehrenfeld (1970) contends that when science clings to its claim of value-free neutrality, that is, when it does not make a clear and accepted space for values and other non-objective ways of knowing, by default it becomes co-opted by economic values. Berry (2002) and Wilson (2000) maintain that it is folly—even insanity—to marginalize the spiritual and other personally meaningful ways of knowing from sustainability issues. Berry (2002, 21) argues,

> It is often proposed, nowadays, that if we would only get rid of religion and other leftovers from our primitive past and become enlightened by scientific rationalism, we could invent the new values and ethics that are needed to preserve the natural world. This proposal is perfectly reasonable, and perfectly doubtful. It supposes that we can empirically know and rationally understand everything involved, which is exactly the supposition that has underwritten our transgressions against the natural world in the first place.

Ehrenfeld warns that the restriction of values to the purely intellectual sphere in science is having disastrous results—"our overweening faith in reason (epitomized by the twin gods of economics and science) and our scoffing at emotion, at nonrational ways of knowing, are killing us and biodiversity" (Takacs 1996, 285).

Deep ecology

In considering the role of spiritual ways of knowing in natural science, it is useful to examine natural scientists' opinion of the deep ecology movement, because these opinions reflect the norms of science, as well as attempts to change these norms. According to deep ecology writers Naess (1973, 1986, 1990), Tobias (1985), Devall et al. (1985), and Foreman et al. (1987), deep ecology is a philosophy centered on the idea that nature is intrinsically sacred—biodiversity is the central tenet of their beliefs—and combines actions supportive of sustainability with objective and non-objective ways of knowing nature. Takacs (1996) contends that aspects of this philosophy can be found in the research and writings of many scientists that support biodiversity, whether or not they are aware of this connection. Some natural scientists are loath to associate themselves with deep ecology. Some find their extremist tactics and ideology

distasteful, while others are reluctant to discuss deep ecology ideas publicly because they feel they must preserve the separation between rational science and intuitive emotion (Takacs 1996).

Soule rejects the dualistic view that separates intellect from emotion, and advocates instead for the personal identification with nature—a central concept of deep ecology—rather than the detached, dichotomous position of the unemotional observer. He observes that many biologists reject deep ecology because "these are concepts which have nothing to do with science as it's routinely practiced in the minds of most scientists in their laboratories…they consider it to be subjective, emotional, mystical" (Takacs 1996, 268). He explains the difference between a movement, like deep ecology, and a discipline, like conservation biology, saying, "A movement requires emotion." In contrast, we think of a discipline as requiring only objective knowledge. Soule calls for more permeable boundaries between the movement and the discipline, more honesty and transparency about the values that most conservation biologists already hold. This would make their work more accurate and holistic, while "laying their values bare for others to emulate."

Integration of Varied Ways of Knowing in Science

Kellert (2002), a social ecologist at the Yale University School of Forestry and Environmental Studies, and Farnham, co-editor with Kellert of a book based on the May 2000 conference held at Yale University that looked at creating an environmental ethic by comprehending and strengthening the bonds between spirituality and science, address the need for an integration of spiritual with objective ways of knowing nature in forging an environmental ethic. They contend that society's environmental and spiritual crises can neither be understood nor effectively resolved until the split between scientific and spiritual understandings, or faith and reason, is effectively integrated into an ethical sensibility capable of dealing with the global environmental crises we now face. Neither science nor religion, when considered alone, can do this adequately. Both represent ways we seek to create an ethical relationship with nature and creation. Kellert and Farnham question the division between empirical and faith-based or

spiritual modes of inquiry, while noting fundamental language and communication barriers that impede reconciliation between these two approaches.

At the core of the current division is the apparent opposition between the spiritual, based on faith, addressing the profound questions about life—often unknowable and immeasurable—and empirical science, based on observation, and addressing only the knowable—yet also profound—questions about life. Realistic concerns arise when considering extremes of each mode of inquiry. Orr (1992) and Berg (2001) contend that science often claims a hegemonic perspective, purporting to explain every aspect of life with an excessive focus on the mechanical and physical properties of the world, a reductionism critiqued by philosopher Dupre (1993), and described by biologist Wilson (1984) as "science run rampant." Kellert (2002) notes similar reductionist tendencies in formalized spirituality. Religion has at times lost its relevance to today's serious problems when its stance has become inflexible and doctrinaire. Religion can sink into an extreme that eschews analysis and leaves little room for discovery and innovation, while science can tend to overanalyze.

Humans have long employed both religion and science in order to understand the world that we experience. Both have deep-seated roots in the human psyche, and serve to imbue life with deeper meaning. The laws of science, says Pulitzer Prize winner and scientist Dubos (1972), can lead us to deeper revelations about life, enriching our understanding of the world in a way that is just as important to us as our myths, spiritual and otherwise.

As science has developed a greater knowledge of the connections between living things and their environments, there is the potential for some convergence between scientific and spiritual thought. Scientific knowledge about complex ecological systems reveals global networks of interdependent relationships, which leads us to consider how our actions affect the rest of the natural world. Perschel (2002), a consulting forester and director of a wild lands program for the Wilderness Society, and Kellert et al. (2002), maintain that science, in its objective examination of the physical universe, need not lessen the value of non-objective ways of knowing life, but can instead function as a crucial component in an environmental ethic which integrates scientific knowledge with

moral and spiritual wholeness, that is, with a personally meaningful connection and commitment to the greater good.

Kegley (1997), ethicist and Professor of Philosophy at California State University, explores the idea of commitment to the greater good in her explanation of the views of the nineteenth-century philosopher Josiah Royce (1855 – 1916). Royce's ideas are applicable here because they offers a guide for responsibility between individual and community, and would be valuable in shaping a "public philosophy" that addresses social problems and is applicable to public policy. We create a public philosophy by creating a sense of public community through shared meaning and ideals. Through this public community we then address social issues that exert significant impact on both the individual and the community. Kegley applies Royce's ideas to discussions concerning the ways we care for ourselves and our world. Current social issues need not be viewed as mere political footballs—most issues, such as education, health, and environment—are deserving of genuine and dedicated concern. Bell (2001), in a discussion paper on Royce's "Philosophy of Loyalty" at the annual meeting for the Society for the Advancement of American Philosophy, notes that these views are enormously applicable to environmental issues, in that they require that our actions support the natural world rather than oppose it.

Royce's philosophy of loyalty calls for our ethics to be directed toward unification between ourselves and the larger community, the community consisting of other beings – both other humans and other species. For Royce, the individual and the community comprise the two interwoven and inseparable strands of life. We define ourselves as individuals through our ties to the community, that is, through our communal ties with other individuals. The unification of many into one has a superpersonal aspect to it, in that it is more than the many private, separate individuals it joins. Simultaneously, this unification has an intensely personal aspect, in that it is composed entirely of individual selves. Loyalty to the community and responsibility to the greater good provides us with individual purpose, and "make of us conscious and unified moral persons" (Royce 1995, 80). Our social purpose and our individual purpose are united by a loyalty that reflects our "practical faith that communities,

viewed as units, have a value which is superior to all the values and interests of detached individuals" (Royce 1995, 85). Rensch (1971), in his discussion on "biophilosophy," frames this idea in terms of fitness, noting that it might well contribute to one's own fitness to work for the improvement of society as a whole.

Benefits of integrated ways of knowing

Because many conservation biologists say they experience a non-objective and personally meaningful sense of connection to nature, Takacs (1996) suggests that a more candid interweaving of their deep caring for biodiversity into their objective observations may be one of the most effective ways for conservation biologists to evoke a deeper response from the public. Many religious teachings can foster a moral vision and values for the environment. Fowler's (1995, 145) examination of environmental activism in Protestant religions, cites as an example the Protestant ecological movement, which calls for a "new consciousness," a meaningful change in values, for the purpose of "helping the environment survive." While not everyone subscribes to religious or spiritual views, Gorman (2002) notes that such views "move millions." He warns, however, that when groups place more importance on their theological differences than on common sustainability goals, or when they become too caught up in vague "spiritual" ideals, they can be sidetracked from finding practical ways to translate their spiritual or religious beliefs into effective environmental action.

Evolutionary Fitness and the Construction of Meaning: Myth and Sustainability

Kellert (2002), along with biologists Iltis, Wilson, and Eisner, interviewed by Takacs (1996, 266)—consider the religious or spiritual way of knowing to be an evolutionary adaptation that is "ineradicable," and express their ideas in terms of evolutionary fitness. In other words, the human tendency to cast survival concerns in spiritual terms, whether those concerns are centered around biodiversity conservation, short term food supply, or fears of death, is actually a biologically adaptive human trait. Kellert connects the concept of evolutionary fitness to environmental ethics, describing

certain values of biophilia[5] that can contribute to an ethic of care and responsibility for the natural world. This would produce an ethic that would be richer and more meaningful than one based solely on utilitarian or even moral perspectives. He notes that, particularly to the evolutionary biologist, "issues of human morality, ethics, spirituality, and religion are relevant insofar as these inclinations and behaviors enhance an organism's survival and fitness over time" (Kellert 2002, 49). He maintains that an environmental ethic can incorporate both scientific and spiritual perspectives—both are rooted in the hereditary traits of our species, because humans depend biologically on a meaningful and multifaceted experience of nature to achieve physical, emotional, intellectual, and spiritual well being. Orr (1996) suggests that, rather than suppress these adaptive traits, we consciously coordinate our non-objective and objective ways of knowing in order to foster sustainability.

Dubos (1972), Oelschlaeger (1991), and Simmons (1993) assert that myths can serve evolutionary fitness because they integrate different ways of knowing, and can impel environmental ethics. Because myths are an aspect of religious and spiritual beliefs, and myth-making is a function of the brain, this human characteristic is ubiquitous—"mythic consciousness is inescapable" (Oelschlaeger 1995, 10). Humans everywhere are storytellers. We create stories in the form of myth or metaphor as a way of processing our complex feelings, beliefs, and information about the world, including the natural environment and our relationship to it. Oelschlaeger contends that successful myths "make intelligible what would otherwise remain incomprehensible." Simmons points out that myths can serve to distill the virtually unlimited information on sustainability into something humans can understand and act upon.

The creation of myths is a way of perceiving or understanding nature that can include both scientific information as well as verbal and non-verbal symbols that represent some aspect of the relationship between humans and nature. These symbols can be shared across cultures, shared within a culture, or be a primarily individual, personal creation. We hold numerous and sometimes competing environmental myths,

[5] biophilia: A genetic inclination among humans to attach physical, emotional, intellectual, and moral meaning to nature; a human biological affinity for life and lifelike processes (Dubos 1972, 42-43.)

e.g., the environment is an inexhaustible cornucopia of resources, humans can "save the earth," the planet is a spiritual goddess (Simmons 1993). Mythic symbols can draw from anthropomorphic images such as Mother Nature, Gaia, or God, or from more generalized images such as the "web of life." Roszak (1981), an articulate interpreter of contemporary culture who has explored the synthesis of psychology, cosmology, and ecology, maintains that myths created around such symbols can inspire and motivate behavior involving the human interaction with the natural world. Use of such metaphoric images need not necessarily violate scientific norms of validity (Simmons 1993). Instead, environmental myths can be a way of integrating objective and non-objective ways of knowing, and can be experienced as personally meaningful or spiritual, according to Short's (1991) and Simmons' (1993) consideration of environmental myth formation, and Newberg and d'Aquili's (1999, 2001) studies on the brain at the University of Pennsylvania.

Myths work through multiple channels of communication, and can be so deeply embedded in our world-view that we are not consciously aware of them. Environmental myths can be constructed through the news, personal stories, product information, television, radio, and the Internet (Simmons 1993). Luhman (1989), who wrote about communication and the modernity of science, maintains that environmental myths are not necessarily consonant with the research presented to us by natural science, but this does not mean these myths are powerless. Myth has power because it engenders changes in behaviors, e.g., concerns about environmental issues can lead people to make changes in laws, education, and daily practice. Knowing how a society processes its environmental information is critical; understanding the power of myth can help us construct myths that incorporate scientific knowledge and so are more effective in motivating sustainable behaviors.

Biological basis for myth creation

The biological basis for the creation of myth is related to the brain's ability to orient the individual in space—a central concern of geography (Newberg et al. 1999, 2001). This higher brain function enables us to negotiate safely around angles,

distances, and other aspects of the physical landscape. The brain performs this function by generating a clear, consistent idea of the physical limits of the self. In other words, it creates a sharp distinction between the self and that which is not the self—between the self and any "other." The brain performs this so well, creating such an accurate sense of our physical orientation to the world, that we are barely conscious of this intense brain activity.

A related function of the brain is myth creation. We may think of myths as simply a way to calm fears about the unknown. But evolution, with practicality as its bottom line, developed the brain's ability to fabricate explanatory stories in order to enhance our chances of physical survival. Our myth-making ability drives us to take action to insure our safety. All the great advances of human kind—from the first stone tool to the latest satellite—have been motivated by our biological need "to reduce the intolerable anxiety that is the brain's way of warning us that we are not safe," according to paleoanthropologist Landau (1984) and Newberg et al (2001, 59).

The brain creates myths through the use of high-function thought processes that allow us to perceive complex threats and resolve them in sophisticated, imaginative ways. Human brains evolved these general analytical functions, referred to as *cognitive operators*, to "allow us to think, feel, and experience the world in an essentially human way." Humans are biologically impelled to use these cognitive operators by the *cognitive imperative*—the "irresistible, biologically driven need to make sense of things through the cognitive analysis of reality," according to Suedfeld's (1964) study on sensory deprivation, d'Aquili's (1972) study on the relationship between brain physiology and human behavior, Larson et al.'s (1997) study on the cognitive imperative, and Newberg et al.'s (2001, 60) studies on the brain and spiritual experience.

Studies show that when the mind is confronted with an overwhelming flow of sensory information, it reacts with increasing anxiety. This anxiety is caused by the frustration of "the mind's insatiable need to sort confusion into order and the difficulty in doing so when overwhelmed by information" (Newberg et al. 2001, 60). Concerns and fears about such unknowns as death, national security, or long-term survival of our

species, center on the question: “How can we live in this world of confusing uncertainties and dangers without being overwhelmed by fear?” The cognitive imperative relentlessly drives the mind to seek resolution to such concerns. In cultures around the world and throughout history, this resolution has been accomplished through myth creation.

Components of myth

Myths begin with the awareness of some metaphysical problem that is then resolved through a mythic story, using metaphorical images and themes. For example, to explain human suffering, some people use the story of God casting Adam and Eve out of the garden. All myths are based on a simple framework: first, there is a focus on a crucial existential concern (such as the creation of the world, or long-term sustainability); second, the concern is framed as a pair of apparently irreconcilable opposites—heroes and villains, or sustainability and extinction, for example; finally, myths reconcile these opposites, often through stories about the actions of gods or other spiritual powers.

These stories take forms that are meant to relieve our existential concerns. One story might say, Adam and Eve disobeyed God; God banished them from Eden; if we are to regain God’s favor, we must obey God. A story more relevant to sustainability might say, nature is the body of God; we must honor God if we are to survive—and to do so, we must reorganize our lives so we can behave more sustainably, and be willing to sacrifice comfort and self indulgence for the general welfare. The “explanation” provided by the story relieves our anxiety, which allows us to live more happily—and perhaps more securely—in the world, even though the myth is not based solely on fact. It must incorporate enough factual information, however, for the story to be effective in guiding wise choices for survival.

Integrated ways of knowing and myth creation

All myths arise in response to the many unanswerable and urgent questions related to survival. Cognitive operators evolved to promote survival, not necessarily to

find the truth. For example, a hunter who relies on hunting for survival must think about the possible causes of any sound she hears in her hunting territory. Is it a dangerous animal to be avoided, or is it food? She will base her actions on how she assesses these possibilities, drawing on the complex interaction of the different abilities of her mind, which in turn draw on her knowledge, intuition, and other ways of knowing. How she frames the sound will not necessarily be the truth—although her survival may depend on her accuracy.

The brain frames the problem in terms of opposites; then a "holistic agreement" of the left and right sides of the brain—logic and intuition—leads to "a whole brain unification that turn[s] logical ideas into emotionally felt beliefs" (Newberg et al. 2001, 70). The brain's left side offers up a logically possible explanation; simultaneously, the brain's right side is proposing holistic, intuitive, nonverbal solutions to the problem. The intellectual ideas get "matched" to the emotional, right-brain "solutions." This triggers a pleasure response, which relieves anxiety and results in those emotionally felt beliefs that resolve our feelings of uncertainty and give us a coherent scenario in which we can react effectively.

This resonant whole-brain agreement between logic and intuition feels like a glimpse of ultimate truth—it is "this quality of *visceral* experience that turns ideas into myths" (Newberg et al. 2001, 56). The power of myth lies in the way its universal symbols and themes connect us to the complex world in ways that logic and reason alone cannot.

Simmons (1993) argues that a more conscious creation of myths about nature is crucial to sustainability—the way we ultimately conceptualize the Earth will determine how we treat it (Takacs 1996). A successful sustainability mythology would frame our connection to the complex, intangible "other" of nature. (The idea an exotic, different, and often marginalized "other" is a concept extensively developed by Said (1978), world renowned scholar and social critic.) Perhaps using a deeply meaningful mythic name, such as Gaia or "Mother Earth," would inspire us to effective action. Thoreau (1817–1862), the classic American philosopher of ecological thought, insisted that deep meaning is rooted in "the relation of human consciousness [to nature], not in [either]

human categorization or use [of nature]" (Thoreau 1864, 163-164; Oelschlaeger 1991, 151). Thus, the myths we create, and the emotions they generate, can direct our actions toward sustainability if we consciously direct our myths and emotions in that direction, and integrate them with accurate objective knowledge (Simmons 1993).

Summary of Literature Review

In summary, while no geographers have conducted a study of non-objective ways of knowing among natural scientists, some have addressed the importance of considering these ways of knowing in geography research. Tuan (1974a, 1974b, 1991) discussed the importance of considering the sense of spiritual connection when examining ways people attach meaning to a place. Simmons (1993) took this idea further by describing the spiritual in terms of myth, and by showing how this way of thinking about nature is a crucial component in our development of sustainable processes. In philosophy, Royce (1995) develops an argument for creating a public philosophy of responsibility and care, by uniting personal meaning and purpose with the good of the larger community—a community that extends to all of life.

Several studies of non-objective ways of knowing among natural scientists revealed that most expressed joy, awe, and wonder at the complexity of nature, and many associated these feelings with spirituality. They combined their professional knowledge about the natural world, including their awareness of the interconnectedness of all things, with a deeply felt, personally meaningful sense of connection to nature (Takacs 1996). An examination of the Takacs study (1996) showed that while some scientists assume that scientists must be agnostic, owing to the impossibility of proving or disproving the existence of God through use of the scientific method, many also see religion, or spirituality, as an evolutionary adaptation. Takacs noted that most of his interviewees firmly rejected religion, but were still willing and sometimes eager to call themselves "spiritual," although "spiritual" is described differently by different respondents. All felt a drive to make sense of the "incomprehensible complexity" of life, and when they were unable to find words to express their feelings, Takacs said they would "resort to the word one resorts to when one can't explain something: *spiritual*."

Some writers covered in this review seem to be caught between two worlds, not wanting to subscribe to a traditional religious belief system, yet feeling a strong sense of spiritual connection to nature. They know that science could probably explain their feelings in scientific terms, but also maintain that science cannot explain all that is important about life (Soule 1988; Takacs 1997; Wilson 2000). Many express the idea that the only thing powerful enough to bring about a transformation of contemporary cultures so that civilization can continue would be some form of Ehrlich's quasi-religious transformation, a change in values deep enough to affect human behaviors. Integral components of this transformation would be the appreciation of biodiversity for its own sake (unrelated to possible benefits to humankind), and a way of understanding the world that is meaningful enough to motivate people to live more sustainably, a way that would place "greater emphasis on empathy and less on scientific rationality" (Ehrlich 1986, 17; Takacs 1996).

