
Brief Comment

Qualitative Insight Into Public Knowledge of, and Concern With, Biodiversity

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INTRODUCTION

While social research continues to document high levels of public concern with environmental issues, substantial evidence also continues to accumulate as to the low levels of public environmental knowledge. As examples, research has revealed public misunderstanding as to the details of natural ecological processes (e.g., Jacobson and Marynowski, 1997), global warming (e.g., Bord, O'Connor, and Fisher, 2000; Stamm *et al.*, 2000), and the processes involved in materials recycling (Ebreo *et al.*, 1999; Gamba and Oskamp, 1994). The present qualitative study contributes to the social research on public environmental concern and knowledge, with a focus upon a topic little studied within social science: biodiversity. Using a case study approach with a study population within a rural, biologically rich region, we ask, *What are the levels of knowledge and concern with issues related to biodiversity?* Insight into this question is useful in several ways. First, public understanding of the issues surrounding diversity within the ecological world represent an interesting indicator of our increasing sophistication with regard to understanding natural processes, the impacts of humans upon ecological well-being, and the implications of human-induced environmental changes. Second, and more directly related to policy, when seeking public involvement in land management decisions, it is useful to have insight into public understanding of the ecological principles upon which conservation policy may be made. Third, and also related to policy, inclusion of local

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narratives and understandings is essential if we are to strengthen the power and voice of local concerns within local, national, and global policy debates around biodiversity (Sullivan, 2000). This work was designed to provide an example of the insights gained when listening to the local voice.

The following paper is presented in five sections. First, we define biodiversity and briefly review perspectives, processes, and implications related to biodiversity decline. Second, we review recent literature examining public concern and knowledge related to biodiversity. Third, our research methods are presented, and following, we review qualitative results in three areas: (1) understanding of the term “biodiversity,” (2) knowledge of the forces leading to species decline, and (3) concern with biodiversity loss. Finally, we conclude by summarizing research findings and implications.

BIODIVERSITY DEFINED

Biodiversity (or biological diversity) exists at several levels, from the smaller scale of genetic diversity to the larger scale reflecting the biological variation present at the ecosystem level (Office of Technology Assessment [OTA], 1987; World Research Institute [WRI], 1994). At the species level, it has been estimated that approximately 25% of known mammals and 11% of known birds are threatened (IUCN-World Conservation Union, 1996). Although there is a “background” level of extinction, human activities have accelerated this natural extinction rate by 1000–10,000 times (Wilson, 1997).

The values attached to biological diversity are many, but can be broadly categorized as environmental, economic, and aesthetic, each providing different utility to natural systems and human populations. As far as environmental impacts, natural life is interdependent and, as such, alteration in any particular aspect of the natural world results in adjustments throughout the system (WRI, 1994). Species diversity also represents economic value through services such as erosion prevention, carbon sequestration, and water sanitation (Tangley, 1997). The economic value of biodiversity is also reflected in its crucial role in medical innovations, namely pharmaceutical products (WRI, 1994). Finally, some argue for the intrinsic, more spiritual values, associated with nature’s diversity. As an example, Kellert (1996) identifies nine basic values of nature and living diversity. His typology includes “naturalistic” values that emphasize the satisfaction people obtain from direct experience with nature, as well as “aesthetic” values in which the emotional arousal resultant of the “physical splendor” of nature is the focus. In a sense, many of these values are linked together by Vandermeer and Perfecto (1995) as they argue that conserving biodiversity is essential as it represents

the very basis of production, therefore conservation ensures both people's livelihoods as well as "nature."

BIODIVERSITY CONCERN AND KNOWLEDGE

Shifts in biological diversity represent important indicators of environmental change, although the study of biodiversity, and indeed the term itself, are relatively new arenas of scientific inquiry, even within the biological sciences. Indeed, research generally suggests that while the public possesses some general wildlife knowledge, individuals are typically unaware of scientific detail (Kellert, 1985a,b, 1993; Kellert and Berry, 1987; Mankin *et al.*, 1999). For instance, studies have shown that the public demonstrates little understanding of the role of invertebrates within ecological processes (Kellert, 1993) or of the ecological import of keystone species such as the prairie dog (Reading *et al.*, 1999). Processes that lead to species decline are also often wrongly attributed. In a study of Illinois residents, Mankin *et al.* (1999) found that statewide declines in wildlife are often incorrectly attributed to hunting, rather than to the true underlying cause, habitat alteration. They argue that residents may have been sensitized by the media to global trends in rare and endangered species driven by overexploitation, with this understanding then incorrectly attributed to the local context.⁴ Indeed, certain types of biodiversity attract the greatest attention—"charismatic megafauna" such as elephants or tigers—but it is often the smallest organisms that are the most specialized and the most vulnerable to extinction from human disruption (Vandermeer & Perfect, 1995).

