The Biophila Hypothesis: Aristotelian Echoes of The 'Good Life'

Stephen R. KELLERT

School of Forestry and Environmental Studies, Yale University, New Haven, U.S.A.

INTRODUCTION

The biophila hypothesis boldly asserts the existence of a fundamental, biologically-based and inherent human need to affiliate with life and life-like processes (Wilson 1984). This supposition further suggests that human identity and personal filfillment are dependent upon our relationship to nature. The human need for nature is not just linked to the material exploitation of the environment, but also to the influence of the natural world on our emotional, cognitive, aesthetic, and even spiritual development. Even the tendency to avoid, reject and, at times, destroy elements of the natural world are viewed as an extension of an innate need to relate deeply and intimately with the vast spectrum of life about us.

The biophila hypothesis suggests the widest valuational affiliation with life confers distinctive advantages in the human struggle to adapt, persist and thrive as individuals and as a species. Conversely, this notion intimates the degradation of this dependence on nature is the increased likelihood of a deprived and diminished human existence, again, not just materially, but also in a wide variety of affective, cognitive and evaluative respects. The biophilia notion, thus, powerfully asserts much of the human search for a coherent, fulfilling and meaningful existence depends upon our relationship to nature. This hypothesized link between personal identity and nature reminds one of Aldo Leopold's adaptation (1966, p. 240) of Descartes famous dictum of selfhood from, "I think, therefore, I am," to "as land-user thinketh, so is he." This paper will explore the biophilia notion by identifying and describing nine fundamental aspects of our presumably biologically based human need to affiliate deeply with the natural world. These hypothesized expressions of the biophilia tendency, in order of their delineation, are referred to as the utilitarian, dominionistic, naturalistic, ecologistic-scientific, aesthetic, symbolic, humanistic, moralistic and negativistic relationships or valuations of nature.

Before beginning this description, I would like briefly to digress by noting how these hypothesized categories of human relationship to nature evolved in my own work. This digression hopefully proceeds less from any egoistic indulgence on my part than from a desire to provide some initial suggestion of how these potential dimensions of

the biophilia phenomenon may be universally present.

A limited version of the typology of nine perspectives of nature was developed in the late–1970s as a way of describing basic perceptions of animals (Kellert 1976). This typology was used in a study of nearly 3,000 randomly distributed Americans residing in the 48 contiguous states and Alaska (Kellert 1979, 1980, and 1981). Expanded versions of the typology were subsequently employed in examining human perceptions of particular taxa such as wolves (Kellert 1986d, and 1991a), bears (Kellert 1992a), marine mammals (Kellert 1986b, and 1991b), various endangered species (1986c) and invertebrates (Kellert 1986a, and 1992b); the views of diverse human groups such as hunters (Kellert 1978), birders (Kellert 1985a), farmers (Kellert 1984a) and the general public distinguished by age (Kellert 1985b), gender (Kellert 1987), socioeconomic status (Kellert 1983) and place of residence (Kellert 1981, and 1984b); in exploring cross-cultural perspectives in Japan (Kellert 1991c), Germany (Schulz 1985, and Kellert 1993), and Botswana (Mordi 1991); and in viewing historical shifts in Western society (Kellert 1985c). Later in the paper, limited results from these studies will be offered to illustrate the empirical expression of the typology, as well as suggest the extent of interest and appreciation of the natural world in modern United States and Japan.

In each of these inquiries, most dimensions of the typology were revealed, although varying, often greatly, in content and intensity. In other words, what began as a restricted attempt to describe variations in human perceptions of nature, eventually pointed the way toward possibly universal categories of basic human relationship to animals, specifically, and more generally, the natural world. The typology may merely be a convenient and useful shorthand for describing human perspectives of nature. More ambitiously, however, it seems reasonable to suggest and explore the possibility that these categories are universal and functional expressions of our species dependence on the natural world.

The task of the paper's next section is to indicate how each of the categories described may reflect our human dependence on nature in the struggle for survival and in the search for personal fulfillment. Nine hypothesized dimensions of the biophilia phenomenon—the utilitarian, naturalistic, ecologistic-scientific, aesthetic, symbolic, humanistic, moralistic, dominionistic, and negativistic—will be separately defined and their adaptational function delineated. This will be followed by an elucidation of how collectively this deep relationship to nature represents the enhanced likelihood of a meaningful and fulfilling existence, and how this pursuit of self-interest constitutes the strongest basis for a powerful conservation ethic. A somewhat more pessimistic conclusion will be introduced, however, by a final examination of the limited expression of the biophilia phenomenon in modern society.