An overview of the literature in this review reveals important connections between objective scientific knowledge, myth creation, and non-objective ways of knowing (in the form of personally meaningful, spiritual and/or religious understanding. Although there are a number of natural scientists who contend that some kind of spiritual and/or religious commitment is needed to spur the cultural transformation required for sustainability, many also note that there are potent regulations in place in natural science against talk about non-objective ways of knowing nature. These regulations restrict such talk to the margins, or exclude them altogether from the accepted discourse of natural science. (The French philosopher and social critic Foucault (1982) explores this kind of social restriction in his complex theory of the emergence of the objects of inquiry.) Some argue that science must expand its role in society so that it can play a more effective part in this cultural transformation. This will involve a thoughtful integration of the personally meaningful and the scientifically provable or valid ways of knowing nature.

Significance of the Research

Many of the natural scientists considered in this review maintain that Earth's species face an unparalleled ecological crisis and that if our own species is to survive, we must bring about a cultural transformation focused on sustainability. Some natural scientists and geographers suggest that the interweaving of science and myth, of objective and personally meaningful non-objective knowledge, is a crucial component in bringing about this transformation. Myth creation integrates objective and non-objective ways of knowing, is a central component in religion, and is a ubiquitous phenomenon, probably with a biological (evolutionary) basis in human nature. Whether natural scientists consciously participate or not, myth-making and spirituality are powerful drivers in human affairs.

Chapter 3
Research Design and Methodology

Hypothesis and Research Questions

This thesis hypothesizes that the norms of natural science restrict different ways of understanding nature, limiting the individual scientist's way of knowing nature to the conventionally scientific, objective point of view. This hypothesis is grounded in the theoretical concept of marginalization of difference, as, for example, when natural scientists are subject to regulation (e.g., derision, censure, rejection) should they express or attempt to explore ways of knowing nature that differ from the norm. These regulations serve to restrict non-objective ways of knowing to the margins of the natural science discourse. In this chapter, I will discuss my hypothesis and the methods used to investigate it. I will also discuss my reasons for examining spiritual ways of knowing, particularly as they relate to sustainability.

I hypothesize that certain norms of objectivity dominate the natural science workplace as the only valid way of understanding nature. These norms restrict natural scientists from talking about non-objective ways of knowing nature (personally meaningful, spiritual, and/or emotionally based), silencing even those who value these ways of knowing nature. Discussion and examination of ways of knowing that are considered different or unacceptable are banished to the margins of that discourse—or from the discourse entirely. These restrictive norms prevail even though literature in the ecology and conservation fields has historically portrayed the non-objective way of knowing as an important factor in understanding sustainability.

I set out to describe and document some of the non-objective ways natural scientists say they understand nature. I focused in particular on the spiritual as one specific way of knowing nature. A spiritual understanding of nature can potentially integrate objective knowledge and non-objective ways of knowing. For example, one's sense of spiritual connection to nature can be informed by objective knowledge about environmental problems and related policy issues. Thus, the spiritual can be relevant to

the discourse, especially insofar as discussions with the general public are concerned, particularly in regard to encouraging behaviors that foster sustainability.

I also examined the opinions of natural scientists regarding (a) the relevance to sustainability of spiritual and/or personally meaningful ways of knowing, and (b) the inclusion of these ways of knowing in an overall understanding of nature. I then describe their comments and opinions regarding norms in the workplace—if any—that discourage or restrict discussion about non-objective ways of knowing nature.

To investigate these ways of knowing nature—ways that are outside the conventional objective view of the scientific researcher—I considered several broad, underlying questions on which to base my thought processes. These foundational questions are as follows:

Foundational questions later refined into interview questions:

1) Do natural scientists deepen their objective view as scientific researchers with non-objective but personally meaningful ways of knowing nature?
2) Do natural scientists describe any of their non-objective experience of nature as spiritual?
3) Do natural scientists express views similar to the literature that maintains that integration of objective knowledge with a spiritual way of knowing nature is important to sustainability?
4) In what settings do discussions of spiritual or personally meaningful ways of knowing nature occur, i.e., what position does discussion about these non-objective ways of knowing occupy in the workplace of natural science?
5) Do norms in natural science restrict discussion of non-objective but personally meaningful ways of knowing nature? If so, how do these norms act to restrict such discussion?

I then refined these into questions better suited to an interview format,[6] questions that would encourage interviewees to bring up these topics without putting words in their mouths.

Research Strategy

To pursue this investigation, I used a predetermined set of questions to interview a total of fifty natural scientists. I informed each individual that the interview was voluntary and that all interviewees would remain anonymous. Some chose to sign my

[6] These interview questions are shown in *Appendix D.*

confidentiality statement, but most simply agreed to the interview, and did not take the time to read or sign the statement.[7] Most of the scientists interviewed worked in academia. While their fields included evolutionary biology, biogeography, zoology, and others, I describe the group as a whole with the term *natural scientists*.[8] Most were biologists in various sub-fields. All had participated in fieldwork—that is, work conducted outside the laboratory, in natural settings—for some portion of their career.

I conducted fifty interviews of natural scientists at three different sites. Over two-thirds of the interviews (*n=38*) took place at the first two sites, both of which were biological field stations. The eighteen interviews conducted at the first site—a field station in the southeastern United States—served as pilot interviews. I used these eighteen pilot interviews to guide the composition of my research questions and methods used at my second and third interview sites, and did not include them in my final analysis. I conducted twenty interviews at a field station in Costa Rica, one of which was eliminated from my main analysis because one interviewee did not agree to answer all interview questions, but did agree to a less formal interview. The remaining twelve interviews took place at the third site, the University of Tennessee.[9] This left me with data from a total of thirty-one interviews (*n=31*) for my final analysis, as detailed in *Box 3-1*.

I chose the Costa Rican site because it hosted researchers from a number of foreign countries. Although most interviewees were from the USA, ten of the thirty-

Box 3-1: Number of interviews conducted and used in analysis:

+ 18 - Field station in southeastern United States
+ 20 - Field station in Costa Rica
+ 12 - University of Tennessee
= 50 - Total interviews conducted
– 18 - Pilot interviews not included [southeastern United States]
– 1 - Interviewee who did not participate in formal interview [Costa Rica]
= 31 - Total number of interviews used in final analysis

[7] The content of this statement is shown in *Appendix C*.
[8] For more details on the interviewees, see *Appendix A and B.*
[9] I do not provide greater detail about these sites in order to preserve the anonymity of my interviewees.

one interviews used in my main analysis were from other countries (*Appendix A*). I hoped this more heterogeneous mix would provide some variety in the perspectives expressed in the interviews. I conducted most of my interviews at field stations because I was interested in interviewing scientists who worked directly with nature, particularly during those phases of their research when they were in direct contact with the natural settings of their research subjects. Those whom I interviewed at the University of Tennessee had also participated in fieldwork, some to a great extent.

Examining the discourse of natural science

The discourse of a profession includes all verbal and even pictorial expressions related to that profession. These various "texts" influence the overall endeavor of research, and are also used to justify and interpret research projects. To examine the discourse of natural science, I used my interview questions to focus on the social space within this discourse, as well as on the abstract space of non-objective ways of knowing nature. I asked about the content of "chitchat" in the workplace, because the workplace is a central element in any profession, and thus is a part of the discourse of that profession.

Sustainability and spiritual ways of understanding nature

The spiritual clearly plays a part in environmental values for some naturalists and natural scientists, as can be noted in Muir (1916), Leopold (1949), Oelschlaeger (1991), Simmons (1993), Kellert (2002), and the interviews by Takacs (1996). Ruether (1994), ecofeminist and professor of theology, Fowler (1995), and Primavesi (2000), research fellow in environmental theology, make the case for the importance of spirituality in environmental activism. However, not all spiritual or personally meaningful ways of knowing nature motivate sustainable behaviors. According to many descriptions in the literature reviewed, a sense of spiritual connection to nature is relevant to sustainability only when it is grounded in objective knowledge, evokes a sense of responsibility to the whole, and inspires changes in people's behavior by sparking or deepening their commitment to sustainability (Thomashow 1995; Takacs

1996).

A meaningful commitment to sustainability may require a sense of connection to the Earth as a whole, beyond the self. Many experience this sense of connection in terms of spiritual understanding or experience. To foster sustainability, this sense of connection must be personally meaningful enough, and widespread enough, to engender significant culture-wide behaviors (Takacs 1996).

I did not investigate whether each interviewee had integrated their sense of spiritual connection to nature (if any) into their other ways of understanding nature, e.g., emotional, non-verbal, intellectual, objective. Neither did I develop any way of measuring whether a sense of spiritual connection to nature led to more environmentally sustainable modes of behavior, as this was beyond the scope of my research. I asked specific questions only about whether each interviewee reported having "a spiritual experience" of nature, and whether he or she discussed such experiences or perspectives with others. I followed these yes/no questions with open-ended questions asking them for more details.

Using the word *spiritual* in interviews

I decided to use the word *spiritual* in my interviews only after much thought and discussion. The spiritual is a messy concept because it does not lend itself to unpacking, that is, to clarifying terms and setting up a problem. I asked natural scientists about the spiritual even though I suspected some of them did not want to be pestered with questions about spirituality; the spiritual is not measurable—and the fundamental work of a scientist is to provide objective, measurable data. But although the word *spiritual* is difficult to define, it is broadly, if vaguely, understood, and most interviewees responded to it readily. By using the word *spiritual*, I hoped to evoke expressions of ways of understanding of nature that were not only personally meaningful, but went beyond material aspects of personal meaning, such as being meaningful to one's career or income. Furthermore, use of the word *spiritual* allowed interviewees a broad range of possible responses to my questions, because individual descriptions and definitions of this way of knowing can range from a fairly superficial

personal understanding of nature to one that evokes deep and meaningful commitment. Questions about the spiritual can open the door to discussion about a sense of connection to—and even responsibility for—something beyond the self, including a sense of responsibility to the preservation of biodiversity and other key environmental issues. Although the word *spiritual* has wide implications, its use can shed light on attitudes about non-objective ways of knowing and sustainability.

I did not define the word *spiritual* in these interviews because I wanted to allow each interviewee to respond using his or her own definitions or concepts about the spiritual. By examining their definitions of *spiritual*, I was able to look for common themes in this way of knowing. Their definitions also provided insight into their attitudes about the relevance of spiritual experience to sustainability, by allowing me to examine whether interviewees mentioned having a sense of connection to life, the planet, or all living beings.

I did not examine the specific characteristics of the spiritual experiences of my interviewees. The individual researcher's integration of different ways of knowing nature—intellectually, emotionally, spiritually, ethically, non-verbally, and so on—is relevant to this thesis, but the particular characteristics of an individual's way of experiencing the spiritual is not, because an analysis of such individual characteristics is beyond the scope of my current research. Instead, I asked my interviewees for their personal, non-objective opinions and descriptions of the spiritual way of knowing nature.

My initial decision to leave the word *spiritual* out of my interview questions resulted in my later decision to include it. Pilot interviews conducted at my first site at the field station in the southeastern United States did not include questions that asked explicitly about spiritual experiences of nature.[10] I had hoped this strategy would allow any mention of spiritual experience or motivation to emerge on its own, but in general it did not. No one at this site mentioned a spiritual connection to nature in his or her interviews. In addition, because so few interviews at this first site described even a

[10] See *Appendix E and F* for the interview questions used at my first site, including my pilot interview questions.

personally meaningful connection to nature—although I sensed that many of them felt such a connection—I decided to redesign my interview questions. I did not want to lead the interviewees, but I also wanted to get responses more directly relevant to the ideas expressed in the literature concerning spiritual or personally meaningful connections to nature.

I considered the questions used and responses gained at the first site in designing my interview questions for the second and third sites. These interview questions were used for the remaining thirty-one interviews conducted at the Costa Rican field station and the University of Tennessee.[11] These interviews contained the word *spiritual* because I could find no less culturally loaded, yet succinct and easily defined substitute to get at their attitudes about non-objective but personally meaningful ways of understanding nature.[12] It quickly became apparent to me that most interviewees would talk about non-objective ways of knowing nature when I used the word *spiritual* in my redesigned interview questions, even if they were describing their suspicions and resistance to the concept of spirituality. My results include only those thirty-one interviews conducted with the redesigned interview questions.

I did not ask direct questions regarding interviewees' opinions about the connection between spirituality and sustainability. Instead, I questioned interviewees on their attitudes about the place for spirituality in environmental issues by asking them their opinions about, and their level of agreement or disagreement with, a quote by the biologist Edward O. Wilson.[13] In the quote, Wilson emphasizes the need to

> spiritualize the environmental movement—not in the sense of starting to offer up prayers—but with a sound empirical base. [We must]...consider the broader meaning of the sacred: the deep sense of spirituality about each other and about our natural environment (2000). I did this by asking broad questions such as, "What is the most important aspect of your work?" and "How does your work fit into the larger picture?"

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[11] See *Appendix D* for the interview questions used at my second and third interview sites.

[12] Although I deliberately included the word *spiritual* in this set of interviews, I did not attempt to demonstrate that spirituality necessarily contributes to sustainability, or results in actions for sustainability. Furthermore, I did not describe any of the abundant examples in society in which spirituality clearly does not result in sustainable actions.

[13] See interview questions in *Appendix D* for full quotation.

I allowed opportunity for additional comments on this topic by asking interviewees on their attitudes about the place for spirituality in environmental issues by asking broad questions such as, "What is the most important aspect of your work?" and "How does your work fit into the larger picture?"

Comparisons to the Takacs and Richert Studies

My research project is similar to the studies by Takacs (1996) and Richert (2001), in that we gave natural scientists an opportunity to talk about the role of the spiritual in their work. We supplemented data gathered from interviews with selections from additional spoken and written words expressed by these scientists about this topic. Richert did this indirectly, by asking people about their definitions of environmental quality, and their opinions on inherent values of nature. Takacs and I asked more direct questions about a personally meaningful or spiritual connection to nature.

Takacs noted that because the complex responses that emerge from social research on scientists are "not easily classifiable," they could be read as case histories. Such case histories offer "suggestive parables rather than conclusive proofs," they are stories from which we can gain broader insights into the production of knowledge about the natural world (Takacs 1996, 190; Cronon 1993).

My study did not have many other similarities to the Richert study, because I limited my interviewees to natural scientists, while Richert interviewed a variety of stakeholders, all of whom were involved in the forestry industry. Only a few of his interviewees were natural scientists, and these were specifically focused on the health and economic potential of forests rather than on larger sustainability issues.

While my study shared far more similarities with the Takacs study, it differs from it in a number of ways. First, Takacs limited his interviewees to conservation biologists, most of whom were openly supportive of biodiversity conservation. He describes their supportive attitude in the foreword to his book, saying, "This book is about biologists, who, for better or worse, often wear their values on their sleeves" (1996, xiv). In contrast, I interviewed any natural scientist or natural science graduate student who would agree to an interview. I did not screen them beforehand about their

opinions on biodiversity conservation, nor on their professional background. Furthermore, unlike the Takacs' interviewees, their sub-fields were not limited to conservation biology. Also, I used the word *nature* in my interviews, whereas Takacs used the more specific word *biodiversity*.

Second, I asked specific interview questions about opportunities for discussion —with colleagues or others—about spiritual or personally meaningful ways of knowing. Takacs took a more informal approach, and got at the topic of norms in the workplace by asking his interviewees what they thought about scientists who, when speaking to non-academic audiences, stepped beyond the borders of "value-neutral" science to express their values and emotions in advocating for biodiversity. His approach encouraged his interviewees to talk about values—including spiritual values for nature—and to discuss their opinions and concerns about expressing such values in their role as scientists.

I avoided the word *advocacy* in my interviews and instead attempted to evoke opinions on this topic with less direct questions. I used several open-ended questions, including the following:

- What would you most want your work to be remembered for?
- How does your work relate to the larger picture?
- What inspires your work?

I purposely left terms such as *larger picture* undefined, in order to allow the interviewee to bring her or his own interpretation to these terms.

The Interview Questions

For my interviews, I used predetermined questions, most of which were open-ended. While I also participated in fieldwork with several interviewees, and noted comments made in the course of fieldwork and daily chitchat, I adhered to the predetermined questions during actual interviews. In addition to the open-ended

questions, I used a five-score Likert scale[14] to determine level of agreement with two quotations. The first quotation introduced the idea of a spiritual way of knowing nature:

> **Interview question:** What best describes your level of agreement or disagreement with the following statement: "...nature generates 'spiritual' experiences" (Rolston 1996)?[15]

As a follow-up to this question, I used the following relatively simple yes/no questions *a* and *b*, and the open-ended question *c*:

a) Have you had this kind of experience in relation to "nature"?
b) Have you had (or do you have) any discussion about this among your colleagues or other people?
c) If yes, under what circumstances did (or does) this discussion occur?

Questions *b* and *c* are designed to investigate the workplace of natural science for talk about the sense of spiritual connection to nature. I used the word *discussion* to spur interviewees to bring up a variety of ways they may have exchanged opinions or shared experiences about the spiritual connection to nature. This question allowed me to investigate whether there were norms in the workplace of natural science that restricted talk about this topic.

Before conducting each interview, I assured confidentiality, and asked them if they wanted to read the confidentiality statement. During the interviews, I wrote down their responses verbatim, and also took notes on other aspects of the interview, such as the setting, social interruptions, and non-verbal expressions such as surprise, enthusiasm, and so on. Interviews lasted from 20 to 90 minutes. Most of my interviews were face-to-face, but some answered the questions by e-mail. I was concerned that the questions answered by e-mail would be less expressive that interviews done in person,

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[14] **Likert scale:** (Mcgraw and Harbison-Briggs, 1989). Example of the Likert 5-score scale used in these interviews: I strongly agree___ I agree ___ I neither agree nor disagree ___ I disagree ___I strongly disagree ___

[15] **Rolston quotation:** In face-to-face interviews, I did not recite the full quotation here, but only asked about their level of agreement with the statement, "nature...generates 'spiritual' experiences." The full quotation is as follows: "...nature generates religious experiences in [the] deeper sense. If [one] wishes to bypass the word 'religion,' owing to its institutional, denominational, and cultural dimensions, nature nevertheless generates 'spiritual' experiences." The quotation was available for each interviewee to read, but some did not choose to do so.

but after comparing the two groups, I noted no difference. Both groups contained a similar mix of abrupt and expressive responses to the interview questions.

Data Management

Interviews were transcribed verbatim soon after the interview was completed.[16] Each interview was recorded as its own document, including interview questions. Any additional comments outside the interview questions were recorded in a separate section of the same document. The names of all interviewees were replaced with pseudonyms, which are the only identification used in the transcripts.

Data Analysis Strategies

Qualitative analysis is essentially a process of inductive reasoning used in thinking and theorizing about a complete set of data, according to Kane's (1995) and Taylor et al.'s (1998) texts on qualitative research methods. In this kind of analysis, the researcher considers all the data collected for a project, including patterns, categories, and themes that emerge. The process of qualitative data analysis continues throughout the data collection phase; this was reflected in my analysis when I noticed that I needed to change my interview questions to evoke more relevant responses. No specific formula or method is employed in qualitative data analysis. Instead, the researcher formulates guidelines to interpret his or her data, as described in Peacher (1995).