Why should we be interested in, or concerned with, public knowledge of, and concern with, biodiversity? As Kempton (1991) notes in his analysis of public understanding of global warming, since the costs of both prevention and adaptation must be borne by the general public, citizens' comprehension of the scientific and policy issues is significant to the political decision-making process. Specifically, reducing greenhouse gas emissions will require the cooperation and consent of consumers and workers, therefore they must possess an understanding and level of knowledge about the specific issue of global warming to make those decisions. In support of this contention, Bord

⁴Variations in knowledge of wildlife and biodiversity issues are apparent along several socio-demographic dimensions. For instance, wildlife knowledge appears highest among those participating in nature wildlife-oriented recreation, with birdwatchers scoring highest on knowledge test scores (Kellert, 1985b). Gender variations are also evident, with knowledge of wildlife greater among males (Kellert and Berry, 1987), and women typically less supportive of hunting (Mankin *et al.*, 1999). Gender differences were also apparent among children, with young males exhibiting greater knowledge of animals (Kellert, 1985a).

et al. (2000) find that environmental concern does not necessarily equate with behavioral changes designed to lessen the environmental insult, and that accurate knowledge is the strongest single predictor of intentions to adjust behavior in ways that might lessen climate change.⁵

Much like the case of global warming, it is logical to consider that protection of biodiversity will require public participation and cooperation, therefore comprehension of issues related to species is critical to the political process. Particularly as related to conservation, key issues may include, for instance, public knowledge of “biodiversity” as an ecological term, the role which species richness plays within ecosystem functioning and sustainability, and the human forces most responsible for habitat impact. Still, policy needs not only public support, but more comprehensive public inclusion. Sullivan (2000) argues that local narratives and discourse must be integrated with science to fully understand environmental change and biodiversity loss; the power and voice of local concerns must be heard within local, national, and global policy debates (Sullivan, 2000). In this sense, the traditional positivist approach to scientific knowledge is increasingly being challenged as the significance of local voices and knowledge is being acknowledged and sought.

DATA AND METHODS

This paper represents the second stage of two-part project on the association between population and biodiversity within the state of Utah; the state provides an interesting choice, given the region’s unique geography and contemporary demographic change. Utah’s diverse ecoregions provide important habitat for a variety of species; its borders encompass alpine to desert terrain, with vegetation ranging from mountain fir and mahogany to desert sage and grassland. Thirty-nine endangered plant and animal species have habitat within Utah, including the threatened Mojave Desert Tortoise in southwestern Utah (U.S. Fish and Wildlife Service [USFWS], 2000).⁶ The importance of regional ecosystems is further evidenced by the 1996 designation of the Grand Staircase Escalante National Monument, 1.7 million acres of arid, red rock country in the southern portion of the state. The monument is bordered by Capitol Reef National Park to the northeast, Glen Canyon

⁵Measured voluntary behavioral changes included the following: (1) choose car with good gas mileage, (2) install more insulation and weatherize homes, (3) drive less, (4) replace old appliances with energy efficient models, (5) use less energy to heat/cool home. Stamm *et al.* (2000) also examined respondents’ support for a set of hypothetical national referenda designed to enact governmental policies to lower CO₂ emissions.

⁶The endangered species include 2 mammals, 6 birds, 1 reptile, 8 fish, 2 invertebrates, and 20 plants (USFWS, 2000).

National Recreation Area to the southeast, and Bryce Canyon National Park to the northwest.

As for threats to the region's biodiversity, the population of the Intermountain West continues to experience tremendous growth. Utah, in particular, has one of the fastest growing populations in the nation. Since 1990, the number of Utahns increased by nearly 30% increasing from 1.7 million in 1990 to 2.3 million in 2000 (U.S. Census Bureau, 2001a). As for Utah's demographic future, the state's Demographic and Economic Analysis division projects a 2020 population of 3.18 million, representing a near doubling of the state's population between the years 1990 and 2020 (DEA, 1999). The rapidly growing population, combined with the ecological richness, makes this region ripe for conflicts between humans and biodiversity.