A CLASSIFICATION OF BIOPHILIA FUNCTIONS

Utilitarian

This category of human dependence on nature is perhaps the most obvious to

describe and something of a misnomer. The term's inappropriateness stems from the presumption that all the biophilia values possess utilitarian significance in the sense of conferring a measure of adaptational advantage. The Utilitarian focus here is the more conventional notion of material value; i.e., the diversity of ways in which the natural world provides humans with the physical means for sustenance, protection and security.

It seems obvious to suggest there exists a biological advantage for humans in exploiting nature's vast cornucopia of potential food, medicinal, clothing, tool and other material products. Still, a major conservation development in recent decades has been the far more detailed delineation of these actual and potential practical benefits associated with the genetic, biochemical and physical use of diverse plant and animal species (Myers 1978, and Prescott-Allen 1986). Of particular significance has been the development of a limited understanding of the "hidden" value in nature represented by obscure species and unimpaired biomes, such as the moist tropical forests, as repositories of material benefit for future generations as human knowledge expands to exploit the earth's vast genetic resources.

Naturalistic

The naturalistic experience may be described, at its most basic level, as the satisfaction derived from direct contact with nature. At a more complex and profound level, this function involves an especially refined capacity for experiencing fascination, wonder and diversity in the natural world. This appreciation for the complexity and intricacy of the natural world stems from an intimate awareness of life and, a related tendency, to place value on all creation.

The naturalistic urge involves an intense curiosity and desire for exploring the natural world. This interest in discovering living diversity, and its possible evolutionary roots, is powerfully described by Wilson (1984, pp. 10 and 76):

> Because species diversity was created prior to humanity, and because we evolved within it, we have never fathomed its limits...The living world is the natural domain of the more restless and paradoxical part of the human spirit. Our sense of wonder grows exponentially; the greater the knowledge, the deeper the mystery and the more we seek knowledge to create new mystery...Our intrinsic emotions drive us to search for new habitats, to cross unexplored terrain, but we still crave this sense of a mysterious world stretching infinitely beyond.

The interest in discovering and exploring life's diversity is certainly associated with increased knowledge of the natural world, and it may not be unreasonable to speculate that such information could have conferred distinctive advantages in the course of human evolution. Seilstad alludes to this benefit when he suggests (1989, p. 285): "the surest way to enrich the knowledge pool that will keep the flywheel of cultural evolution turning is to nourish the human spirit of curiosity." The possible genetic basis for this naturalistic urge is further suggested by Iltis (1980, p. 3): "Involvement with nature...may be in part genetically determined; human needs for natural diversity...must be inherent. Man's love for natural colors, patterns and harmonies, his preference for forest-grassland ecotones...must be the result...of...natural

selection through eons of mammalian and anthropoid evolution."

The naturalistic tendency can also be linked to the greater likelihood of physical fitness and to the acquisition of various "outdoor skills" such as climbing, hiking, tracking, orienteering, etc. Both the possession of these skills and associated mental and physical states of well-being have been identified in a variety of studies of such naturalistically-oriented programs as the National Outdoor Leadership School and Outward Bound (Driver and Brown 1983). The therapeutic mental benefits of this naturalistic experience have been related to increased tension release, relaxation, enhanced peace of mind, and mental satisfaction from observing nature's variety and beauty. These psychological values of the outdoor recreational experience are noted by Ulrich *et al.* (1991, p. 203) in an extensive review of the scientific literature: "a consistent finding in well over 100 studies of recreation experiences in wilderness and urban nature areas has been that stress mitigation is one of the most important verbally expressed perceived benefits." Kaplan (1983, p. 155) similarly concluded, based on many studies of the psychological affects of the outdoor experience: "Nature matters to people. Big trees and small trees, glistening water, chirping birds, budding bushes, colorful flowers—these are important ingredients in a good life."

Ecologistic-Scientific

While important differences distinguish the scientific from ecologistic perspectives of nature, both are similarly characterized by a commitment to precise study and systematic inquiry of the natural world and to the related belief that nature can be understood through empirical study. The ecologistic view involves the recognition of interconnection and interdependence in the natural world, and a related awareness of interactive ties between biotic and abiotic elements stemming from a flow of energy and materials within a systemic framework. The ecological notion is a modern scientific concept, what Leopold (1966, p. 176) even claimed as "the outstanding scientific discovery of the twentieth century." Still, an understanding and recognition of organismal and habitat interdependence and human benefit derived from these interrelationships was, in all likelihood, the mark of the observant individual throughout history. Leopold, despite his previous assertion, recognized this possiblity when noting (1966, p. 266): "Let no man jump to the conclusion that Babbitt must take his Ph.D. in ecology before he can 'see' his country. On the contrary, the Ph.D. may become as callous as an undertaker to the mysteries at which he officiates."