The analysis of interview data follows several stages. In the first stage, the data are "reduced" by the iterative reading of interviews and notes, where several readings are accompanied by a listing of related ideas and possible interpretations of the data. Each new list is then examined for themes, patterns, and categories of types of data—which could include conversation themes, opinions on similar topics, use of the same or similar words, and descriptions of relevant experiences. The researcher then takes the first step toward interpretation of data and formulation of theory by putting forth several propositions, or generalizations, about these reduced data.

[16] After each interview, I entered all relevant details (e.g., years of education, sub-field, responses to yes/no questions), into an Excel spreadsheet, for further analysis.

In the second stage of qualitative data analysis, the researcher codes the data with his or her final presentation in mind. It is helpful to develop a theoretical "story" to help determine how the many data pieces, concepts, and themes will fit into this final presentation, and to determine which data are relevant to this story, and which data are not. The data are not forced to fit into any particular category; rather, categories are adjusted to fit the data. The data are then coded for all relevant categories. Some data will fall into more than one category. After the data are categorized, they are then sorted in some way that allows the researcher to analyze together all data under each specific theme, concept, or proposition. This enables the researcher to begin grounding the theory in supportive data (Taylor et al. 1998).

In this thesis, I allowed the categories to emerge from the responses of my interviewees, letting the data speak for themselves, so to speak. In pursuing my particular theoretical story, I followed the following steps:

- First, I asked interviewees if they experienced nature through spiritual ways of knowing, by using one simple yes/no question and one question whose responses were limited to the five-point Likert scale;
- Second, I ask interviewees to define *spiritual;*
- Third, to enrich these data, I asked them their opinions on the spiritual in relation to sustainability. I got at this by using a Likert scale to determine their level of agreement (Likert scaled) with a quotation by Wilson, which emphasized the importance of "spiritualizing the environmental movement." This gave interviewees a common—and more specific —"starting point" from which to express their opinions, as opposed to the definition for *spiritual*, which allowed for more far-ranging interpretation. This also helped me to better determine if my interviewees held similar opinions to those of renowned naturalists Muir (1916) and Leopold (1949), or noted scientists Wilson (1993) and those described in Oelschlaeger (1991), Simmons (1993), Takacs (1996), and Kellert (2002). I followed up this Likert-scaled question with an open-ended question asking them their opinion about Wilson's quotation.

- Fourth, to enrich the data still further, I looked again at their level of agreement with the Wilson quotation, which emphasized basing the spiritual on "a sound empirical base." This allowed me to determine their attitudes about how the spiritual fits with other ways of knowing nature. I also examined their open-ended comments on the Wilson quotation, and their descriptions and definitions of *spiritual*. This added to my ideas about their agreement with Wilson and other noted scientists.
- Fifth, in looking at these data from multiple perspectives, I was able to note a broad range of attitudes about the spiritual way of understanding nature, including opinions on the importance of the spiritual to sustainability goals. This range of attitudes was broad and detailed enough for me to observe that they could be used to form a continuum from a more detached to a more connected position in relation to nature.
- Finally, to determine where non-objective ways of knowing fit in the discourse of natural science, I noted whether they agreed with Wilson and others about including the spiritual or personally meaningful in their understanding of nature, and about the importance of the spiritual in relation to sustainability. I then asked them if they integrate these different ways of knowing into their discourse with colleagues, and if so, how, and if not, why not.

Chapter 4
Results

Introduction

Before I began this research, I had mixed perceptions about natural scientists. Natural scientists have chosen a career dedicated to the study of nature, yet their talk—as viewed from my position as an outsider—seemed to be limited to a narrow, exclusively objective view of nature. In this view the natural world is seen only as an object of research, with little personal meaning except for intellectual stimulation, beauty, or recreation. I am not a natural scientist, but hoped that I would thus bring an outsider's view to the study. In my limited interactions with natural scientists up to that time—including my participation in an extensive water sampling studies in the Great Smoky Mountain National Park, field work with soil sampling and other studies as an assistant to fellow students on their projects, and chats with speakers at geography colloquiums, (and my own experience with my research project for a biogeography seminar)—I had noticed that talk or discussion of spiritual or personally meaningful understanding of nature seemed somehow unacceptable. Responses to such talk in casual conversations often seemed to evoke a sense of discomfort, changes of subject, and even jocular name-calling such as "It's a warm-fuzzy lecture."

Because we have such a complex and multifaceted relationship with nature, and because we are feeling as well as thinking creatures, I wondered why more personally meaningful expressions of this relationship seemed to be almost taboo among natural scientists. It was a kind of religious fundamentalism in reverse – instead of an acknowledged insistence on framing the world solely in spiritual terms, there was an unacknowledged insistence on framing the world exclusively in non-spiritual terms. There appeared to be no opportunity for examination of the role of non-objective ways of knowing in natural science, although many environmentalists—including some natural scientists—contend that an integration of these ways of knowing with objective knowledge was a crucial element for sustainability.

I had observed a growing number of non-religious groups outside the professional science community[17] who blended their intellectual concerns about environmental issues with a deep emotional caring for, and sense of unity with, nature, and who conceptualized and articulated their relationship with nature in spiritual terms. Furthermore, an increasing number of religious groups[18] were moving beyond their traditional boundaries to integrate scientific knowledge about the natural world into their spiritual understanding of the world.

I observed no corresponding effort among natural scientists to expand traditional ways of thinking in science. Instead, there seemed to be restrictions against the creation of a legitimate space for exploration or talk about personally meaningful or spiritual connections to nature. These restrictions appeared to marginalize non-objective but personally meaningful ways of knowing. Despite my observations, I believed that there was more to this story. I suspected that some natural scientists had a more complex and more personally meaningful view of nature than what I was seeing on the surface.

Examination of different aspects of the natural science discourse

I noticed examples of this marginalization in my examination of the content of various aspects of the discourse of natural science. While I do not present my findings in detail here, I analyzed ten natural science journal articles, five lectures (at least one at each of my research sites), a book referenced in one of these lectures, a booklet on science by the National Science Academy, two articles (Frank 1993; Turk 1993) on human factors in geographical information systems (GIS), and a lecture series (in book form) by the prominent physicist Feynman (1998), in which he discusses his thinking on the scientific world as it applies to religion, politics, and everyday life. Overall I found that none of these pieces of scientific literature included expressions of personally

[17]Web sites for several groups integrating sustainability with spirituality:
a) Narrow Ridge Earth Literacy Center: <http://www.korrnet.org/narrowr/>
b) Harvard's Environmental Ethics & Public Policy Program: <http://ecoethics.net/index.htm>

[18] Religious groups integrating information on the natural environment with religious beliefs:
a) The National Religious Partnership for the Environment [Jewish, Christian, Catholic, Evangelical] <http://www.nrpe.org/>
b) National Council of Churches: Eco-Justice Working Group <http//www.toad.net/!cassandra/>

meaningful or spiritual connections to nature, nor did they include any discussion of ways to combine objective knowledge with these non-objective ways of knowing nature.

The interviewees

During my interviews, many interviewees expressed surprise at my questions, some saying they were not used to being asked about, or even thinking about, the spiritual dimension of their ways of knowing nature. Many of them, however, opened up about the subject during the interview, and seemed to be aware of this way of knowing, even if they did not talk about it very often. They appeared to be comfortable in talking to me, perhaps because, as interviewer, I was acting outside the norms of science and was not in a position to judge them in any significant way. Some interviewees even talked enthusiastically about spiritual ways of understanding nature, indicating that they placed some value on these alternative perspectives. Their reactions to my questions began to validate my initial suspicions that although there was no room in the natural science discourse for open discussion of it, this way of knowing was valued by some.

Regardless of their response, I am deeply grateful to all those who gave of their time to be interviewed by me. Although some disagreed with aspects of my study, all were considerate, thoughtful, and informative, generously sharing their insights, perspectives, and even deeply felt convictions. I look at their comments here with a critical eye because I am committed to uncovering those aspects of the human relationship with the natural world which may contribute to sustainability—but this in no way diminishes my appreciation for the openness and participation of my interviewees.

Overview of this chapter

The primary purpose of this research is to investigate whether or not the norms in natural science restrict talk about spiritual or personally meaningful ways of understanding nature, and if as a result, such talk has, or has no, acknowledged and

accepted space in the natural science workplace. I also intend to investigate whether and how some natural scientists may experience and even value a spiritual or personally meaningful connection with nature. Some scientists also may consider these non-objective ways of knowing important to sustainability goals, but do they feel restricted in examining this connection within the discourse of natural science?

This chapter meets the above queries by examining this complex topic from a variety of perspectives. It includes a presentation of the results of the interviews I conducted, and my analysis of these interviews.[19] As outlined in *Chapter Three*, I coded the transcripts of these interviews and rearranged data from these transcripts into several themes. These themes were taken directly from the foundational questions posed in *Chapter Three*, and repeated here:

1) Do natural scientists deepen their objective view as scientific researchers with non-objective but personally meaningful ways of knowing nature?
2) Do natural scientists describe any of their non-objective experiences of nature as spiritual?
3) Do natural scientists express views similar to the literature that maintains that integration of objective knowledge with a spiritual way of knowing nature is important to sustainability?
4) In what settings do discussions of spiritual or personally meaningful ways of knowing nature occur, i.e., what position does discussion about these non-objective ways of knowing occupy in the workplace of natural science?
5) Do norms in natural science restrict discussion of non-objective but personally meaningful ways of knowing nature? If so, how do these norms act to restrict such discussion?

In addressing these questions, I will discuss the main themes suggested by the data. I will then weave these themes together to convey the larger story that emerged from the stories told by individual interviewees. I use their words as much as possible to describe how they understand nature in ways that differ from the conventionally scientific, objective way of knowing. I use ellipses […] to indicate breaks in the interview when we lapsed into irrelevant comments such as, "What was the question again?" I also use them to skip small sections of an interviewee's comments that are

[19] To insure anonymity, and for a smoother, more readable style, I have alternated male and female pronouns for each of my descriptions of interviewees below. I refer to all interviewees by pronouns rather than by names or pseudonyms.

not related to the theme being discussed. I differentiate longer quotes from the rest of my text by indenting and single-spacing them, to keep them visually separated from the text of the chapter.

Experiencing Nature through Spiritual Ways of Knowing

In response to questions from my second set of interviews, in which I asked questions containing the word *spiritual*, a solid majority of the thirty-one scientists I interviewed indicated they were acquainted in some way with the "spiritual experience" of nature. For example, ninety percent of those interviewed said they either agreed (*n=18*) or strongly agreed (*n=10*) with the statement: "nature generates 'spiritual' experiences." Of the ten who strongly agreed, one expressed reservations. Of the eighteen who agreed, four expressed reservations. These four groups comprise ninety percent of the thirty-one interviewed, and are noted separately in *Table 4-1*. Two interviewees disagreed with the statement, and one was neutral (*Table 4-1*).

Of the four who agreed but expressed reservations, three specified that they had reservations about the word *spiritual*. One said spiritual experience was "generated [by] my own perceptions, attitudes, and responses to my surroundings," not by nature. Two said the statement was not true for everyone: "...my version of spirituality is a lot more general than most people's." The fourth agreed, but added, "I don't think it always happens. But it does happen."

Table 4-1: Responses to the interview question, "Nature generates 'spiritual' experiences."

Level of Agreement	**Percentage of Responses** (approximation)	**Number of Responses** (N=31)
Strong Agreement	29%	9
Strong Agreement, with reservations	3%	1
Agree	45%	14
Agree, with reservations	13%	4
Neither Agree nor Disagree	3%	1
Disagree	6%	2

To determine whether these natural scientists had experienced nature in ways they would describe as spiritual, and were willing to acknowledge such experiences, I asked them the question, "Have you had this kind of experience in relation to nature?" (*Table 4-2*).[20] Over seventy percent of interviewees said "yes," some emphatically. Of those saying yes, two voiced reservations. One said he was reluctant to define his experience as specifically spiritual; the other was unclear, saying, "I think I have a spiritual relationship with nature," but then distanced herself from this way of knowing by saying, "I'm not a religious or spiritual person myself." Another noted how elusive it is to define spiritual experience, saying that when we step out of ourselves and view the experience as an outsider, it can become something other than a spiritual experience. In her words, "If you're out in the woods and you ask yourself if you're having a spiritual experience, you've already lost it. Like the Zen masters say, if you're looking for it, you've missed it."

Some interviewees seemed to be thinking aloud, forming their definitions and even their concepts of the spiritual throughout the process of our interview, exploring the idea of spiritual connection from different viewpoints as we spoke. One in particular, whom I counted in the category, "Not spiritual, but something," presented

Table 4-2: Responses to the interview question, "Have you had this kind of experience in relation to nature?"

Level of Agreement	**Percentage of Responses** (approximation)	**Number of Responses** (N=31)
Strong "yes"	19%	6
Yes	48%	15
Yes, with reservations	7%	2
Not spiritual, but something	13%	4
No	13%	4

[20] This table also indicates comments made in addition to, or instead of, the simple "yes" or "no" responses expected.

several points of view rather than answer the question with a clear "yes" or "no." She described an experience in which she felt a personally meaningful connection to something in nature beyond the self, but refrained from labeling the experience spiritual, saying, "When I heard the calls [from the animals she was researching in the field], the experience was "beyond myself," which was pretty cool, whether it was spiritual or not." The interviewee then clarified her personal take on spiritual experiences, saying, "I've had what I consider to be spiritual experiences, sometimes within and sometimes outside formal religion. I don't connect with God in all experiences out of self." She described these experiences as "pleasant," then framed them in naturalistic terms, saying, "[these experiences] may have an entirely neurological, mechanistic basis." This interviewee also mentioned the moral aspects of the spiritual, but placed the spiritual outside religions that emphasize reward and punishment, saying, "It's not formally religious, and not about a reward/punishment system. There are moral imperatives outside this. We are stewards of the earth." She finally described it in terms of professional research breakthroughs, associating the spiritual with an exploration mentality aimed at being the first to discover new information: " I'm just blown away by the intricacy of what I discover, going somewhere people haven't gone before. And that's cool about this profession, being first on the scene—that's spiritual."

Defining and describing the spiritual: Main themes

To further investigate the ways these natural scientists conceptualized the spiritual experience of nature, I followed the question about spiritual experience of nature by asking interviewees how they would define *spiritual*. I also drew on their responses to my other open-ended interview questions, looking for any comments that described or defined the spiritual, especially in relation to nature. I grouped these definitions and descriptions into eight common themes.[21] There was some overlap between themes, and many interviewees defined *spiritual* in several ways.

[21] My descriptions include only those comments that best represent that theme. Comments from some interviewees appear in more than one theme described.

These overlaps in themes, and the multiple or vague definitions given by some interviewees, reflect the inexact nature of qualitative research (Kane 1995). I did not determine percentages of definitions within each theme, because I am not attempting a qualitative analysis of this portion of the data. Instead, I draw on these descriptions and definitions—especially those that include a reference to nature—to create a collective story about the personally meaningful or spiritual aspects—if any—of the natural scientist's non-objective relationship with nature.

Personal meaning: All interviewees described their relationship with nature as personally meaningful, but expressed this in different ways. While all described the meaningfulness of their experience of nature in terms of being intellectually stimulating, only three put it solely in those terms. Four talked about how research in nature provided the thrill and prestige of discovery along with an interesting career. Nineteen described it in terms of emotional experience, and talked about "feeling good," "rejuvenated," "peaceful," or "elated" when spending time in natural surroundings. Two defined *spiritual* in terms of personal meaningfulness or as "something to believe in," but did not say if this included nature. Another described *spiritual* in terms of one's relationship with the universe, rather than with "nature," saying, "I think of spirituality as being subjective, things about meaning…how someone conceptualizes the universe and themselves, and their relationship with it." One interviewee expressed discomfort with the word *spiritual*, but expressed her connection to nature as personally meaningful, saying, "*Spiritual* is a weird word, but certainly some of my happiest, and when I'm reflective, my best moments, are in a natural place."

Two went beyond defining *spiritual* as simply reflecting on the meaning of life, to explicitly include their personally meaningful experience of nature. One interviewee emphasized the importance of "feel[ing] the connections" to life. "You can't just look at it technically" if you are to fully understand it. Several expressed a moral involvement in their experience of nature. One said, "There are moral imperatives [outside religious injunctions]. We are stewards of the earth." [See *Figure 4-1*.]

Dissociation from religion or the supernatural: Several explicitly dissociated the spiritual from the supernatural or from religious beliefs, one defining it as "a deeper

Do you agree or disagree with the statement that nature generates spiritual experiences?

- There [are] lots of different spiritual aspects to nature, different lessons or points nature makes about spirituality. But there [are] so many different ways nature informs people's views on what the universe is like, and what we are, and what's meaningful. And there [is a lot] in nature that's meaningful to me personally.
- When I'm alone in nature, I can see that I'm a small part of what's going on in the world, so I feel better about life.
- Nature is infinitely strange—it provides endless fascination, and provides inspiration about life in general, for work and for everything else…my awareness of the beauty and value of life affects what I choose to study.
- Nature has nothing to do with religion, but I enjoy it and I know what I am doing there, but it's not spiritual, just relaxing. I am not spiritual.
- It's my first experience here in the rainforest. It's a very intense experience; I didn't know where to look, there was so much going on. The life cycle is so fast here.
- [Nature] excites me to no end! It's fascinating.
- I go there [to the forest] to try to relax.
- I think that scientists are doing good work for advancing our knowledge about the natural world. While we do that work, we have the special opportunity to experience the natural beauty, wonder, and spirituality of the world around us.
- The sacred inherently includes the natural environment and each other.

Have you had this kind of [spiritual] experience in relation to nature?

- Absolutely. That's one of the places I feel [the spiritual experience] the most.
- Most definitely! That was a major part of [my] becoming a scientist, and still is today.
- All the time. Any time. Less so when I'm wrapped in my own tiny obscure cyclone of effort and self-will, more so when I'm at ease with myself and my fellow travelers.
- I think I have a spiritual relationship with nature; it's a feeling, undefined.
- I wouldn't define it as s*piritual*. It's more about feeling good, at ease, in awe, internally quiet. But I don't think I attribute anything supernatural to it.
- No. When I'm working, it's as a scientist, so I leave this out. You DO have moments where you think something [in nature] is beautiful—and that's the scientist.

What do you most enjoy about this work? The contact with nature.

How would you define spiritual? Something deep that happens to you in the forest, as you try to understand what's going on. It's a part of yourself, your personality, not just your mind and logic, but your feelings, and sensations…a peace from all the stress of life; harmony.

- Sense of connection to the natural world or to other people—often as [a] recognition of beauty."
- Deeply personal attachment to something, like to the forest.

Figure 4-1: Expressions of personally meaningful relationship with nature (in response to different interview questions):

sense of peace and well-being, although not of a religious context." Another connected the spiritual to an ethical way of life, while expressing distaste for the hypocrisy of some religious people, saying,

> I think it's possible to have lots of spirituality without being very religious… many of those religious people weren't spiritual at all. Maybe you could say that it's a feeling within that manifests as a way of life that's overall ethically and morally "good"…It's not necessarily about belief in God.

One interviewee associated the spiritual with values, also without connection to religion, saying, "I have trouble with a 'spirit world' so to define it I have to look for something else—outside self—a higher value, but not 'higher purpose.' Purpose must be eschewed as naturalistic." Another defined *spiritual* as "a general sense of awe, without particular references to supernatural entities," and noted that this sense of awe "was a major part of [my] becoming a scientist, and still is today." This interviewee went on to describe his philosophy of life as based on "rationalism and naturalism...not mysticism." (*Naturalism* is the system of thought holding that all phenomena can be explained in terms of natural causes and laws.)