The Utah-based project's first phase identified biodiversity "hotspots" within the state by merging spatially explicit census data with indicators of biological richness from the National Biological Service's Utah Gap Analysis (Hunter and Beal, in press). Gap Analysis is a recently developed tool designed to inform conservation policy, basically allowing geographic comparison of land management status and species distributions to identify "gaps" in biodiversity protection.⁷ Gap areas are those in which vulnerable species are present and unprotected, and it is anticipated that developing an understanding of these gaps in the protection of biodiversity will assist in avoiding future biodiversity conservation crises (Scott *et al.*, 1987). Within this project's first phase, we made use of Gap Analysis data for Utah to measure biodiversity at particular geographic locations through calculation of "species richness," defined as the number of vertebrate species representing four specific taxonomic groups (mammals, birds, amphibians, and reptiles) expected to be found in each census-defined block group.⁸ Our map of species richness was then intersected with census data, the intersection allowing the identification of "hotspots"—block groups with high levels of population density and relatively high numbers of vertebrate species.

The goal of the project's second phase, reported here, was to develop an understanding of knowledge and concern with regard to issues related to

⁷The species distributions are estimated from vegetation coverage as discerned from remotely sensed imagery. Of the several types of satellite imagery available, Gap Analysis programs have used either Landsat Multispectral Scanner (MSS) or Landsat Thematic Mapper™ scenes—each allows identification of boundaries between major changes in vegetation.

⁸This particular measure of biodiversity is more representative of overall levels of biological diversity than are measures of single species or taxa (Sisk *et al.*, 1994), and is based upon the principle that vertebrates can serve as ecological bellwethers for a multitude of organisms, most of which are still unlisted, which comprise the genetic-, species- and ecosystem-level components of biodiversity (Wilson, 1992). Further, the use of these four categories in the species richness model provides a representative group of species due to their diverse habitat requirements and life history strategies.

biodiversity among residents of one of the above-determined hotspots. Many communities are scattered throughout the hotspot regions; the one chosen for in-depth qualitative research is fairly isolated in a geographic sense, contains fewer than 1000 residents (U.S. Bureau of the Census, 2001b), and is bordered by public lands. Twenty interviews, averaging 1.5 h each, were conducted during the summer of 1998. Respondents included 11 women and 9 men, and the mean age was 52 years (minimum = 27, maximum = 74). On average, the respondents had lived in the community for 17 years (minimum = 2 months, maximum = 61 years). Finally, the respondents represented a variety of occupational backgrounds including professionals (e.g., accountant, marketing consultant, teachers), laborers, artists, and several retirees. The study participants were recruited from randomly selected telephone numbers and offered \$20 compensation for their time.⁹ A 10-page interview guide structured the discussions, although participants were allowed the opportunity to expand upon their thoughts, as they desired. Each interview was recorded and transcribed in entirety for analysis.

INTERVIEW RESULTS

Findings based upon analyses of the interview data are presented in three parts. First, we provide a review of respondents' understanding of the term "biodiversity." Second, we review respondent knowledge of the forces leading to species decline as related to both local and global issues. Finally, respondent concern with the loss of biodiversity is addressed. The quotations selected for inclusion represent clearly articulated expressions of what we deemed to be more general patterns within the data. All names are pseudonyms.

Understanding of the Term "Biodiversity"

The respondents were directly asked to define the term "biodiversity;" few could. Samantha's (age 36, unemployed professional) response was typical: *I have no idea . . . what does that mean?* while Paul (age 37, self-employed) expressed similar sentiment: *I don't know, you explain it to me.* Nonetheless, after admission of uncertainty, many respondents dissected the term in attempt to craft a definition. Samantha struggled with *Biodiversity? "Bio" means two . . . let's see what does "biodiversity" mean?* Bob (age 55, professional) remained uncertain although offering an accurate definition:

⁹Forty-eight contacts were made to achieve the research goal of 20 interviews.

“Well . . . I’m just putting words together and putting a meaning to it, and I suppose “bio” meaning biology and “diversity”—the diversity of biological resources in our area. You know, I’m just making a guess. Also exhibiting uncertainty, Joe (age 63, retired professional) was nonetheless successful at dissecting the term: “That’s too big for me . . . “diversity” of course means spread out, I guess “bio” would be biological type stuff?”