The ecologistic perspective involves a recognition of organizational structure in nature emerging from complex and barely discernible interactions among natural properties. These ecological processes are often manifest at the bottom of biological food chains, typically expressed in the activities of invertebrates and microbial organisms. Invertebrates, as more than 90% of the planet's biological diversity, frequently perform such critical ecological functions as pollination, seed dispersal, decomposition, energy and nutrient transfer, providing a constant stock of edible materials for adjacent tropic levels, maintaining biotic communities through mutualism and host-restricted food webs, parasitism and predation, to mention a few. Most people hardly recognize these ecological functions or the species integral to their performance prefer-

ring, instead, to direct their emotional and visual interest to the larger vertebrates.

The human understanding of ecological function has clearly just begun to develop through systematic inquiry and careful study. Still, a broad recognition of ecological process has probably always been evident to the astute observer. One can speculate this ecological insight could have provided distinctive advantages in the meeting and mastering of life's exigencies. In addition to increased knowledge, the honing of observation and recording skills and the recognition of potential uses of nature through direct exploitation and human mimicry probably occurred. An understanding of nature's functional interconnection and the human dependence on this intricate complex may have further instilled in the prudent observer a caution and respect for nature's conservation.

The scientific perspective of nature somewhat differently involves a primary focus on physical and mechanical functioning, as well as the systematic classificatiion of the natural world. Like the ecologistic outlook, the scientific view reflects an interest in studying nature's complexity and diversity, and a shared commitment to empirical investigation of the earth's biotic and abiotic elements. Somewhat unlike the ecologistic outlook, the scientific approach involves a more reductionistic emphasis on nature's constituent elements often ignoring or minimizing the understanding of entire organisms or their natural habitats. The scientific interest tends to emphasize physical and mechanical functioning in nature, and a related stress on the study of morphology, taxonomy and physiological process.

Despite this restricted scientific focus on biological functioning and structure, often divorced from direct experiential contact with nature, this outlook shares with the ecologistic an intense curiosity and fascination for studying life. The depth and intensity of the scientific-ecologistic exploration can often lead to a profound feeling for nature's wonder. Powerful elements of this awe of nature's complexity and diversity can be discerned in McVay's description of the scientific perspectives of Wilson, Vishniac and Von Frisch (1987, pp. 5–6):

> I start with wonder, awe and amazement of the profusion of life...E. O. Wilson...wrote that a genetic description of a mouse would fill every page of the Encyclopedia Britannica in every edition starting with the first printing in the 1750's to the present day...Roman Vishniac...[said he found] more wonder in a drop of pond water than in traveling to the most remote places on the planet...Karl von Frisch...said that there was miracle enough in a single species to provide a life's work.

The scientific-ecologistic perspectives can result in satisfaction from studying life and natural process quite apart from its apparent utility or practical advantage. Yet the actual and potential practical value of the scientific-ecologistic perspectives are also apparent, and one can imagine advantages of vastly enhanced knowledge and understansing conferred upon those who developed the capacity for precise observation, analysis and detailed study of even a fraction of life's intricate expression.

Aesthetic

The physical beauty of nature is certainly among its most powerful attractions to

the human animal. The complexity of the aesthetic response is suggested by its wide range of expression from the sinuous contours of a mountain landscape to the ambient colors of a setting sun to the fleeting vitality of a breaching whale. Yet, each exerts a powerful aesthetic register on most people, leaving them awed by the extraordinary physical appeal and beauty of the natural world.

The human need for nature's aesthetic is suggested by the apparent inadequacy of the artificial or human-made when people are exposed to manufactured products as presumably physically attractive substitutes for the natural. This preference for natural design and pattern has been revealed in many studies. As Ulrich notes (1983, p. 109): "One of the most clear-cut findings in the experimental literature.. is the consistent [human] tendency to prefer natural scenes over built views, especially when the latter lack vegetation or water features. Several studies have [shown] that even unspectacular or subpar natural views elicit higher aesthetic preference...than do all but a very small percentage of urban views." Research has also suggested this preference exists across cultures intimating the aesthetic response to nature does not reflect an ethnocentric bias. As Ulrich further notes (1983, p. 110), "although far from conclusive, these findings...cast some doubt on the position that [aesthetic] preferences vary fundamentally as a function of culture."