Not logically explainable: Six interviewees explicitly dissociated the spiritual from logic and objectivity, defining *spiritual* as "beyond logical ideas...it can't be proven," "…can't be explained by grounded science." One said that because it was "beyond" logic, she was not interested in it. She cared deeply about environmental issues, "just not in a spiritual way." But another interviewee contended that a sense of spiritual connection could contain both logic and something outside logic, describing the spiritual as "not necessarily explainable—or *un*explainable."

Intellectual explanations: Three defined *spiritual* only in terms of the conventional epistemology of science, answering "no" to the question about having had spiritual experiences in relation to nature. One of these three apparently associated the spiritual—and the spiritual experience of nature—exclusively with religion, saying, "Nature has nothing to do with religion." This interviewee described her non-objective experiences of nature only in terms of enjoyment. "I enjoy [nature] and I know what I am doing there," she said, "but it's not spiritual, just relaxing. I am not spiritual." The second interviewee limited these kinds of experiences to enjoyment of beauty, and did

not describe experiences of nature outside his work as scientist, saying, “When I'm working, it's as a scientist...[but] you *do* have moments where you think something's beautiful.” He went on to say, “The concept of spiritual is something constructed, rather like a religion. And it's a word. I'd just look it up in the dictionary. There's a definition out there, and that's what I'd use.” A fourth interviewee explained his “sense of awe” about nature as naturalistic, saying, “I am committed to philosophical naturalism—otherwise I wouldn’t be a scientist—because it works and it’s a sensible assumption to make about the world.”

Human-centered: Some interviewees included their experiences of nature in their definition of *spiritual*, but their view of nature could be described as “human-centered.” Nature was seen only in terms of its usefulness to humans. Several described their experience of nature in terms of an amenity, in which nature served as a pleasant backdrop to human activities, a source of intellectual stimulation, or a kind of anti-depressant. One interviewee said, “In general, people feel good when they're outside and they feel some sense of spiritual connection.” Some expressed stronger emotions, but these comments were nonetheless focused on peaceful feelings for the individual, rather than on a personally meaningful sense of connection to nature that extended beyond the self, for example, to include other species. Several defined *spiritual* with the words “awe” or “wonder”, which could describe anything from a pleasant feeling to a deeply inspired sense of commitment to nature.

Discrete or continuous experience: Some interviewees seemed to view the spiritual experience of nature as an out-of-the-ordinary but discrete experience: “Sometimes when I climb to the highest peaks, and can see down to the [ocean] and...the islands below, I would feel something I don't feel all the time, and an hour could pass and I wouldn't notice.” These comments could be describing either a pleasant, human-centered, and what I categorize as superficial, experience, or an experience of deeply meaningful connection to nature.

Other interviewees indicated that they were aware of their spiritual connection to nature in an everyday, continuous sense, one that included all aspects of their lives rather than specific, limited experiences. These described the spiritual as a

"fundamental sense of kinship," and "...the common theme that relates us to nature—the spirit of life." One interviewee did not describe the spiritual in terms of "connection" to life beyond the self, but instead described it as a blend of objective and non-objective ways of knowing that permeated multiple aspects of the self. She said the spiritual was "something deep that happens to you in the forest, as you try to understand what's going on. It's a part of yourself, your personality, not just your mind and logic, but your feelings, and sensations…a peace from all the stress of life; harmony."

Connection to something outside the self (specified or unspecified): Twelve of the thirty-one I interviewed mentioned a sense of connection to something beyond themselves, without specifying nature. One said the spiritual "has to do with a feeling of non-material unity with other things...a sense of being a part of something bigger, where I don't have to be the center of it." Another began his definition of *spiritual* in terms of connection, but could not complete his thoughts, saying the spiritual is "Something that gets you thinking about or in contact with...I don't know...I'm at a loss for words." But later he described the relationship between nature and people as spiritual, saying, "The sacred inherently includes the natural environment and each other."

Nine interviewees defined *spiritual* specifically in terms of connection to nature, such as "[a] sense of connection—to the natural world or to other people—often as recognition of beauty," and "[a] deeply personal attachment to something, like to the forest." One described it as "realization" rather than connection or unity, saying, "It would be a humbling experience, a realization of greater processes and powers. Seeing a wall of water, for example, shoot up from a glacier in Alaska was a humbling and spiritual experience."

Emphasis on connection to nature: Three interviewees not only mentioned a connection to nature, but emphasized it. One interviewee, in response to the question about defining *spiritual*, said, "A good question for a scientist! It's a connection between myself and *all* the other elements in nature—humans, rocks even, and soils. It's exactly that—the connection. Togetherness." Two interviewees described the spiritual way of experiencing nature as an important aspect of the human relationship with

nature: “The spiritual/emotional connection to nature is important, and most people have it.” One described how field work provides the “opportunity to experience the natural beauty, wonder, and spirituality of the world around us,” and then referred to the literature of “John Muir, Aldo Leopold, Rachel Carson, Edward Abby, John McPhee, Wallace Stegner, Thoreau, [and others].” One interviewee emphasized the importance of a sense of connection to—and spiritual alignment with—that which is beyond the self, including other species, “place,” and the universe:

> *spiritual* means affairs that make us animate: personality, sentience, will, and awareness of a larger personality, larger sentience, greater will outside of us, in our fellows—the "actual other," yes—but more than that, inherent in the universe itself...We experience relief, relaxation, regrowth when we align ourselves with something larger than ourselves, with another person, with the harmony of a place, with non-human lives, and with something larger yet.

Opinions on the role of the spiritual in the environmental movement

To further examine interviewees’ attitudes about the spiritual or personally meaningful aspects of the human relationship with nature, I asked interviewees to indicate their level of agreement[22] with a quotation by Wilson (*Table 4-3*). Over seventy percent agreed with it. In follow-up open-ended comments,[23] interviewees expressed their agreement—or disagreement—with one or more of the following points from the quotation:

- The relevance of natural science to the environmental movement.
- Making room for dialogue about “the spiritual impulse” in the dialogue between science and the public [so that such dialogue is not limited to “a humanistic ivory tower…”].
- Whether talk about spiritual ways of knowing “can be done in a way that touches what people like Joe Six-Pack are thinking.”
- Spiritualizing the environmental movement.
- Integrating objective and non-objective ways of knowing—by basing the sense of the spiritual on “a sound empirical base”—in the dialogue about environmental issues.
- Considering “the broader meaning of the sacred: the deep sense of spirituality about each other and about our natural environment.”

[22] Using a Likert scale to indicate level of agreement, from “strongly agree” to “strongly disagree.”
[23] Attitudes expressed in these comments have been included in the text of this paper, if they were relevant to the theme being discussed.

Table 4-3: Responses to the question, What best describes your level of agreement or disagreement with the following statement:

In an interview in Salon on-line magazine, 4/22/00, the biologist E. O. Wilson discussed the idea that if natural science is to have relevance to the environmental movement, it must make room for dialogue about "the spiritual impulse," which he considers an evolutionary advantage central to human nature. In the interview, he said, "I don't think it is something that's going to be done in a humanistic ivory tower. It's got to be done in a way that touches what people like Joe Six-Pack are thinking. We've got to get moving on an effort to spiritualize the environmental movement—not in the sense of starting to offer up prayers—but with a sound empirical base. The naturalistic view…requires that we consider the broader meaning of the sacred: the deep sense of spirituality about each other and about our natural environment."

Level of Agreement	**Percentage of Responses** (approximation)	**Number of Responses** (N=31)
Strong Agreement	19%	6
Strong Agreement, with reservations	3%	1
Agree	26%	8
Agree, with reservations	23%	7
Neither Agree nor Disagree	23%	7
Disagree	6%	2

Summary of definitions and descriptions

A summary of these definitions and descriptions about the spiritual or personally meaningful aspects of the human relationship with nature can provide insight into the different perceptual positions natural scientists might assume in relation to nature. I have regrouped them slightly differently here, and have condensed the eight themes into six. Virtually all those I interviewed indicated that nature was personally meaningful to them in some way. These six themes reflect the way their expressions of meaningfulness ranged from a relatively distanced view such as an interest in nature based solely on aesthetics or intellectual curiosity and career benefits, to a deeply connected view that blends emotions, intellectual knowledge, a sense of spiritual

connection, and other ways of knowing into a personal commitment to sustainability. I present these six viewpoints as separate themes, although a few interviewees expressed viewpoints from multiple themes.

Nature as amenity

While most of those I interviewed expressed familiarity with, and even enthusiasm for, the spiritual experience of nature, some expressed this only in terms of nature as amenity. They described their experiences of nature by the benefits it offered them, such as beauty or pleasant feelings. They spoke of the spiritual dimension of their relationships with nature in terms of discrete experiences, limited to the rejuvenating, enjoyable, or even awe-inspiring feelings experienced in natural places, rather than as an ongoing sense of connection to nature. Their descriptions did not include a personal commitment to sustainability goals, however, or refer to stewardship or other ethics regarding nature. Although these interviewees described their spiritual experiences of nature from what could be described as a human-centered perspective, none of them indicated that nature was unimportant to them. These human-centered experiences of nature could be contributing to a transformation of the way they identify themselves in relation to nature, a process described as "ecological identity work"[24] stemming from the "transformative value"[25] of nature.

Intellectual explanations

One interviewee assumed the position of distanced observer even as she supported the spiritual connection to nature, explaining it as naturalistic. She indicated that she did not believe in religion or any other form of spirituality, but said that if this sense of connection moved people to be committed to sustainability, we should use it: "There's no supreme being (at least, that can't be proven nor disproved, so we won't

[24] Ecological identity work: Using the direct experience of nature as a framework for personal decisions, professional choices, political action, and spiritual inquiry (Thomashow 1995, xiii).

[25] Transformative value: The ability of the experience of nature to transform the human observer when she becomes aware of the majesty of natural processes, feels herself to be a part of that process, and feels a responsibility to foster its continuance. This transformation includes a reconsideration of present consumptive preferences, and a consequent adoption of values that are objectively better in sustaining ecological and evolutionary processes (Norton 1987; Takacs 1996). Such transformation involves the observer's non-objective as well as objective ways of knowing.

try)—but maybe it's best for our health, our 'fitness,'[26] to be religious because we've evolved that way for some reason, and so we do better when we use it, when we act religiously. It increases our survival in some way." She added that this sense of spiritual connection should be encouraged, if it is found to motivate environmentally sustainable behaviors. She clarified that spiritual feelings would not motivate her, but that they may well motivate people who were not interested in quantifying these feelings. She assumed that in general, these people would not be scientists.

Most interviewees who described the spiritual in intellectual terms dismissed the spiritual because it was not testable, describing the spiritual as a "constructed" concept, or as "something that can't be proven." One interviewee, however, argued that while the spiritual was not logically explainable, this did not negate the possibility of spiritual connection to nature.

Skepticism

Several interviewees were skeptical of talk about spiritual connections to nature, especially regarding its potential to inspire commitment to sustainability goals. One said, "I think the environmental movement has more pertinence and necessity in our lives than having it be based on spirituality; it's more about survival. We're pretending we have the luxury of combining the two." This perspective suggests that we are still in an era of disbelief that we could be ecologically threatened, so spirituality as a hook is necessary, and that once humans as a whole understand the crisis, mere self-preservation will be sufficient to get people to work for sustainability.

Several pointed out that the spiritual is not relevant to everyone's understanding of nature. One said, "I agree that [nature] generates spiritual experiences for some people, but not all people." Another was more critical, saying, "If we put more emphasis on [the spiritual], I think we would *lose* people supporting the environmental movement." Another vacillated in his opinion of Wilson's call to "spiritualize the environmental movement" (2000), saying that while it might motivate non-scientists,

> if you follow along these lines you cut out lots of people who work in the natural science part...The majority of natural scientists would *not* agree with the statement, I think. Then again, many of them could

[26] Fitness: a trait that helps insure survival of the species.

> appreciate the spiritual impulse in some way—but it's got some problems associated with it, perhaps.

Another interviewee indicated that she was aware of environmentalists who integrated a sense of spiritual connection to nature into their work, but said she thought the spiritual was simply "another attempt by environmentalists to package the environment in a way that gets people to understand the need to preserve it." She expressed doubt that this would be effective: "[Wilson] is saying we haven't formulated the message in the right way, but is that really true? ...[T]he truth may be that some people just don't care."

Spiritual connection

Most interviewees did not express such skepticism, and saw the spiritual as part of a deeper connection to nature: "[the spiritual] is an important way of understanding nature," and "nature is sacred." One interviewee said he combined spirituality, values, and environmental concerns, to help in "a substantive way to save the planet." He talked about the importance of aligning behavior with values, and expressed faith in the viability of doing so. He pointed out that this could involve taking risks in the discourse and workplace of natural science, saying,

> Have the courage to speak of the spiritual in things like scientific and scholarly writing, in how one describes oneself, one's reasons, et cetera... We have to live our beliefs, live the reality that we understand and experience and espouse.

Spiritual connection and sustainability

Several interviewees emphasized the importance to sustainability of "this spiritual, emotional connection to nature...because ultimately that's at the heart of everything, this connection. We aren't going to solve any environmental problems by ignoring that!" Two interviewees spoke about the intrinsic value—and rights—of other species, even placing the sustainability of the whole of nature ahead of the sustainability of the human species, while calling for more responsible human behavior: "We are stewards of the earth…It doesn't matter if a species serves an economic purpose—they have a right to exist, apart from any benefit to ourselves. I even think maybe the small pox virus has a right to exist." The other interviewee stated it more strongly, saying,

"Many times I get asked what kind of medicine my research will come up with, but that's not what I care about at all. Humans are a low priority for me. I'm not interested in preserving forests for future *human* generations, for example. I don't think we even have the right to think in that way."

Integrated knowledge

Most scientists I interviewed seemed comfortable with their ability to experience nature in this non-objective way without jeopardizing their objective way of knowing as natural scientists, as evidenced by their acknowledgments of their spiritual experience of nature. Seven of the thirty-one natural scientists interviewed specifically mentioned ways to combine objective and non-objective ways of knowing. While their ideas on this blended way of knowing were not fully developed, each described a combination of objective knowledge with emotion, motivation, behavior, and a sense of connection to nature (whether described as spiritual or personally meaningful). The first interviewee, in his comments about inspiring the general public to become involved in environmental issues, talked about the importance of encouraging a personally meaningful connection to nature while presenting factual information, saying,

> Part of the problem with science is that people don't identify with what you're doing. It is seen as removed from daily life. [Spirituality] can really relate to feelings and [convey] the relevance of what you're doing to the general public…At a whale watch, the scientist (me) is reporting on the facts of their behavior, but it's also more than that, and it can move people deeply. Seeing the animal in nature can sometimes move people to then get involved in work for preservation and environmental issues.

Two interviewees emphasized the importance of integrating different ways of understanding the natural environment, including values and ethics along with objective knowledge and personally meaningful connection: "We are stewards of the earth, behaving in the right way." One maintained that ignoring the spiritual aspect of our human selves threatened our future, because "Humans are multipart [sic]. Our spiritual aspect is as strong as our need for air or food or companionship. We ignore it at our peril…if we are] to save the planet." The other focused on the integration of non-objective and objective ways of knowing to inspire sustainable behaviors in people:

It's a battle [to solve environmental problems], and it's going to be won

> by...somehow opening [people's] hearts to caring about it—and that's where the spiritual connection comes in, effecting behavioral change...It's important to reach out to the emotional part of humans, "spiritualizing the environmental movement" (Wilson, 2000), but to do so with scientifically accurate, empirical information...

Another interviewee felt it was not possible to integrate a sense of spiritual connection to nature with an empirical way of knowing, saying, "I agree [with Wilson] that the spiritual impulse drives the environmental movement, but I don't see how it can be embedded in natural science." He then followed this with a statement that, which perhaps not his intention, suggests an appropriate way to integrate the two, saying, "We use spirituality to set goals, and then use natural science to accomplish those goals."

Another interviewee described a blend of the intuitive, the objective, and the spiritual, noting that each was an integral part of her science work:

> There are 10,000 climatologists out there who believe that global [climate] change is coming at us big time...Yet the evidence, arguably, is hardly in. Why are those 10,000 convinced? Because they weigh what they see and hear and feel, and then use their internal compass… [They] build a picture greater than the sum… Almost all scientists do this whether they admit it or not…[When I am] out in the field... why do I choose this [stream] bank instead of that one…? I don't know…Like the spiritual in general, it's part of the fabric of my life, and I take any help I can (internal or external) any time I'm charitable enough to recognize and accept it.

The final interviewee of this group noted that "the best scientists" are open to the sense of non-objective connection to nature. She described the integration of objective observation with spirituality, personal experience, and a sense of connection to "all the other elements in nature," but implied that specifying the details of such a blend would be difficult, saying,

> The scientific approach should be from your actual experiences, putting it all together…through your own paradigms. You don't personalize it too much, you just gather the information and let it be. [Yet] the only way to really realize something is to feel the connections. You can't just look at it technically. Spirituality and science definitely meet somewhere, but it's a long winding road to that place. The best scientists are open to this connection, though.

Interpretation: A continuum of attitudes

These definitions and descriptions about the spiritual or personally meaningful aspects of the human relationship with nature indicate that natural scientists construct meaning about nature and their spiritual or personally meaningful way of understanding it. These constructed meanings—or attitudes—can be arranged along a continuum ranging from a distanced position of objective detachment from nature, with little or no sense of connection or responsibility to the ecological whole of nature, to a position of deep connection to nature, in which objective ways of understanding are integrated with non-objective ways to form a responsible commitment to sustainability. Arranging attitudes in this way helps us gain insight into the personally meaningful ways that natural scientists understand nature, as well as their attitudes about these non-objective ways to think about nature. It also sheds light on their attitudes about sustainability, because for some scientists, sustainability concerns are integral to the way they think about nature.

I have clustered these attitudes into broad categories. Their arrangement on the continuum is rather arbitrary, because, as indicated by my interview data, some attitudes can overlap, and some individuals hold a number of attitudes simultaneously—even slightly contradictory ones.

This continuum is presented in three parts:

(1) A comparison between the attitudes expressed by my interviewees and those expressed in the literature reviewed, including the interviewees from the studies by Richert and Takacs;
(2) An abstract portrayal of this continuum of attitudes held by natural scientists about nature and the non-objective positions they might assume toward it, including a personally meaningful and/or spiritual sense of connection to it. This portrayal also compares attitudes to areas of potential influence—indicated by social circumstances in which the natural scientist chooses to engage in discussions about these topics.
(3) A portrayal of the attitudes of two hypothetical natural scientists, and their areas of potential influence. A matrix showing potential overlaps between these attitudes.

I have included one or two interviewee comments for each attitude, as well as an estimate of the number of interviewees who made comments reflecting each attitude.

(This estimate does not reflect the number of interviewees who may identify with a particular attitude. I did not analyze any individual's overall attitude about nature, only their comments about it.) Most of the categories contain several related attitudes; some are more extreme than others. An individual need not support all attitudes in each category.

In the comparison, I have listed the names of those who clearly expressed a specific attitude in their literature, although this is not a comprehensive list. The comparison is skewed in (1) through (6), where attitudes express skepticism, or a disconnect from nature. While there may be a considerable amount of literature that expresses these attitudes, I did not review such literature for this thesis.

A continuum of attitudes held by natural scientists about nature and the personally meaningful and/or spiritual connection to it, with a comparison between my interview data and the literature.

I. Disconnected from and dominant over nature; no focus on sustainability; position of excessive distance, with no integration between objective and non-objective ways of knowing.