As suggested by these examples, although often unable to provide a concise definition of the term, respondents realized that “biodiversity” related to ecological issues in some manner. Karla (age 54, professional) contended, *It’s got to relate to environmental issues . . .* while Mark (age 38, self-employed) commented, *I don’t know. I guess it might have something to do with environmental differences or something like that.* And although uncertainty predominated, six respondents (representing 30%) demonstrated a more complete understanding. Ben (age 45, self-employed) stated, *It’s the quantity of different species existing in different environmental situations within a given area,* while Tonia (age 27, professional) similarly defined “biodiversity” as *“different things living in one place.”* Both species and habitat were included in George’s definition (age 74, retired): *I suppose it means the diversity of the wildlife . . . also places where they need to eat.* Joan (age 46, student) and Nancy (age 51, professional) remained uncertain even in the midst of a fairly accurate understanding: *I’m not really sure. Different types of life, is that what you’re talking about? Diversity of life? I’m assuming you’re talking about the plant and animal kingdom (Joan). Does it mean that you have your little area and in the area there’s the diversity of animals and people and the land and water and of those sorts of things? (Nancy).*

In general, the respondents exhibited substantial uncertainty as to the meaning of the term “biodiversity,” although dissection of the term allowed many to craft a fairly accurate, generalized ecological meaning.

Knowledge of Species Decline and the Forces Acting Upon Biodiversity Loss

The shift to a discussion of species loss more generally generated evidence of some topic familiarity. A common response to the general topic of species loss was the view of such decline as occurring elsewhere, particularly in Africa and Asia. In fact, over half of the respondents characterized species loss as a global issue as opposed to a local one; species loss occurs to “exotic” species in “exotic” ecological systems (female, age 51, professional). When asked about areas of the world in which biological diversity is threatened, Karla (age 54, professional) contended, *I think maybe the rain forest, probably, . . . and . . . maybe the animals in Africa.* Bob (age 55, professional) agreed and offered a partial explanation for his perspective: *I think your*

tropical jungles are probably impacted the most. You know, you got some mammals down there that only live on certain types of leaves, like your mountain gorillas and there are some others—your orangutans. . . the animals that are so specific in their diet, they're in real trouble as far as I'm concerned.

While portions of Africa and Asia do, indeed, represent “hotspots” as identified by some biodiversity researchers (e.g., Wilson, 1992), the study respondents were generally hesitant to acknowledge species loss as a local environmental issue in any regard: *As far as Utah, I don't think there's any [species] that are in that much danger . . . they still have lots and lots of space . . . But I imagine some places, like Florida, they're losing some of their [biodiversity] . . . [and] overseas and places like that . . . Africa . . . Right here we don't have that problem [of species loss] . . . there's a lot of them . . . but I imagine when you think about losing the Koala Bear and things like that . . .* (Judy, age 55, retired professional). Those that did acknowledge local issues as related to particular species tended to focus upon local game populations, particularly Mule Deer and Elk. Bill (age 53, professional) is an avid outdoorsman who expressed concern with the decline of *Deer, mule deer for one . . . pheasant population is [also] in big decline “cause when we first came here I was amazed at the number of ringnecks we saw in this area . . . you don't see as many now.*

As for respondent understanding of the forces that ultimately yield biodiversity loss, most acknowledged population pressures as a key factor in biodiversity decline, but little discussion took place of the *mechanisms* through which population impacts environmental context other than development-related land use change. As an example, Samantha (age 36, unemployed professional) argues that biodiversity loss is driven by *Sheer numbers . . . People just [move] in on animal territory] . . . destroying where they live.* Interestingly, most respondents discussed population pressures in local terms, although noting species decline primarily on the global level. For instance, Mary Ellen (age 74, retired) noted above that southern Utah still offers *a lot of space*, although she later contends that population pressure exists on a local scale: *On the old highway . . . (there were very few houses . . . coming home from work at night we would see a lot of deer . . . now there's all houses there.* Jason (age 56, self-employed) also offers personal observations of local population change: *. . . when I first moved here . . . a lot of the fields . . . had doves . . . and pheasants that made nests out there . . . so they reproduced . . . But now there [are] houses there and . . . no pheasants. So [human] population . . . pays a big part in the [slowed] reproduction of animals.*

In general, the respondents have limited knowledge of local issues regarding threatened and endangered species and the decline of biological diversity, although many correctly attributed some species shifts to development. At the local level, game populations provided the focus of

discussion, with respondents typically attributing shifts in game populations to local population increases. Nonetheless, the most important issues related to biodiversity decline are seen as related primarily to “exotic” ecological systems such as the rainforests of South America or the savannas of Africa. Finally, virtually no discussion was offered of the more complex mediating factors linking human populations to species decline (e.g., international markets).