Those expressing the ideas in (1) or (2) did not express their attitudes about nature in terms of the personally meaningful.

1) Humans are the dominant species. It is natural that some species die as a result of our dominance. Nature is an adversary that we have the power to control.
Literature: One of the scientists interviewed in the Richert's study.
My Interviewees: None.

2) Nature is only a commodity for humans; it has no intrinsic value.
Literature: One of the scientists interviewed in the Richert's study.
My Interviewees: None.

In (3) through (5), attitudes about nature are judged by me to be superficial, even if expressed in terms of personal meaning. These attitudes can be described as discrete experiences, in which a pleasant or even spiritually moving experience of nature is seen as a product of nature. The experience is not incorporated into a broader, ongoing sense of caring, responsibility, or commitment to the whole of nature.

3) Nature is an amenity (I). Nature is only an aesthetically beautiful backdrop for one's work.
Literature: None.
My interviews: None. [Several of my interviewees at the field station in the southeastern United States expressed this attitude, enjoying the beauty of nature while conducting research focused on products that produce harmful effects on the environment, e.g., pesticides. But because I did not use the word *spiritual* in those interviews, I did not list them here, and have not included them in my overall findings, as I noted in *Chapter Three.]*

4) Nature is personally meaningful only in terms of intellectual stimulation and research in one's career. The thrill of discovery, and the potential prestige that can result.
Literature: None. [Several, however, expressed anger toward scientists who hold this superficial attitude towards nature and sustainability. Lovejoy (one of Takacs' interviewees) expressed frustration and even disgust with the "...large numbers of [single organism biologists] who don't even think [biodiversity] is important enough to care about…The very stuff on which their science is being built is vanishing while they play their little games" (Takacs 1996, 137).]
My Interviews: Three. [Outside the context of my interviews, I heard several natural scientists express a hopeless attitude about sustainability, while expressing intellectual enthusiasm for their research. For example, in an informal conversation at the 2003 Conference of the Association of American Geographers in New Orleans, a natural scientist described to me his interest and zeal for his work, but then argued that the environment is doomed, and that humans will not last many more generations. He was angrily dismissive of my suggestions for considering the possibility of a more hopeful, problem-solving focus on sustainability. One interviewee expressed this same pessimism: "I am pretty confident that humans will damage their environment so thoroughly that we will eventually drive ourselves to extinction."

II. Less disconnected; less focused on dominance over nature; position is mildly distanced.

5) Nature is an amenity (II). Nature is personally uplifting, and even spiritually moving. Natural areas should be preserved for human enjoyment of these qualities. [This attitude does not incorporate a concern for larger environmental issues, but can serve as a small step toward a more meaningful dedication to sustainability.]
Literature: None.
My interviews: Three. [The experience of nature "is perhaps pleasant and something healthy about it. Emotionally rejuvenating."]

Attitudes expressed in (6) through (9) are more concerned with the role of the spiritual in sustainability—and discomfort with it—than with a personal attitude toward nature. I include them on this continuum because these attitudes about spiritual or personally meaningful ways of knowing can overlap with attitudes that support an integrated way of understanding nature.

6) Skeptical; the idea that the spiritual has a role in sustainability issues is dubious. A focus on the spiritual can be self-indulgent, and distract from important work on environmental issues.

Certain so-called "spiritual" ways of knowing nature, as for example those that evoke a mythical explanation such as Gaia, are misinformed and misleading. A sense of spiritual connection to nature cannot be proven objectively, or explained rationally (except in terms of a "natural" human characteristic). For these reasons, this way of knowing is irrelevant to sustainability issues.

Literature: None.

My interviews: Four. ["I think the environmental movement has more pertinence and necessity in our lives than having it be based on spirituality; it's more about survival. We're pretending we have the luxury of combining the two." "I've seen attempts to spiritualize environmental issues with just plain false (non-empirical) information…taking the low-road of fantasy arguments…such as arguments that rain forests have a consciousness that is similar to human awareness."]

7) The sense of spiritual connection to nature can be explained as naturalistic, that is, based on the system of thought holding that all phenomena can be explained in terms of natural causes and laws. Whether or not an individual scientist holds any spiritual beliefs, he or she can refer to such non-objective ways of knowing in order to motivate people to act more sustainably.

Literature: Wilson, Takacs' interviewees: Ehrlich, Eisner, and Iltis.

My interviews: Two. ["There's no supreme being—at least, that can't be proven nor disproved, so we won't try. But maybe it's best for our health, our 'fitness,' to be religious because we've evolved that way for some reason, and so we do better when we use it, when we act religiously. It increases our survival in some way. In other words, believe in something that is *not* real, in order to bring about real, measurable results."]

III. Beginning to connect to nature, and focus on sustainability and responsibility to nature.

Attitudes expressed in (8) through (14) take the form of continuous experience. While one's spiritual and/or personally meaningful experience of nature may be experienced in a discrete way, the experience is part of an individual's continuous and personally meaningful sense of connection to nature, and part of an individual's overarching philosophy about nature.

8) Spiritual connection may be a part of our relationship with nature, but it should not be discussed in environmental work because it creates problems among people. It can be too personal, too uncomfortable, too unprofessional, or too controversial.

Literature: None. [Takacs presents an examination of both sides of the argument about whether natural scientists should discuss their personal and/or spiritual connection to nature. He ends by making the case for more discussion, not less.]

My interviews: None. [Most interviewees indicated that they refrained from such talk for various reasons, but no one argued against such talk.]

9) All species have a right to exist, but humans are a low priority. Humans are so destructive to the natural world that their continued survival is not necessary, and is even undesirable to the

whole of nature [See also Qiammem's (1998) interviews with world-renowned evolutionary biologists.]
[This is a reverse image of the extreme attitude expressed in (1), in which the individual does not feel that loss of non-human species is important, and that nature exists as a commodity to be exploited by and for humans. In (1), the human species takes precedence over all other species. Humans are seen as separate from and dominant over nature, and all other species are seen as expendable. In (9), all non-human species take precedence over the human. Humans are seen as expendable, but still somehow separate from nature.]
Literature: None.
My interviews: Three. ["Many times I get asked what kind of medicine my research will come up with, but that's not what I care about at all. Humans are a low priority for me. I'm not interested in preserving forests for future human generations, for example. I don't think we even have the right to think in that way." "Humans are a pestilence on the earth!"]

10) We are stewards of the earth. We are caretakers, and therefore dominant over nature, but we have a moral responsibility to care for nature and manage it wisely.
Literature: Muir, Leopold, Shepherd, Fowler.
My interviews: Eleven. ["(I want) to think there's something I've done to make a difference in conservation for the future. It's important to learn…but more important to plant a tree, to make a change in some way…"]

IV. More connected; focused on sustainability.

11) All species have an equal right to exist (including humans). Nature has intrinsic value.
Literature: Muir, Leopold, Carson, Naess, Ehrenfeld, Shepherd, Soule, Takacs, Gorman, Kellert.
My interviews: Twenty-eight. ["…all species have a right to live and that should be enough."]

12) Integration of different ways of knowing nature may motivate more sustainable behaviors, but such integration is difficult, if not impossible.
Literature: None.
My interviews: Two. ["Spirituality and science definitely meet somewhere, but it's a long Winding road to that place. The best scientists are open to this connection, though." "I agree that the spiritual impulse drives the environmental movement, but I don't see how it can be embedded in natural science."

V. Open to integration of different ways of knowing.

13) The sense of spiritual connection to nature cannot be entirely explained by science, and is not measurable, explainable, or provable—but for many of us it is an important factor in our relationship with nature.
Literature: Muir, Leopold, Shepherd, Fowler, Naess, Ehrenfeld, Nash, Mayr, Soule,

Simmons, Takacs, Thomashow, Orr, Berry, Berg, Wilson, Rennie, Gorman, Kellert et al., Takacs' interviewees: Raven, Ehrlich, Orians, Noss.

My interviews: Two. ["(the spiritual is) not necessarily explainable—or *un*explainable." While only two interviewees specifically mentioned the immeasurable aspect of the spiritual, over seventy-three percent of interviewees agreed or strongly agreed with Wilson's quote on the importance of spiritualizing the environmental movement.]

VI. Connected to and cooperating with nature; fully focused on sustainability; position of deep involvement, integrated with the distanced perspective of the objective researcher.

14-a) Integrating our different ways of understanding nature is crucial to sustainability. An integration of our emotions, sense of spiritual connection, intellectual knowledge, and other ways of knowing can form a holistic and effective commitment to nature.

Literature: Muir, Leopold, Carson, Naess, Shepherd, Ehrenfeld, Simmons, Nash, Mayr, Soule, Takacs, Thomashow, Orr, Berry, Berg, Wilson, Rennie, Gorman, Kellert et al., Kaiser, Takacs interviewees: Raven, Ehrlich, Noss, Orians.

My interviews: Seven. ["To get people to act in an altruistic fashion, their spirits must be moved. Without that, [environmental education and the environmental movement] won't do us any good." "[Use] Wilson's 'spiritualizing' [of the environmental movement], but do so with scientifically accurate (empirical) information." "Humans are multipart [sic]. Our spiritual aspect is as strong as our need for air or food or companionship. We ignore it at our peril…[if we are] to save the planet."]

14-b) In addition to the facts, it is important to talk to the public about the spiritual connection to nature, because it is part of what motivates many people to act more sustainably.

Literature: Leopold, Naess, Berry, Soule, Ehrenfeld, Simmons, Mayr, Takacs, Thomashow, Orr, Wilson, Rennie, Gorman, Kellert et al., Takacs interviewees: Raven, Ehrlich, Noss, Orians.

My interviews: Six. [(Spirituality) can really relate to feelings and [convey] the relevance of what [scientific research] you're doing to the general public…" "The spiritual connection—it's what moves the masses."

An abstract portrayal of this continuum of attitudes held by natural scientists about nature and the non-objective positions they might assume toward it, is shown in *Figure 4-2*. This portrayal also compares attitudes to areas of potential influence—indicated by social circumstances in which the natural scientist chooses to engage in discussions about these topics.

KEY to Figure 4-2: ***Attitudes held by individual natural scientists about nature, reflecting different perceptual positions in relation to nature [See Attitudes (1) through (17) in Figure 4-2]:***

1) Nature is a commodity for human use; economic value is important.

2) Nature is an amenity; economic value for aesthetics and recreation is important.

3) Nature is intellectually stimulating.

4) I study nature because it offers opportunities for professional prestige.

5) I study nature because it is an interesting career.

6) I study nature because it offers opportunities for the thrill of discovery.

7) Time spent in nature is enjoyable.

8) Time spent in nature is inspiring, rejuvenating, and/or peaceful.

9) Nature evokes a sense of connection to something beyond self; spiritually inspiring.

10) I experience a sense of kinship and/or unity with nature.

11) Nature should be preserved.

12) We are stewards of nature; we should take responsibility to protect it.

13) All species in nature should be protected, but humans are a low priority.

14) All species in nature should be protected (including humans).

15) Integration of objective with personally meaningful and/or spiritual (non-objective) ways of knowing is important for achieving sustainability goals—but such integration is difficult.

16) Personally meaningful and/or spiritual (non-objective) ways of knowing nature are not measurable or explainable, but are important for sustainability.

17) Integration of personally meaningful and/or spiritual (non-objective) ways of knowing is crucial for sustainability.

Social Circumstances for Discussion (*Check all that apply*):																	
Non-science groups, e.g., church – focused on environment																	
Science groups for non-science public – focused on environment, e.g., Sierra Club																	
Science groups for non-science public – no focus on environment																	
Acquaintances																	
Friends																	
Family																	
Students																	
Professional science groups, e.g., seminars																	
Journals																	
All colleagues																	
More powerful colleagues																	
Friendly colleagues																	
Trusted colleagues																	
Personal attitude																	
Attitudes: (See key, p. 84)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Perceptual positions in relation to nature:	← Distanced from nature, less likely to integrate objective and non-objective ways of knowing; more importance placed on personal and/or human gain.								Connected to nature, more likely to integrate objective and non-objective ways of knowing; more importance placed on benefits to nature as a whole, beyond self. →								

Figure 4-2: Attitudes held by individual natural scientists about nature, reflecting different perceptual positions in relation to nature. Comparison of attitudes to areas of potential influence—indicated by social circumstances in which the natural scientist chooses to engage in discussion.

Details on Figure 4-2: ***"Social circumstances for discussion":***

- Non-science groups (e.g., church group) for the non-science public—with a focus on environmental issues
- Science groups for the non-science public—with a focus on environmental issues (e.g., Sierra Club)
- Science groups for the non-science public—no explicit focus on environmental issues (e.g., wildflower tours)
- Non-colleague acquaintances
- Non-colleague friends
- Family
- Students
- Professional science groups (e.g., conferences, workshops, seminars)
- Journals
- All colleagues
- More powerful colleagues (e.g., department head; director of research center)
- Friendly colleagues
- Trusted colleagues
- [*Personal attitude—inner dialogue or understanding*]

Figure 4-2 can help determine:

- *Potential for influence:* Who an individual natural scientist is likely to talk to about nature.
- *What kind of influence:*
  - Distanced and disconnected from nature [no need to focus on sustainability goals]; not open to integration of objective with personally meaningful and/or spiritual (non-objective) ways of knowing,

  OR:
  - Connected to and cooperative with nature, focused on sustainability goals; open to integration of objective with personally meaningful and/or spiritual (non-objective) ways of understanding nature.
- *How an individual natural scientist is likely to influence others:* what topics is she likely to talk about?

When a natural scientist sees himself as more connected, caring, and/or responsible to nature, he is more open to the integration of objective knowledge with certain non-objective ways of understanding nature. This in turn may determine how likely he is to talk about sustainability issues, and how much influence he exerts regarding these issues. For example, Carl Sagan was open to integrating objective knowledge with personally meaningful (non-objective) ways of understanding nature, along with a sense of care and responsibility to the overall sustainability of nature. Furthermore, he was willing to speak with a wide variety of social groups, by participating in different venues. In doing so, he may have contributed to an expansion of the influence of science in sustainability issues.

Two hypothetical examples for *Figure 4-2*

I have created these two hypothetical natural scientists from the experience I gained through my interviews. They are not based on any particular individuals, but are amalgams of common attitudes and communication styles that I observed. A portrayal of the attitudes of the first hypothetical natural scientist, and the potential areas of his influence, is shown below. In this hypothetical example, the natural scientist holds a wide range of attitudes about nature, from seeing the economic benefits to humans, enjoying the career benefits of being a natural scientist (time spent in nature, prestige, thrill of discovery, intellectual stimulation), to believing that we are stewards of nature and should work to preserve it. But this scientist is not comfortable talking about many of these attitudes with others. For example, he talks about the economic benefits of natural resources when he feels it is necessary to fit in professionally (he may talk about this with his superiors, and he talks with other scientists about this if he feels it is necessary to go along with discussions that focus on these benefits). He would rather not focus on economic benefits of natural resources, if it involves environmental degradation, e.g., research or discussions about economic profit from strip mining. He prefers to focus on the economic benefits of recreation and aesthetics; because this is professionally acceptable, he engages in discussions about this with all colleagues, attends seminars or workshops on this topic, and writes related journal articles.

He is not interested in prestige, although he privately enjoys his successes. He is in natural science because of his enjoyment of and caring for nature. He is quite willing to talk about the enjoyment of being in nature—this is a safe topic for discussions with students, co-workers, and friends. He is involved in groups that are not focused explicitly on environmental issues, because he is concerned that interaction with environmental groups may not meet the approval of his superiors. He does volunteer for wildlife education workshops. He is not comfortable talking to people about his beliefs in biodiversity conservation, but does occasionally talk about this with trusted colleagues, and friendly colleagues (if they bring it up). He talks about preservation with his students, but is careful not to be adamant about it. [See *Figure* 4-2 (a).]

Social Circumstances for Discussion (*Check all that apply*):																	
Non-science groups, e.g., church – focused on environment																	
Science groups for non-science public – focused on environment, e.g., Sierra Club																	
Science groups for non-science public – no focus on environment							X X										
Acquaintances							X X										
Friends							X X										
Family				X X		X X	X X										
Students	X X	X X			X X	X X	X X				X X						
Professional science groups, e.g., seminars		X X															
Journals		X X															
All colleagues	X X	X X															
More powerful colleagues	X X	X X															
Friendly colleagues		X X	X X		X X	X X	X X				X X	X X					
Trusted colleagues		X X	X X		X X	X X	X X			X X	X X	X X					
Personal attitude	X X	X X	X X		X X	X X	X X	X X	X X	X X	X X	X X		X X	X X	X X	X X
Attitudes:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Perceptual positions in relation to nature:	← Distanced from nature, less likely to integrate objective and non-objective ways of knowing; more importance placed on personal and/or human gain.								Connected to nature, more likely to integrate objective and non-objective ways of knowing; more importance placed on benefits to nature as a whole, beyond self. →								

Figure 4-2 (a): Attitudes held by individual natural scientists about nature, reflecting different perceptual positions in relation to nature. Comparison of attitudes to areas of potential influence—indicated by social circumstances in which the natural scientist chooses to engage in discussion.

A portrayal of the attitudes of the second hypothetical natural scientist, and the potential areas of her influence, is shown in *Figure 4-2 (b)*. This second hypothetical natural scientist places more importance on sustainability issues, although she also values some of the economic benefits from natural resources. She is willing to stick her neck out and talk with many different people about the issues she supports. She enjoys some of the career benefits of natural science, from the prestige to the thrill of discovery—and is willing to talk to her colleagues about these perks – but she also feels a deep devotion to nature, and is dedicated to sustainability issues, on a personal as well as a professional level. She shares her deeply held views on sustainability issues with trusted colleagues, including her ideas about the importance of the spiritual connection to nature. She also talks about this with students, family, and non-colleague friends—but not with other colleagues. She contributes some of her time to meeting with environmental groups, and non-environmental groups that are interested in doing something to support environmental issues. She shares her knowledge of sustainability issues with them, and is open about the spiritual and personal aspects of her dedication to nature.

A comparison

While the first of these two hypothetical natural scientists considers sustainability issues to be important, he is not comfortable speaking about his views with many others. Furthermore, he limits the ways he is willing to communicate about these views, and sticks to objective presentations. He keeps most of his views on sustainability to himself.

The second hypothetical scientist also considers sustainability issues to be important, and is willing to talk about these views with colleagues, personal friends, family, and environmental groups. While she does feel some constraints in professional dialogue, she communicates with a wide circle of non-scientists. She presents them with objective knowledge about sustainability issues while allowing them to voice their personally meaningful sense of responsibility to nature. In this way, she provides more people with information about the issues she considers important, and also reaches them

Social Circumstances for Discussion (*Check all that apply*):																	
Non-science groups, e.g., church – focused on environment							X X	X X	X X	X X	X X	X X		X X		X X	X X
Science groups for non-science public – focused on environment, e.g., Sierra Club							X X	X X	X X	X X	X X	X X		X X		X X	X X
Science groups for non-science public – no focus on environment							X X	X X			X X	X X		X X			
Acquaintances							X X	X X			X X						
Friends							X X	X X	X X	X X	X X	X X		X X			X X
Family							X X	X X	X X	X X	X X	X X		X X		X X	X X
Students			X X				X X	X X	X X	X X	X X	X X		X X		X X	X X
Professional science groups, e.g., seminars											X X			X X			
Journals											X X			X X			
All colleagues			X X				X X	X X									
More powerful colleagues			X X			X X	X X	X X			X X						
Friendly colleagues			X X			X X	X X	X X			X X	X X		X X			
Trusted colleagues			X X		X X	X X	X X	X X	X X	X X	X X	X X		X X	X X	X X	X X
Personal attitude		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X		X X	X X	X X	X X
Attitudes:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Perceptual positions in relation to nature:	← Distanced from nature, less likely to integrate objective and non-objective ways of knowing; more importance placed on personal and/or human gain.								Connected to nature, more likely to integrate objective and non-objective ways of knowing; more importance placed on benefits to nature as a whole, beyond self. →								

Figure 4-2 (b): Attitudes held by individual natural scientists about nature, reflecting different perceptual positions in relation to nature. Comparison of attitudes to areas of potential influence—indicated by social circumstances in which the natural scientist chooses to engage in discussion.

in ways that are meaningful to them in addition to the strictly objective.

Summary: Experiencing nature through multiple ways of knowing

As indicated by the interview data thus far, many of these natural scientists understand nature in spiritual or personally meaningful as well as objective ways. Some support an integration of these ways of knowing, and may even emphasize the importance of a spiritual connection to nature. Many natural scientists appear to hold views similar to the literature regarding these issues. The hypothetical examples provided above indicate a potential in the discourse of natural science for a rich variety of opinions and discussions about the role of non-objective but spiritual or personally meaningful ways of knowing in sustainability issues. With these observations in mind, I present the results of my investigation into the role of talk about these attitudes among colleagues in the discourse of natural science.

The Spiritual in the Discourse of Natural Science

Interview responses to the question asking natural scientists whether or not they talk with colleagues about spiritual or personally meaningful ways of knowing nature indicate that there is little space in the workplace of natural science for such discussions (*Table 4-4*). Although ninety percent of those interviewed either strongly agreed or agreed that "nature generates spiritual experience" (including the sixteen percent who agreed or strongly agreed, but with reservations), and seventy-three percent agreed that the spiritual was part of their experience of nature in some way, talk about it was rare. Forty-three percent said they did talk about this topic, but not frequently; fifty-seven percent indicated that they did not talk about it at all.

Three interviewees said they had shared spiritual experiences with colleagues at research sites in natural settings, but only non-verbally. While their sense of communication may well have been genuine, I categorized it as a "no" response, because they did not verbalize their impressions with their colleagues, and I am interested only in the spoken discourse. For the same reason, I counted as "yes"

Table 4-4: Responses to the question, "Have you had (or do you have) any discussion about this [the spiritual] among your colleagues or other people?"

Level of Agreement	**Percentage of Responses** (approximation)	**Number of Responses** (N=30)
Yes	43%	13
No	57%	17
Details for Responses counted as "Yes"		
Often	0%	0
Occasionally	7%	2
Occasionally/ It depends	23%	7
Only with students, not colleagues	3%	1
Rarely	7%	2
Details for Responses counted as "No"		
No (no additional comment)	27%	8
Not exactly/ probably not	10%	3
Probably not (unclear)	10%	3
With others (not students or colleagues)	3%	1
Non-verbal (shared experience but not discussion)	10%	3

responses only those who indicated they talked with students and/or colleagues in addition to, or instead of, people outside natural science.

Reasons for avoiding talk about spiritual understandings of nature

Although forty percent of those I interviewed indicated that they talked with colleagues and/or students about the spiritual connection to nature, almost all of these interviewees expressed caution about doing so. Seven indicated that they talked about this occasionally, but freedom to talk depended on different factors. A few mentioned certain circumstances. Several said it depended on the colleague: "only if the person values spirituality."

One interviewee said she rarely talked about the spiritual connection to nature, and conjectured that the general lack of discussion among natural scientists about this topic was because "scientists…don't have much of a voice for it."[27] This assessment could explain the responses of those who mentioned sharing experiences in the field non-verbally: "…more of a bond than something that is discussed," "a deep personal experience that is generally not verbalized." Others said the spiritual was too personal to discuss, or difficult to define "because of our upbringing, culture, and many other factors." Some interviewees were simply unsure as to what such discussions would address, even though they clearly indicated—one "definitely!" and one "absolutely!"—that they had experienced nature in a spiritual way. One said he did not talk about this, then said he wasn't sure, but if so, it was rare. Two others described talk about plans for hiking or camping: "I do talk a bit about this [spiritual experience of nature] with my wife, mostly about how we're going camping on the weekend." They did not clarify how talk about camping relates to talk about a sense of spiritual connection to nature.

Several interviewees did not discuss the spiritual simply because they did not believe in its validity, and assumed that "my associates, I think they all think like me." Another, commenting on the Wilson quotation about spiritualizing the environmental

[27] Rennie concurs with these observations. He notes that natural scientists "may feel that it is not appropriate to talk about it, or feel self-conscious talking about it" (1999b).

movement, indicated that he thought such talk was simply out of place, saying, "…when you talk about the environmental movement, you don't talk about spirit or soft-sided issues." Two equated the spiritual with religion, saying the spiritual was not a topic of conversation "unless [we're] having a discussion about religion," and indicated that they were "not spiritual" or "religious." Another noted that when "some define the spirit as religion, whether or not you believe in religion… this can create dialogue—or cause problems in dialogue—with those who don't agree."

A few interviewees indicated that they felt uncomfortable talking about the spiritual and nature. Several gave reasons—it was too personal, or too socially risky—but two simply could not say why they felt this discomfort. One said that he had not thought about it before. This discomfort was prevalent even though many I interviewed were familiar with, and even enthusiastic about, the spiritual dimension of their relationship with nature, as indicated by the high percentage agreeing with the questions regarding spiritual experience.

One interviewee judged some of her fellow scientists harshly. When I asked her the follow-up question, "Do you think discussion between scientists and non-scientists about this spiritual, emotional connection to nature is important?" she was adamant, replying, "Yes, because ultimately that's at the heart of everything, this connection. We aren't going to solve any environmental problems by ignoring that." She then argued that many scientists do ignore this connection, and that their sense of spiritual connection to nature is so weak that it is overruled by career concerns or desire for intellectually stimulating work. Hence, they do not take action to support sustainability goals, because

> Many scientists are very selfish, focused on their own egos. For example, when a petition was circulated calling for the preservation of a certain species recently, some scientists didn't sign it, even though it was the very species they were researching. They're more concerned with their reputation, or don't really care about that species per se, and just want to have something interesting to research.

She seems to be suggesting that if scientists talked more often about the sense of spiritual connection to nature, and placed more value on it, they might be more likely to focus their research on sustainability issues.

I prompted most interviewees with follow-up questions about the frequency of discussion about the spiritual. Responses to these prompts and later informal conversations indicated that talk about the spiritual was generally considered to be an unusual and sometimes uncomfortable topic. This provided another indication that talk about such ways of knowing was indeed restricted to the margins of the discourse, as I had hypothesized at the beginning of my study.

Places for discussion about spiritual ways of knowing nature

I then asked interviewees about the circumstances in which they might discuss the spiritual. I have categorized their descriptions in *Box 4-1*, and have included some of their comments. I have indicated in parentheses the total number of comments made in each category.

These descriptions of circumstances for discussion about the spiritual—with colleagues or other people—indicate that space is limited for such talk in the workplace of natural science, as well as between natural scientists and the public. Although informal conversations with colleagues and others are mentioned, no interviewee said this kind of talk happened often, or was an accepted part of everyday discussions. Furthermore, I heard no conversations about the spiritual or personal way of knowing nature in my daily interactions[28] with natural scientists at the two field stations I visited.

Only two mentioned talking with the public about such topics. One of these described such discussions as rather adversarial: "Not with colleagues, [but] with other people…Mostly with religious people who tend to see me as devoid of spirituality." Two others mentioned talking at meetings about wilderness preservation, parks, and scenery, but did not say whether these were open to the public, or were limited to natural scientists.

Almost all who mentioned discussing this topic with colleagues also indicated a wariness about having such discussions. Several did talk about it, but were either uninterested or dismissive. Only two mentioned accepted workplace venues—panel

[28] My daily interactions included conversations with natural scientists at meal times, during leisure activities, while sharing workspaces, and while conducting fieldwork, as well as through my interviews.

discussions, bull sessions, and the meetings described above (about wilderness preservation, and so on). Both were tenured and well established, so may have had more freedom to engage in such seemingly rare discussions. But of the two, one was dismissive, responding to the question about defining *spiritual* by saying, "Damned if I know; it always seemed personal and sometimes fairly flaky to me." This seems to indicate that although she occasionally participated in these accepted venues, she was either uncomfortable, or did not take such discussions seriously. Neither of the two gave details about the discussions in these venues.

Box 4-1: "Under what circumstances did (or does) this discussion [about the spiritual] occur?" [Note: Numbers in parentheses indicate the number of comments relevant to that category.]

Informal conversations [in the field, doing research, passing comments, and/or in casual conversation] **(4)**

Professional meetings (2):
- "Meetings related to wilderness preservation, parks, scenery."
- "...Almost always in bull sessions, but occasionally in panel discussions…[but it seems] fairly flaky to me"

With like-minded colleagues (5):
- "Rarely...only if the person values spirituality."
- "[Only] with people I feel comfortable with in saying something out of the ordinary, where I won't be judged. I often get these looks, when I make a mistake about who to talk to about it (which is often)."

Colleagues as well as other people (2):
- "In conversations [with colleagues], but more with people who are *not* colleagues."
- "With spouse in addition to colleagues."

Only with people who are *not* colleagues (2):
- "Not [with] colleagues, but [with] many students, [in] casual conversation."
- "With colleagues, I talk more along the lines of professional conversations about scientific results. But I do talk a bit about this with my [spouse], mostly about how we're going camping on the weekend, and so on."

In discussions focused on theology and/or religion (2):
- "I do talk about it among small groups of friends [who are colleagues], but I also talk with other people, trying to reconcile theology and science."
- "No, unless I'm having a discussion about religion." [She said she did not have a spiritual experience of nature.]

Shared experiences (4): Several indicated that they did not discuss the spiritual very often, if at

all, but were aware of this dimension in their relationship with nature, and shared it—sometimes non-verbally—with colleagues while doing field work:

- "Usually the professional discussion of these experiences is [confined] to the science conducted and methods used in the field. If a person experiences this with you, it is more of a bond than something that is discussed."

Norms regulating the natural science discourse: A comparative summary

My interview data indicate that talk about the spiritual or personally meaningful way of knowing nature is marginalized in the workplace of natural science. A comparison of opinions from my interviewees to those in the study done by Arne Naess[29] can offer some insights into norms in science that regulate talk about spiritual ways of knowing in the natural science workplace (Takacs 1996, 157, 512, 513; Naess 1986). The focus of these two studies is slightly different but not substantially so. My study examined reasons natural scientists feel restricted in such talk by norms in the science workplace. Naess examined norms inhibiting biologists from expressing strong views on biodiversity conservation to the general public. His study looks at the passions sparked by knowledge about biodiversity conservation—passions to protect other species and to inspire the public to join in this endeavor. My study looks instead at the personally meaningful and/or spiritual sense of connection to nature. Naess' categories indicate current norms in science that restrict advocacy for biodiversity, and specifically target concerns about adverse effects on promotion and professional status. I did not question interviewees about advocacy or status concerns, because I hoped if such concerns were present, they would emerge without prompts.

Naess' categories summarize most of the concerns expressed by Takacs' interviewees. I have added to his final category a related concern expressed by some of Takacs' interviewees—the concern that expressions of such views might affect one's professional career, including tenure. Categories from both studies pertain only to reasons natural scientists feel inhibited about expressing certain non-objective views. Neither study includes categories for those who refrain from talking about such views because they have no interest in talking about them, not because they feel restricted by

[29] Arne Naess: The Norwegian philosopher whose writings inspired the deep ecology movement.

norms, e.g., those who view such ideas as invalid, who associate the spiritual with religion (and are not interested in religion), or have little interest in biodiversity or in the personally meaningful or spiritual connection to nature. The categories from the Naess study, and the categories I formed from my interview data, are listed in *Box 4-2*.

Box 4-2: A comparative summary of norms regulating the natural science discourse

The Arne Naess study ~ reasons inhibiting biologists from expressing strong views on biodiversity conservation to the general public:

- Negative attitudes attached to the expression of personal opinions and values.
- Fears of violating norms of objectivity.
- Concern that colleagues or bosses will consider their advocacy work irrelevant or controversial, or that publicity-seeking drives their work with the public.
- Fear of the stigma of being considered "unscientific" by fellow researchers, institutional personnel, funders, or administrations [including concern about effects on professional career, including tenure].

My Study ~ Reasons natural scientists feel restricted from talk in the science workplace about the spiritual or personally meaningful connection to nature:

1) *More comfortable talking about these topics with one's students than with colleagues.*
2) *Comfortable talking only with a few "like-minded" colleagues.*
3) *Concerned that talk about the spiritual can lead to uncomfortable differences of opinion.*
4) *Consider the spiritual too difficult to describe.*
5) *Consider the spiritual too personal to discuss.*
6) *Equate the spiritual with emotions or "soft-sided issues, and consider it inappropriate to "talk about feelings" when talking "about the environmental movement."*
7) *Concerned about being judged as "flaky," strange, or unprofessional.*

Naess: Negative attitudes attached to the expression of personal opinions and values.
My Study: Several of my interviewees expressed similar attitudes, mostly in the form of discomfort about such talk, or about consequences resulting from such talk:

3) Concerned that talk about the spiritual can lead to uncomfortable differences of opinion.

5) Consider the spiritual too personal to discuss.

6) Equate the spiritual with emotions or "soft-sided issues, and consider it inappropriate to "talk about feelings" when talking "about the environmental movement."

7) Concerned about being judged as "flaky," strange, or unprofessional.

Naess: Fears of violating norms of objectivity.
My Study: None of my interviewees explicitly mentioned concerns about violating norms of objectivity by talking about spiritual ways of knowing. Such concerns could act to restrict talk, however, for those who:

5) Consider the spiritual too personal to discuss.

6) Equate the spiritual with emotions or "soft-sided issues, and consider it inappropriate to "talk about feelings" when talking "about the environmental movement."

7) Concerned about being judged as "flaky," strange, or unprofessional.

Naess: Concern that colleagues or bosses will consider their advocacy work irrelevant or controversial, or that publicity-seeking drives their work with the public.
My Study: The following category has some similarity to Naess' category:

1) More comfortable talking with one's students than with colleagues.

The interviewee who mentioned this did not specify why she was more comfortable talking with students. While I suspect that some interviewees felt constrained in their talk about the spiritual due to concerns about colleagues considering such talk irrelevant or controversial, this interviewee did not mention that concern in her comment about talking with her students. There could be other, perhaps personal, reasons for preferring talk with students or like-minded colleagues, rather than restrictive norms. This same caveat applies to:

2) Comfortable talking only with a few "like-minded" colleagues.

The following category could fit this Naess category if:

- "differences of opinion" about spiritual views are considered to be controversial:
  3) Concerned that talk about the spiritual can lead to uncomfortable differences of opinion.
- talk about soft-sided issues are considered inappropriate due to fears about being considered irrelevant:
  6) Equate the spiritual with emotions or "soft-sided issues, and consider it inappropriate to "talk about feelings" when talking "about the environmental movement."

The phrase about "publicity-seeking" is not relevant to my study, because none of my interviewees described their personally meaningful or spiritual sense of connection to nature as being related to publicity-seeking.

Naess: Fear of the stigma of being considered "unscientific" by fellow researchers, institutional personnel, funders, or administrations [including concern about effects on professional career, including tenure].
My Study: Some similarity to Naess, but the cautions mentioned in the previous box apply to these categories also. These interviewees implied that they were concerned

about their professional reputation, without specifying if this was related to being considered "unscientific." No interviewees mentioned concern about tenure:

1) More comfortable talking with one's students than with colleagues.
2) Comfortable talking only with a few "like-minded" colleagues.
7) Concerned about being judged as "flaky," strange, or unprofessional.

The following category could fit this Naess category if talk about soft-sided issues are considered inappropriate due to fears about being considered unscientific:

6) Equate the spiritual with emotions or "soft-sided issues, and consider it inappropriate to "talk about feelings" when talking "about the environmental movement."

Note: The following category did not fit into any of the categories created by Naess:

4) Consider the spiritual too difficult to describe.

Responses to questions about discussions of spiritual topics indicate that talk about spiritual experiences was limited to the margins of the natural science discourse, at least in this particular group. Norms restricting discussion in the workplace were generally not examined in depth—only a few gave specific details. Most indicated that their reluctance to talk stemmed from peer pressure from colleagues, difficulty in defining the spiritual experience of nature, or a vague sense of discomfort in discussing spiritual experiences and ways of understanding.

Peer pressure was not specifically described as such, but rather as expressions of discomfort about discussing personally meaningful ways of knowing with colleagues. Several said they were only comfortable discussing these topics with students or lay people. Two provided examples of enforcement from peer pressure that was limited to non-verbal expressions: "I often get these looks, when I make a mistake about who to talk to about it—which is often!" Several commented on how there were very few colleagues with whom they felt safe talking about this. One said, "You have to pick and choose [who to talk to about the spiritual way of knowing]" in order to avoid being "judged." Several mentioned that they knew few colleagues who were "like-minded" enough for them to feel comfortable discussing such topics. Such restrictions relegated talk about the personal or spiritual way of knowing nature to the unexamined margins of the discourse, although over seventy percent expressed agreement with Wilson's idea that such a way of knowing is an important factor in "the environmental movement."

Chapter 5
Discussion

Summary of the Research

The results presented in *Chapter Four* demonstrated that natural scientists understand nature through non-objective but personally meaningful ways of knowing, in addition to the objective view of the scientific researcher. Talk about these ways, when expressed in terms of spiritual experience or ideas, is restricted by norms in the workplace of natural science. In this section I will summarize and discuss results of my interviews with natural scientists, and present some conclusions to the research questions of this study.

Because the natural scientist's spiritual or personally meaningful way of knowing nature is virtually unstudied, there are little data with which to compare the results of my study. The studies done by Takacs (1996) and Richert (2001) were similar to mine, in that those studies also asked natural scientists, either directly or indirectly, about spiritual ways of knowing nature. Both studies differed from mine, however, in fundamental ways. Takacs' study limited interviewees to natural scientists in the field of conservation biology. The study done by Richert involved interviews with a range of stakeholders, all of whom were involved in the forestry industry. Only a few of his interviewees were natural scientists.

My initial interest in this research project was based on my sense that for sustainability to be a viable and meaningful part of our lives, something more than the objective examination of nature is required. I had become aware of a growing body of opinion among some environmentalists expressing this idea, such as AtKisson (2001), a founding member of the international Consultative Group on Sustainable Development Indicators, Thomashow (1995; and Bache (2001), a teacher at the California Institute of Integral Studies in San Francisco, and director of transformative learning at IONS, a nonprofit organization that conducts research on multiple ways of knowing and the relationship between personal and social consciousness and the physical world. I also found similar ideas expressed by a number of conservationists and natural scientists,

including Muir (1911, 1916), Leopold (1949), Carson (1962), Mayr (1982), Miller (1988), Soule (1988), Shepherd (1993), Rolston (1996), Rennie (1999a, 1999b), Wilson (1993, 2000), Farnham et al. (2002), Kellert 2002; Kellert et al. (2002), Perschel (2002), and those interviewed by Takacs (1996), Gorman (2003), and Kaiser (2003).

I had also observed a growing number of groups outside the professional science community integrating their objective knowledge about environmental issues with a non-objective sense of unity with nature, conceptualized and articulated in spiritual terms. Some of these groups—particularly those associated with traditional religions, as described in Gottlieb's (1996) collection of environmental statements from a number of world religions, Feldman et al.'s (2003) research on Christian, faith based environmental reform initiatives in Appalachia, and an article in the local newspaper (Miller 2001)—were redefining their role in society by doing so. I wondered if natural scientists were making similar moves at a personal or collegial level to redefine and even expand their role in society by integrating their accepted way of knowing nature with ways of knowing that may be currently unacceptable in science but which are deeply meaningful for many people, including the literature produced by some well-known and professionally established natural scientists.