Concern With Biodiversity Loss

In general, respondents acknowledged a basic understanding of the need to protect species, but they struggled with identifying specific concerns with species loss and specific reasons for biological conservation. The concern for species decline was identified in vague, broad terms, as evidenced by Samantha (age 36, unemployed professional): *Well I think that it's important to keep species alive. Because obviously they 're here for a reason.* Particularly among outdoor enthusiasts, much concern was expressed with the decline of game species. The viability of the deer population is of concern to Jeff (age 46, laborer), *You know, when I grew up . . . we'd get up early in the morning and head up to [the] lake . . . up in the mountains . . . we 'd count the deer . . . “we saw sixteen today” . . . in the last ten years, you can go up there and you're lucky to see even one.* Representing a different perspective, Jason's (age 56, self-employed) comments characterized the moralistic sentiment expressed by several individuals with regard to reasons for concern with species decline: *Because I don 't believe that the earth can live without all the creatures.*

In many cases, concern with biodiversity decline was manifested relative to local issues and personal loss, as evidenced by Nancy (age 51, professional): *I guess personally it sounds like [biodiversity loss] should be of importance because we'd hate to lose anything or any form of life we have now on the planet, but . . . it's hard for me to get excited and concerned about those that I don 't know. I think if those issues come up the best thing you can do is let people know about them so that they can feel the need to protect them because we only protect what we know. We only care about what we know.* Judy (age 55, retired) offered an intergenerational perspective on the rationale in preserving biological diversity: *Because I want my children, my grandchildren, my great grandchildren, to be able to know that those animals exist and that they are still there.*

In general, respondents express vague concern with species decline generally, although some invoke strong moralistic and sentimental rationales. Heightened concern was expressed with regard to local species, particularly game species.

CONCLUSIONS, DISCUSSION, AND IMPLICATIONS

Our in-depth interviews with residents of a rural Intermountain West community revealed low levels of knowledge with regard to conservation terminology and issues, as well as little understanding of the forces leading to species decline (excepting local population and development pressures), or the implications of biodiversity loss. In addition, most respondents were hesitant to acknowledge biodiversity loss generally as a local concern; none provided mention of a regional endangered species. Some respondents did, however, express specific concern for the maintenance of viable populations of local game species, focusing upon resulting reduction in local recreational opportunities. Other respondents, however, exhibited the perspective that humans have a moral obligation to protect elements of the natural environment, while there was also some note of importance of environmental sustainability for the sake of future generations. Discussions revealed only a vague notion of species diversity as related to ecosystem viability.

There are many interesting links between these qualitative insights and existing social research on environmental concern and knowledge. Our results suggest that biodiversity may represent another environmental arena (much like global warming) in which the lay public expresses general concern, but possesses little underlying knowledge of the ecological principles related to the environmental issue, the complex forces leading to environmental change, nor the implications of such change. To be fair, perhaps such knowledge should not be expected; as mentioned at the onset, "biodiversity" is a fairly new term and arena of scientific inquiry. In addition, species loss is the product of complex forces, and the discussion of species decline often takes on a global perspective (e.g., loss of rainforest due to international markets). Pierce *et al.* (1992) would argue that such new terminology is scientifically and technically complex, often far beyond the grasp, or interest, of the average member of the public. Dunlap *et al.* (2000) also note that today's public may see contemporary environmental outcomes are "geographically dispersed, less directly observable, and more ambiguous in origin," thereby cannot be expected to grasp the complex synergies responsible for specific environmental outcomes.

These results also have interesting implications in an applied sense—suggesting that when seeking public involvement in land management decisions, it is important *not* to assume that the general public has been exposed to the ecological principles upon which conservation policy may be made. As reflected by our work and also stated by Mankin *et al.* (1999, p. 472), "environmental issues are becoming important to many people, but the extent of superficial knowledge, misconceptions, and lack of diverse experiential involvement by citizens are a serious concern." Research on

other environmental issues (e.g., global warming, recycling) suggests accurate knowledge is an important component of support for environmental policy (e.g., Bord *et al.*, 2000; Gamba and Oskamp, 1994). As such, educational efforts must be extended to clarify the scientific rationale underlying conservation agendas—an important lesson relevant to land managers, activist organizations, and academics alike.

In a sense, Sullivan (2000) would interestingly argue the opposite, emphasizing a political ecology approach to the disconnect between knowledge and biodiversity. According to Sullivan, it is not simply about “educating the local” about the importance of biodiversity, but more importantly it is about educating the scientists and policymakers about local perceptions and social constructions of biodiversity. Although scientific knowledge about biodiversity was lacking within our study, participants typically demonstrated some knowledge of local species, particularly charismatic and/or game species. In an applied sense, land managers would be wise to be cognizant of this local knowledge and concern, thereby better allowing placement of management costs/benefits discussions within the most salient framework for local residents. In other words, place-based knowledge and concern of species richness and biodiversity should be incorporated into the discussions of land management practices and policies that support biodiversity over the long term.

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