The purpose of this research project was to investigate whether and how natural scientists consider non-objective along with objective ways of knowing in constructing their professional understanding of nature, whether they consider certain non-objective ways of knowing to be important to sustainability, and whether certain norms restrict discussion of non-objective ways of knowing. I also considered the literature emphasizing the role of certain non-objective ways of knowing in sustainability, and note how this literature compared with the attitudes expressed by the natural scientists I interviewed.

I looked in particular at natural scientists engaged in fieldwork. I hoped this group could offer insights into a more integrated way of understanding nature, because they spent significant amounts of time in natural settings, and were dedicating their careers to the study of the natural world. I used the word *spiritual* in my interview questions, because I found that those I interviewed were familiar with this word and

seemed to draw them out. *Spiritual* could be interpreted as that which is personally meaningful, and could refer to an integrated way of knowing.

Summary of results

Because the spiritual or personally meaningful way of knowing nature is difficult to define or measure, in order to determine if natural scientists included this way of knowing in their overall understanding of nature, I incorporated a number of approaches into my investigation. These different approaches yielded similar results. A majority (seventy-four percent) of interviewees either agreed or strongly agreed that "nature generates 'spiritual' experiences; an additional sixteen percent either agreed or strongly agreed, but expressed reservations. Over seventy percent acknowledged that they had experienced nature in this way. A majority (seventy-one percent) either agreed or strongly agreed with the Wilson quotation about "spiritualizing the environmental movement," including the twenty-six percent with reservations. Their comments on this quotation revealed a general support for discussion about the spiritual way of knowing, and for basing such non-objective ways of knowing on objective, empirical knowledge. These comments, as well as their descriptions of spiritual ways of knowing nature, revealed similarities to the literature on the importance to sustainability of integrating objective knowledge with non-objective ways of understanding nature.

About one third of those interviewed conveyed some idea about the position they personally constructed in relation to nature, mostly through their definitions of *spiritual*. They described *spiritual* in terms of connection to something beyond the self, although not all specified a connection to nature. They used comments such as "non-material unity with other things," "kinship with all of nature," and "connection between myself and…nature." These expressions speak from a connected, involved, and for some, even a responsible position, rather than from the position of distanced, objective observer—the only voice allowed in the accepted discourse of natural science. Some natural scientists chose to see nature from different positions, seeking—albeit not consciously, perhaps—to blend objective and non-objective viewpoints. A few seemed stuck in the viewpoint of the superiority of objective observation, even when they were

not involved in the process of applying the scientific method.

I portrayed the different ways natural scientists construct meaning about nature and the sense of spiritual or personally meaningful connection to it as a continuum of attitudes. This continuum incorporates data from interviews and opinions from the literature, and ranges from a position of distanced and dominant observer of nature to one of deep connection to nature. Of those interview comments I analyzed, none fell into that portion of the continuum representing extremely disconnected, distanced attitudes about nature; most fell into the middle or opposite end of the continuum, representing increasing connection and commitment to nature.

I also portrayed how a natural scientist could assume the position of distanced observer, viewing nature as pleasant amenity or something that intellectual stimulation, and could also see nature from the position of deeply meaningful connection, committed to sustainability goals. This portrayal, along with the two related hypothetical examples given, suggest a potential for rich dialogue about sustainability issues.

Although over seventy percent of the natural scientists I interviewed said they experienced some form of spiritual connection to nature—indicating that they understand nature in spiritual or personally meaningful ways in addition to their objective knowledge—they felt restricted in talking about this with colleagues, and even with the public. Seventy percent expressed agreement or strong agreement with the Wilson quotation, which emphasized the importance of dialogue about this way of knowing. Their responses to the question on discussion with their colleagues, however, indicated that the space for such discussion was limited to the margins of the natural science discourse. Those interviewed for this study were willing to share this kind of talk with me—someone outside the norms of science—but did not feel they could talk openly about these topics in the natural science workplace. They saw restrictions coming from unspoken censorship, often largely unexamined—in the form of peer pressure among science colleagues, discomfort in discussing spiritual experiences, and limited perceptions of the personal connection to nature.

The comparison of my findings with those in the Naess study show that there are norms in the natural science workplace that restrict the creation of legitimate space for certain non-objective ways of knowing nature, and hence marginalize talk about such ideas. Although many in this group experience and even value spiritual or personally meaningful ways of knowing, and although many seemed to be comfortable with non-objective as well as objective stances, they were not discussing how to consciously integrate these ways of knowing, or even if such integration would be relevant to sustainability goals. It seemed to me that interviewees were willing to talk to me from a position of personally meaningful connection and kinship with nature, but this way of knowing was split from their position as distanced objective observer—the position they felt they had to maintain in the workplace.

Interpretation: A Conceptual Framework

One way to think about these findings is to conceptualize them in abstract, spatial terms: a thin margin of unaccepted, even unacknowledged ideas and discussion, surrounding a large central space of accepted ideas and discussion. The ideas in the margin are restricted by norms that also serve to protect the accepted center. In natural science, the traditional, objective, logical, measurable way of thinking is accepted throughout the central space of science, while other, non-objective ways of thinking, including those that foster connection and commitment to nature, are banished to the margins. These marginalized ideas are widespread among natural scientists, but talk about them must be covert, in order to avoid the consequences of violating restrictive norms. There is a disconnect between professional, accepted discussion, and private attitudes that lend support to an integration of objective and certain non-objective ways of knowing, a split between the position of objective, distanced professional scientist, and the position of the natural scientist who feels kinship and personal connection to nature.

The norms of the workplace of natural science maintain this split between professional stance and personal values. These norms form a wall around the traditional, accepted way of thinking, protecting the hegemony (and the illusion) of

objectivity in science, and censuring talk that might threaten this hegemony. Because there is a majority of support —albeit covert—for discussion about these marginalized ideas, the potential exists for claiming a space in that discussion, allowing the opportunity for these oppositional ways of thinking to merge. This space could be thought of as a passageway through the wall of norms, allowing ideas at the accepted center to integrate with those at the margins and beyond, into society at large. This "passageway" could serve to expand the role of science in society, and increase science's influence on social attitudes toward and practice of sustainability. Some contend that the way we understand nature is already a contested space because restrictions against more subjective ways of knowing are being challenged (Chargaff 1980; Naess 1986; Orr 1992; Simmons 1993; Takacs 1996; Wilson 2000; Kellert 2002; Berry 2002).

While creation of this passageway would be accomplished by creating opportunity, validity, and professional acceptance for discussion about marginalized ideas, the currently covert support and value for spiritual or personally meaningful ways of knowing nature would serve as the driver for this work. Open examination of the wall of norms might chip a passageway through this wall.

This examination of restrictive norms would likely be composed of two sets of talking points. The first set would try to determine if creation of such a passageway connecting central and marginal ways of thinking would be worth the energy and risk involved; the second set would examine the specific norms inhibiting discussion:

Talking points ~ First set:

- Is it worth the time, risk, and energy involved in breaking through norms preventing discussion? Is the maintenance of the hegemony of objectivity—and the "wall" of norms protecting it—more important than the creation of space for examination and discussion about an integrated way of knowing, especially regarding sustainability issues? What is the payoff for maintaining the split in natural science between the professional stance and personal values?

- Would discussion about the integration of objective knowledge and non-objective connections to nature form a meaningful contribution to the debate on sustainability goals and practice? How would discussion among colleagues and discussion with the general public compare?

- Would such discussion lead to an expansion of the role of science in society, for example, into the cultural spaces of policy, ethics, values, religion, communication, and myth (Takacs 1996)? If so, what would be the benefits and drawbacks of such an expansion?

- If considered worthwhile, what would make such discussion effective?

Talking points ~ Second set:

- If breaking through the wall of norms in natural science is determined to be worthwhile, how would such a breakthrough be accomplished?

- Would increased recognition that many natural scientists acknowledge experiencing nature in non-objective (as well as objective) ways increase the likelihood for examination of norms preventing discussion about these ways?

- In examining specific norms inhibiting discussion about these marginalized ideas, and involving:
  - **Discomfort** [stemming from fear of being judged as unprofessional, irrelevant, too far outside accepted norms, or fear of possible effects on career, such as on funding, tenure, and prestige]—**or**—
  - **Disapproval** [based on opinions that these marginalized ideas are inappropriate, irrelevant, or threatening to the credibility of science],

  —what aspects of this discomfort or disapproval regarding discussion about marginalized ways of knowing can be attributed to unexamined social norms in natural science, norms that may or may not lend much benefit to science as a whole?

- In examining specific norms inhibiting discussion about these marginalized ideas, and involving:
  - **Difficulty in defining** or describing spiritual or personally meaningful ways of understanding nature—**or**—
  - **Difficulty finding common ground** [based on desire to avoid controversy and differences of opinion],

  —are difficulties in defining these non-objective ways of knowing, or in finding common ground, maintained by the lack of discussion about them? Does this create a feedback loop—in which these difficulties lead to lack of discussion, which in turn maintains the difficulty in finding common ground, or the difficulty in defining or describing them? Does this in turn discourage examination of ways to integrate objective and non-objective understandings of nature?

Limitations of the Research

This study of spiritual and personally meaningful ways of knowing nature, and marginalization of talk about these ways of knowing in the discourse of natural science,

was encumbered by the difficulty in collecting information on philosophical attitudes. The data were inherently "messy"—an individual's attitudes about something as complex and difficult to define as nature, and one's personally meaningful understanding of it, can easily overlap or be contradictory. Furthermore, the interview data could be described as "squishy"—most interviewees had not thought through concepts such as the "spiritual experience" of nature before I questioned them about it, or at least they had not formally articulated their ideas and commitments. Arguments in feminist theory literature, however, maintain that the difficulties involved in studying these issues, or in nailing down these points of view, in no way present a tenable reason for avoiding such research.

Admittedly, some aspects of my questions were slightly problematic due to these difficulties in getting at such messy concepts. For example, I asked interviewees to respond to the statement that nature "generates" spiritual experiences. This statement could be taken to mean that nature, particularly "nature" as we popularly think about it as a force separate from ourselves, can somehow make us feel "spiritual." Furthermore, this statement does not present spiritual experience in a way that implies a sense of personally meaningful connection to and/or responsibility for nature. This avoids leading the interviewee, and leaves the concept of spiritual experience open to individual interpretation. Some described the spiritual experience of nature in terms of discrete experiences, however, rather than as an ongoing commitment to nature underlying one's behavior. These descriptions could well have been prompted by my term "spiritual experience" in the interview question, which term implies a discrete experiential event. Some interviewees limited their descriptions of the spiritual experience of nature to pleasant feelings about the world, or to other attitudes that may not be likely to fuel a deeply felt commitment to sustainability, even though an interviewee may have such a commitment. My question asking interviewees their opinion on the Wilson quotation (*page 71*), touched on the interrelated issues of "spiritualizing" the environmental movement, dialoguing about this with colleagues, integrating objective and non-objective knowledge, and making scientific information relevant to lay people. But several interviewees indicated that the quotation covered too

much ground. One said, “I'm not sure which part of the above [quotation] I'm being asked about.”

I did not ask specific questions about whether or not interviewees had integrated their sense of spiritual connection to nature (if any) into their other ways of understanding nature, e.g., emotional, non-verbal, intellectual, objective. I had hoped they would bring up this integration of objective and non-objective ways of knowing in their descriptions of spiritual experience or definitions of *spiritual*. While some interviewees described this kind of integration indirectly, more direct questioning on my part may have yielded more usable data on this aspect of the research.

My interview question, “Have you had (or do you have) any discussion about this among your colleagues or other people?” did not separate discussion with colleagues from discussion with non-colleagues. This wording gave interviewees more of an opportunity to bring up such differences on their own. It may have been more effective, however, if I had asked interviewees to check all that applied from a selection of possible discussion scenarios, followed by an open-ended option for “other.” Similarly, I did not ask specific questions about the reasons they may have felt constrained in talking about the spiritual or personally meaningful connection to nature with colleagues. While it became clear that a majority of interviewees felt such constraints, and while I did gain some data regarding these constraints from their comments to my informal follow-up prompts, I may have gained more information by asking them to select from a list of options similar to the one described above. Furthermore, the question about discussion is a yes/no question, and thus cannot indicate how often discussion occurs. I prompted interviewees with informal follow-up questions, which, as with the other questions about discussion described above, did not insure uniformity of responses.

This study of evidence of the marginalization of non-objective ways of knowing is focused only on discussion in the workplace. I did not look at all aspects of the natural science discourse, but I did observe the content of several workshops and presentations. While my observations were not in depth, John Rennie, a retired professor in forestry, bolstered my observations with his impressions about the extent of

marginalization of non-objective ways of knowing in this area. He described a workshop on spirituality in forestry that he had attended at a national forestry conference in 1999. He said that this was the first workshop on this topic that he had heard of in his many years in the field. He noted that while it was well attended, many traditional foresters dismissed the topic as irrelevant (Rennie 1999a, 2000). Rennie addressed the difficulty of developing ideas about the role of spirituality in forestry, saying, "the people who get it are already there, and don't need much explaining, and the people who don't get it don't even want to talk about it. The problem becomes one of getting this idea across to others in such a way as to appear legitimate enough to them to discuss and examine seriously" (Rennie 2000). His opinion was echoed by one of my interviewees, who said, "With some [colleagues], [the role of the spiritual or personally meaningful in sustainability issues] is simply understood. With others it's a subject of curiosity and puzzlement and focused effort at least sometimes. With others it's beyond their event horizon." If these observations are accurate, such attitudes could present a hurdle to overcome in creating the passageway in my conceptual framework described above.

Finally, I would note that the findings from this research are applicable only to those populations living in developed areas, with some exceptions. For example, in 1973 in the Chamoli district of Uttar Pradesh, India, villagers considered the trees in a nearby grove to be sacred. In her textbook on world regional geography, Pulsipher (2000) describes how the villagers' spiritual reverence for the trees inspired some of them to protest logging in the grove. Their actions led to the founding of an environmental activism movement,[30] which spread to other forest areas and stimulated locals to protect their forests while increasing their awareness of environmental issues. Much of the world's population lives in poverty, however, and may not be likely to be inspired by "nature" or by a non-objective, personally meaningful connection to it. They would have more immediate survival concerns, and may not have the resources, emotional or otherwise, to take actions supportive of long-term environmental quality.

[30] The literal translation of the "Chipko movement" is the "stick to" movement.

Potential for Further Research

To stimulate societal changes that support sustainability goals, it is necessary to gain a greater understanding of key factors involved. Many environmentalists maintain that a spiritual or personally meaningful ways of knowing nature is one of these key factors (Muir 1911, 1916; Leopold 1949; Carson 1962; Mayr 1982; Miller 1988; Soule 1988; Shepherd 1993; Thomashow 1995; Rolston1996; Takacs 1996; Rennie 1999a; Wilson 1993, 2000; AtKisson 2001; Bache 2001; Farnham et al 2002; Kellert 2002; Kellert et al 2002; Gorman 2003; Perschel 2002; Kaiser 2003). However, there are few studies done on the role of this way of knowing—if any—in inspiring widespread and effective support of sustainability goals. Neither are there many studies on the norms that restrict discussion of this topic to the margins of the natural science discourse. Further research is needed to give a more accurate picture of the relationship between this way of knowing and sustainability.

Several directions could be pursued to this end. First, and perhaps most importantly, it could be fruitful to investigate whether an integration of scientific knowledge with certain non-objective ways of knowing nature is an important factor in achieving sustainability goals, as many natural scientists in the literature review contend. Does a spiritual or personally meaningful way of knowing inspire sustainable behaviors, and if so, under what conditions? The researcher would bear in mind Simmon's caveat against seeking specific sustainability goals. He warns against the quest for a Utopian, prescriptive set of specific sustainability goals, and advises instead that we focus on "getting the [sustainability] processes right" for meeting the practical needs at hand, rather than set up "some long-term and overarching aim" (Simmons 1993, 163).

Second, it may be useful to examine conditions under which the norms of science might allow examination of integrated ways of understanding nature, and to investigate the factors and attitudes that create resistance to such examination.

Third, research could examine the physical evidence of marginalization of certain non-objective ways of knowing in the natural science workplace. Some physical spaces in the workplace may be more available than others for discussion, examination,

or expression of spiritual or personally meaningful ways of knowing nature. The geography researcher could examine whether certain physical spaces have fewer restrictions than others, or what factors make some physical spaces more openly conducive to such discussion. Similarly, one could examine whether certain disciplines within physical science—physical anthropology as compared to geomorphology, for example—are more open than others to such discussions.

Finally, in order to determine the role of the spiritual or personally meaningful connection to nature in the work of natural science, more specifics are needed. Further research could examine whether natural scientists draw on their personally meaningful ways of knowing nature to set goals for their research. Is this a factor in producing better research about sustainability? Does it result in more effective communication with the public, as far as inspiring commitment to sustainability? More details are also needed on the kinds of topics, and social circumstances for discussion, that are most conducive to communication between natural scientists and the public about sustainability issues. These specifics have not been explored, at least not as far as determining what aspects, if any, of a spiritual or personally meaningful way of knowing nature are effective factors in sustainability processes.

Recommendations

These data on restrictions in the discourse of natural science on spiritual or personally meaningful ways of knowing provide specific examples of the feminist theories on marginalization of the "other." The results from this research provide a descriptive starting point for examining the disconnect between the objective way of knowing at the accepted center of the natural science discourse and the marginalized "other" of spiritual or personally meaningful ways of knowing nature. This examination would mesh with an examination of how different ways of knowing are regulated in the abstract spaces of natural science discourse and in the production of knowledge about sustainability.

Such examination is becoming more urgent as current culture-wide ways of thinking—and living—result in increasingly harmful effects on the natural environment,

"creating a need not only for a better understanding of human nature but for a more powerful and intellectually convincing environmental ethic based upon it" (Wilson, 1993, 40). An increasing number of prominent environmentalists contend that a cultural transformation that effectively implements sustainable processes is crucial to our survival as a species, and that non-objective as well as objective ways of understanding nature are key factors in this transformation process (Leopold 1949; Naess 1986; Orr 1992; Simmons 1993; Takacs 1996; Wilson 1993, 2000; Kellert 2002; Berry 2002; Gorman 2002). Several aspects of the natural science discourse could be considered in the examination of the disconnect between objective and non-objective ways of knowing. The aim would be to discover how—or if—inclusion in the discourse of natural science of integrated ways of knowing could enhance conventional scientific understanding, deepen the relevance of natural science to sustainability, and contribute effectively to the cultural transformation many maintain is crucial to sustainability.

Natural science education: Natural science education is one key area in which to challenge the status quo. This can be accomplished by examining the disconnect between the way many students are initially drawn to the natural sciences by their personally meaningful way of knowing nature, and the way this dimension of the human relationship with nature is rarely mentioned or addressed in natural science education (Rennie 1999a).

In educational activities with the general public, natural scientists can bring more awareness of the power of spiritual or personally meaningful ways of understanding. Including openings for discussion about these non-objective facets of learning may reach more people than objective knowledge alone. Such openings are more likely to convey the scientific facts in a way that also speaks to their sense of connection to nature, and can "sometimes move people to then get involved" in conservation and other environmental issues.

Research: When nature is perceived primarily in terms of benefits for humans, whether for recreation, medicines, or intellectually stimulating careers, research on sustainability processes may be limited. But nature can be considered instead as a

social construct, not in the superficial and facile way that critical social theorists use the term, but rather as a personal embodiment of an ideal; an ethos or ethic. This ethos is likely to influence one's research differently than the view of nature as commodity. One interviewee inadvertently suggested a way of aligning one's research with such an ethos, by integrating the spiritual or personally meaningful with an objective way of knowing nature. "We use spirituality to set goals," she said, "and then use natural science to accomplish those goals."

Communication: Norms of science currently limit examination of individual ways of knowing to discussions of bias. There is some acknowledgment that values play a part in the work of science, but most perceptions about the legitimate role of values are limited to individual preferences about what research to do and how to interpret results (National Academy of Sciences 1989). This produces an enterprise of science having a different relevance to sustainability than it would if contributing individuals were encouraged to understand nature in ways beyond the conventional, objective viewpoint, to consciously incorporate the multiple aspects of the self into a more holistic way of knowing nature. When natural scientists remain silent on values, they are implying that there is no way for ordinary non-scientists to take meaningful action. Yet the current paradigm in natural science provides no language to describe and investigate integrated ways of knowing, as noted by Bolkan (2001), a chemical engineer, and Haisch (2001), an astrophysicist, who write about science and non-objective ways of knowing. Natural scientists lack "much of a voice" for the spiritual connection to nature. A language that is more transparent in incorporating non-objective ways of knowing into the examination of nature could contribute to the "expansion of the role of science" that Wilson calls for (Takacs 1996, 164).

Discussion about the integration of different ways of knowing might lead to the discovery of more effective forms of communication about sustainability issues between natural scientists and the general public. For example, natural scientists could consider the power of myth in the way that people construct their attitudes about environmental issues. However we may understand nature, whether primarily emotional, intellectual, or spiritual, or a balanced combination of these and other

factors, we use the human biological trait of myth and metaphor formation as a tool in that understanding (Newberg et al 1999, 2001). The role of myth in blending fact and desire is part of an integrated way of knowing in which we all engage in our quest for understanding our place in a complex natural world. To many people, certain myths provide as much authenticity and personal meaning as scientific evidence (Simmons 1993). Natural scientists that communicate with the public could consider ways to direct their influence toward illuminating myths with knowledge grounded in science, rather than engage in efforts to disprove such myths.

If scientists create a more effective language for non-objective ways of knowing nature, and draw on the non-verbal, personally meaningful sense of connection to nature that most of them feel, their communication with the non-science public may be more likely to resonate with them. Admittedly, this language would not be the precise and mutually understood language of mathematics, and would therefore be subject to misinterpretation. This points to the need for increased discussion and examination about effective roles for non-objective ways of knowing in science, rather than for the continued dismissal or censure of such ways of knowing. In rethinking and perhaps restructuring current restrictions against non-objective ways of knowing nature in natural science, a less fragmented , more integrated understanding of our relationship with nature becomes possible, and more forms of communication become available for evoking culture-wide commitment to sustainability.

Conclusion

In this research project, I provided a group of natural scientists with the opportunity to talk about their personally meaningful or spiritual ways of knowing nature, their opinions on the role—if any—of this way of knowing in sustainability, and their observations about restrictions in natural science on this way of knowing. I have used the words of those I interviewed wherever possible to demonstrate their perceptions and opinions on each of these aspects of the research topic. In researching this group of natural scientists, I found that talk about non-objective ways of knowing nature, when expressed in terms of spiritual experience, is regulated by the norms of

natural science.

This research began with a look at different ways of knowing nature among natural scientists, specifically at those ways of knowing that differ from the traditionally accepted, scientific, objective way of knowing. Most interviewees acknowledged their experiences of—and occasionally their familiarity with, and even value for—this spiritual or personally meaningful way of knowing nature. The concluding story I gleaned from my observations is that a majority of natural scientists value these non-objective ways of knowing, and agree that they play a role in sustainability processes. This indicates agreement with the literature expressing similar ideas. However, norms prevailing in the natural science workplace stifle examination and communication about these non-objective ways of knowing. Consequently, there is little attempt to examine their potential contribution to sustainability goals.

The research also yielded examples of some of the ways meaning is constructed. Interviewees constructed meaning about the discourse of natural science, in what they felt should—and should not—be included in the space of natural science discourse. Interviewees also constructed meaning about their relationship with nature, some primarily as detached observers, and some blending objective observations with a sense of kinship or unity with all life on Earth. Several were more conscious of blending their objective and non-objective ways of knowing nature, constructing their relationship to nature as "connected" in both an objective and a non-objective way. As one interviewee put it, "The only way to really realize something is to really feel the connections. You can't just look at it technically." He added that while this was difficult to do, "the best scientists are open to this connection."

This research provides examples of feminist theories that consider ways we position ourselves—or are positioned—in relation to what is perceived as "other," or that which is different from the self. It also considers the power implications that result from the assumption of these different positions in abstract space. The researcher constructs, or imagines, an abstract position for him- or herself in relation to the subject of research—some aspect of nature. Some natural scientists see nature from a distanced, separate view from above, even framing their spiritual experience of nature

as an amenity. Others see themselves as connected to nature, able to "look at it technically" while also able to "feel the connections."

Social and professional norms in natural science exert power over which positions scientists can assume. The distanced position of objective observer is considered acceptable in the discourse—and is granted a central position in the space for discourse. Other, non-objective ways of knowing are banished to the margins. This marginalization is accomplished through largely unspoken and unexamined restrictions, professional norms which are a result of—and enforce—what is considered normal in the natural science discourse, that is, the day-to-day activities that are so accepted in the discourse that such restrictions are almost unnoticed. When scientists communicate their knowledge to the general public, these other ways of knowing remain marginalized.

Restrictions also serve to maintain the traditional position of the scientist in society. If spiritual or personally meaningful ways of knowing nature were brought into a more central place in the natural science discourse, it would affect the role of the scientist in the production and communication of knowledge about sustainability. It would also affect the general public's perception of the natural scientist—and science. Society's view of the scientist as a source of reliable, unbiased, objective observations—and the prestige attached to this position—could be jeopardized, as discussed by Takacs (1996). On the other hand, as natural scientists seek more effective ways to support sustainability goals, they may redefine the role of the scientist in society. When the natural scientist allows space for non-objective as well as objective knowledge in her communication with the public, this communication could become more effective in achieving sustainability goals. One interviewee noted,

> part of the problem with science is that people don't identify with what you're doing...[Talk about the spiritual connection to nature] can really relate to feelings and [convey] the relevance of what you're doing to the general public…[This can] sometimes move people to then get involved in work for preservation and environmental issues.

Restrictions on the examination and discussion of non-objective ways of knowing, whether in the form of the spiritual or something else, influence the way we

create knowledge about, communicate about, and take action for sustainability. The disconnect within the individual scientist between the professional scientific observer of nature, and the personal, connected participant, a disconnect enforced by restrictive norms in the natural science workplace, produces such fragmented knowledge about sustainability. Many contend that our fragmented way of understanding nature has resulted in a disastrous imbalance in nature.

At present, when natural scientists communicate with the general public, restrictions against certain ways of knowing nature limit this communication to empirical knowledge, fact collecting, and an exclusively objective understanding of everything from simple systems like the internal workings of a leaf or the ecosystem of their backyard, to complex ones like watersheds or global climate changes. This conveys the idea that factual knowledge alone is enough—even as some natural scientists notice this is *not* enough—to motivate people to act sustainably. There is no consciously created, obvious, and accepted place in natural science for what is often found in the individual. There is no clearly acceptable place for the rich blend of factual knowledge, feelings, non-verbal images, stories, memories of beloved or devastated natural places—the blend that comprises a deeply felt sense of connection to nature that some contend has the power to inspire commitment to sustainability, to "move the masses," as one interviewee put it.

Discussions about spirituality can touch on the deeply personal. Like poetry, it encompasses the subjective—that which is not provable—as well as the observable. It is understandable that it can be uncomfortable to discuss among colleagues grounded in a tradition of objectivity. Furthermore, it can feel invasive to be subjected to claims to truth that differ from one's own. There is a danger of the same kind of orthodoxy as that which is keeping scientists from talking about spirituality. Differences in spiritual beliefs have certainly had a dark history in restricting science, and this history has exerted an influence over the way science has developed throughout history. But this need not negate a place for the topic of spirituality or other non-objective ways of knowing in the discourse of natural science and in the dialogue about sustainability.

Discomfort in discussing topics currently banished by natural science norms need not dictate that natural scientists wait until we are in an environmental crisis mode to take responsibility for challenging the status quo. Natural scientists can claim space in the dialogue for what many of them feel and value privately. Rather than continue to be stuck in currently accepted ways of thinking limited by largely unexamined norms, they can talk about and ask questions about topics that reflect their more fully human way of knowing.

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APPENDICES

Appendix A: Demographic Information on Interviewees Included in Results

*Academic Discipline	Sub-discipline	Highest Level of Education
N=31		
Agriculture	Animal science	Ph.D. (15 years); **PNA
Aquatic ecology	Ecotoxicology	Ph.D. (21 years)
Biology	Plant physiology/ ecology	Post-doc
Biology/ Bio-geochemistry	Paleo-ecology	Graduate student – Masters
Biology/ Population	Tropical insects	Graduate student – Doctorate
Biology/ Zoology	Ornithology	B.S. [Consultant; PNA]
Biology	Entomology	Graduate student – Masters
Biology	Geography	Masters; PNA
Biology	Zoology/ecology/ Physiology/ethology	Graduate student – Doctorate
Biology	Environmental science/ Carbon cycling	B.S.; PNA [planning graduate work later]
Biology	Behavioral ecology	Graduate student – Doctorate
Biology	Aquatic ecology	Ph.D. (35 years)
Biology/ecology	Plant community ecology	Graduate student – Masters
Botany	Fern ecology	Graduate student – Doctorate
Ecology	Soil ecology/geochemistry	Graduate student – Doctorate
Ecology	Metapopulation biology	Graduate student – Doctorate
Ecology	Plant/animal interactions	Graduate student – Doctorate
Ecology/evolutionary biology (EEB)	EEB	Ph.D. (25 years)
Ecology/evolutionary biology	Biogeography/ecology/ conservation biology	Ph.D. (32 years)
Environmental science	Aquatic ecology	Ph.D. (27 years)
Evolutionary biology	Population ecology	Ph.D. (7 years)
Forestry	(not specified)	B.S.; PNA
Geography	Biogeography	Ph.D. (15 years)
Geography	Biogeography	Post-doc
Geography	Geomorphology	Ph.D. (14 years)
Geography	Climatology	Ph.D. (9 years)
Geology/Anthropology/EEB	Environmental studies	Ph.D. (15 years)
Psychology/Animal Research	Developmental genetics	Ph.D. (35 years)
Soil science	Environmental science	Graduate student – Doctorate
Zoology	Insect ecology	Ph.D. (10 years)
Zoology/biology	Physiology/ecology	Graduate student – Masters

* Academic discipline and subdiscipline (as reported by interviewee)
** PNA: Professional—not academic (visiting or consulting at field stations)

Overview:	**Education**	**Nationality**
	25—Ph.D. (includes 8 post-docs)	USA: 40
	7—Working in jobs directly related to natural science (e.g., manager of a biological field station) and planning to return to graduate school in the future	Costa Rica: 2 Canada: 2 Colombia: 1 Croatia: 1
	7—Graduate students, working on Ph.D.	Germany: 3
	11—Graduate students, working on Masters	Turkey: 1

Appendix B: Demographic Information on Other Interviewees

*Academic Discipline	Sub-discipline	Highest Level of Education
N=19		
Interviewed but not included in Results:		
Biology	Avian behavioral ecology	Post-doc
Biology	Evolutionary ecology	Graduate student – Doctorate
Biology/Zoology	Animal behavior	Post-doc
Biology	Evolution	Ph.D. (20+ years)
Biology	Animal behavior-ornithology	Graduate student – Doctorate
Biology	Behavioral endocrinology	Post-doc
Biology	Conservation, ecology	Post-doc
Biology	Plant ecology	B.S.
Biology	Evolutionary biology	Graduate student – Masters
Biology	Amphibians/behavioral ecology	Graduate student – Doctorate
Biology	Mycology	Ph.D. (18+ years)
Biology	(not specified)	Post-doc
Biology	Population genetics	Graduate student – Masters
Botany	Population ecology	Post-doc
Ecology	Invasive plant biology	Graduate student – Doctorate
Engineering	Physics	Masters; PNA
Evolutionary biology	Plant evolution	Ph.D. (18+ years)
Evolutionary ecology	Population dynamics	Ph.D. (20 years)
Geography	Biogeography/ecology	Graduate student – Masters

Appendix C: Statement Insuring Anonymity for Interviewees

This survey is part of my master's thesis project in Human Geography at the University of Tennessee in Knoxville. I am investigating subjective aspects (such as values, intuition, emotions) of scientific work, particularly in the natural sciences, because these may serve as common ground for more effective communication between scientists and the public at large. While science must necessarily be conducted within an objective frame, scientists as individuals may bring various subjective elements to their work. This survey is part of my examination of these subjective elements.

All responses will be kept strictly confidential. Note that some questions are optional. These can be skipped if you do not have time to respond to the full questionnaire. Your participation in the survey is completely voluntary, and your responses are greatly appreciated.

Marianne Russell Chrystalbridge,
Department of Geography, University of Tennessee

Appendix D: Interview Questions

1) Academic discipline: _____
2) Sub-discipline (sub-field): _____

Check one:
3) Degrees: Undergraduate:____ Working on master's degree: _____
Master's degree____ Working on Ph.D.: _____
Ph.D. (indicate number of years): __
4) Male _____ Female _____

5) Describe the ways you've experienced nature in the last year or so.
6) Check which best describes your level of agreement or disagreement with the statement below:
"...nature generates religious experiences in [the] deeper sense. If [one] wishes to bypass the word 'religion,' owing to its institutional, denominational, and cultural dimensions, nature nevertheless generates 'spiritual' experiences." [From Holmes Rolston, III, Department of Philosophy, Colorado State University, in Nature and the Human Spirit: Toward an Expanded Land Management Ethic, Venture Publishing, Inc., State College, Pennsylvania
I strongly agree_____ I agree _____ I neither agree nor disagree _____
I disagree _____ I strongly disagree _____

6a) How would you define "spiritual"?
6b) Have you had this kind of experience in relation to nature?
6c) Have you had (or do you have) any discussion about this among your colleagues or other people?
6d) If yes, under what circumstances did (or does) this discussion occur?

7) Check which best describes your level of agreement or disagreement with the statement below:
In an interview in Salon on-line magazine, 4/22/00, the biologist Edward O. Wilson discussed the idea that if natural science is to have relevance to the environmental movement, it must make room for dialogue about "the spiritual impulse," which he considers an evolutionary advantage central to human nature. In the interview, he said, "I don't think it is something that's going to be done in a humanistic ivory tower. It's got to be done in a way that touches what people like Joe Six-Pack are thinking. We've got to get moving on an effort to spiritualize the environmental movement—not in the sense of starting to offer up prayers—but with a sound empirical base. The naturalistic view...requires that we consider the broader meaning of the sacred: the deep sense of spirituality about each other and about our natural environment."

I strongly agree_____ I agree _____ I neither agree nor disagree _____
I disagree _____ I strongly disagree _____

Optional: 7a) What do you think of these ideas?

8) What kind of work do you do in your sub-field?
9) What led you to choose your sub-field?
9a) Was there a single event that led you into this work?
10) What do you most enjoy about this work?
11) What do you consider the most important aspect of your work?
12) How does your work relate to the larger picture?
13) Do you think subjectivity plays a role or roles in the work of science? If so, how?
14) Do your values play any part in your work, or in your approach to your work?
14a) If so, how?
15) What INSPIRES your work?
16) What MOTIVATES you in your work?
17) How does your work relate to you personally?

OPTIONAL:
18) Does intuition play any part in your work, or your approach to your work?
18a) If so, how?
18b) Describe any particular experiences you have had in which intuition provided a benefit for your work.
19) Are you aware of having a philosophical perspective that informs and affects your work?
19a) If so, what is it?
20) What personal interests do you have that center on the natural world? [This can include hiking, gardening, the arts, charities, etc.].
20a) To what extent do you engage in these activities?

Appendix E: Pilot Interview Questions Used at First Interview Site (second set)

1) Academic discipline:
2) Sub-field:
3) Highest degree:
4) Gender:

5) What led you to choose your particular sub-field?

6) What kind of work do you do in your sub-field?

7) What do you most enjoy about this work?

8) What do you consider the most important aspect of your work?

9) How does your work relate to the larger picture?

10) Do you think subjectivity plays a role or roles in the work of science? If so, how would you describe this role(s)?

11) Do your values play any part in your work, or in your approach to your work? If so, how?

12) What INSPIRES your work?

13) What MOTIVATES you in your work?

14) How does your work relate to you personally?

15) What personal interests do you have that center around the natural world (this can include hiking, gardening, the arts, charities, etc.)? To what extent to you engage in these activities?

16) Does intuition play any part in your work, or your approach to your work? If so, how?

17) Are you aware of having a philosophical perspective that informs and affects your work? If so, what is it?

Appendix F: Pilot Interview Questions Used at First Interview Site (first set)

1) Academic discipline:
2) Sub-field:
3) Years of education:
4) Gender:

Describe the following on a separate piece of paper, if necessary:

5) What do you do as a ___?
   (Refer to academic discipline mentioned in Question 1)

6) What led you to chose your particular sub-field?

7) What do you most enjoy about this work?

8) What are do you consider the most important aspects of your work?

9) What keeps you interested in your work?

10) What personal interests do you have that involve the natural world (this can include hiking, gardening, etc.)? To what extent do you engage in these activities?

11) Do you talk much about the things you enjoy about your work with others in the workplace? Why or why not? If so, what is discussed?

12) Do you talk much about the things you consider important about your work with others in the workplace? Why or why not? If so, what is discussed?

13) Are you aware of having a philosophical perspective that informs and affects your work? If so, what is it?

14) How would you describe the "subject" and the "object" in your work?

15) How does your work relate to the larger picture?

16) How does your work relate to you personally?

17) Do you think subjectivity plays a role or roles in the work of science? If so, how would you describe this role(s)?

VITA

Marianne Russell Chrystalbridge (maiden name Back) was born in Springfield, Massachusetts on April 20, 1950. She attended public schools in Southwick, Massachusetts and in Bloomfield, Connecticut. She then attended Northwest Catholic High School, where she graduated in June, 1968. She entered Greater Hartford Community College in September of 1969, and received an Associate Degree with Highest Honors in June of 1971. After traveling in the United States, Canada, and Puerto Rico, she and her husband began raising a family in Illinois, where she ran a small business for six years. She and her family then moved to Breckenridge, Colorado, where she attended Colorado Mountain College for several courses in writing and mountaineering. She and her family moved to Tennessee in November of 1983, where she continued her education at the University of Tennessee, Knoxville. She received the Bachelor of Arts in Economics with Highest Honors in December 1990. She then participated in numerous research projects at the University of Tennessee, including research on environmental decision making for the National Center for Environmental Decision Making Research, and on environmental education for the Center for Geography and Environmental Education, as well as surveys and analysis for the Community Health Research Group and for the Municipal Technical Advisory Service at the Institute for Public Service. She served one year with the AmeriCorps National Service Program, working on environmental tourism planning and development with the Clinch-Powell Resource Conservation & Development Council. She returned to the University of Tennessee in January of 1997 to pursue the Master of Science degree. She received the Master's degree in August, 2004. She continues to write about sustainability issues and different ways of knowing nature.