Living organisms are often the centrally valued element in people's aesthetic responses to nature. In contrast to the previously described ecologistic/scientific emphasis on relatively obscure organisms, often invertebrates, the human aesthetic preference is for the larger, so-called charismatic mega-vertebrates. The basis for this aesthetic interest in animals is elusive yet vital to the understanding of the human attraction to nature. Leopold (1966, pp. 137, 129–130) powerfully alluded to the aesthetic significance of animals in describing the typical reaction to both the presence and absence of wildlife in the natural landscape:

> The physics of beauty is one department of natural sciences still in the Dark Ages...Everybody knows, for example, that the autumn landscape in the north woods is the land, plus a red maple, plus a ruffed grouse. In terms of conventional physics, the grouse represents only a millionth of either the mass or energy of an acre. Yet subtract the grouse and the whole thing is dead. An enormous amount of some kind of motive power has been lost...My own conviction on this score dates from the day I saw a wolf die...We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain.

Leopold referred to this central aesthetic of animals in nature as its "numenon", in contrast to merely the "phenomenon" of a static and lifeless landscape. Perhaps this essential aesthetic is what George Schaller (1982) had in mind, when upon discovering the near extirpation of the caprid fauna from its biological homeland in the Himalayas, he referred to these mountains as "stones of silence," in contrast to Leopold's revelation of the wolf's aesthetic and ecological role as requiring one to "think like a mountain."

The biological advantage derived from the aesthetic response to nature is difficult to

comprehend yet, as Wilson suggests (1984, p. 104), "with aesthetics we return to the central issue of biophilia." Perhaps the aesthetic response represents a human yearning or reaching for an ideal of harmony and order in nature. Kaplan and Kaplan suggest the aesthetic tendency may involve an intuitive assessment of safety and security in nature. They remark (1989, p. 10): "Aesthetic reactions [to nature]...reflect neither a casual nor a trivial aspect of the human makeup. Rather, they appear to constitute a guide to human behavior that is both ancient and far-reaching. Underlying such reactions is an assessment of the environment in terms of its compatibility with human needs and purposes." Iltis further argued for a genetic component in the aesthetic response and suggested (1973, p. 5), "human genetic needs for natural pattern, for natural beauty, for natural harmony, [are] all the results of natural selection over the illimitable vistas of evolutionary time."

The adaptational value of the aesthetic relationship to nature may also derive from associated feelings of tranquility, peace and harmony, and a related sense of psychological well-being and self-confidence. The aesthetic preference for particular landscapes and species has also been hypothesized as reflecting a selective tendency for situations more likely to produce safety, food, water and security (Orians 1980, and Heerwagen and Orians 1993). Whatever the explanation at this point, as Wohlwill suggests (1983, p. 35), "the evolutionary heritage of the individual may well underlie man's consistent preference for stimuli taken from the natural environment."

Symbolic

The symbolic relationship to nature reflects our use of the natural world to facilitate communication and thought. Levi-Strauss (1970) alluded to this symbolic function in referring to animals as food for thought as much as for eating.

The use of nature as a symbol is most critically reflected in the development of human language. The acquisition of language is facilitated by the engendering of refined distinctions and categorizations, and nature as a rich taxonomy provides a vast metaphorical opportunity for making elaborate differentiations. As Lawrence suggested in the case of animals, but can be more broadly extended to nature (1993, p. 2), "it is remarkable to contemplate the paucity of other categories for conceptual frames of reference, so preeminent, widespread, and enduring is the habit of symbolizing in terms of animals." Shepard also powerfully alluded to this symbolic use of animals in his argument that (1978, pp. 249, 2):

> Human intelligence is bound to the presence of animals. They are the means by which cognition takes its first shape and they are the instruments for imagining abstract ideas and qualities...They are the code images by which language retrieves ideas...They enable us to objectify qualities and traits...Animals are used in the growth and development of the human person, in those most priceless qualities we lump together as 'mind'...Animals...are basic to the development of speech and thought.

Limited indication of the symbolic function was evident in our research (Kellert 1983b) which found more than 90% of the characters employed in language acquisition and counting in preschool children's books were animals. Studies by Shepard

(1978), Bettleheim (1977), Campbell (1973), Jung (1959) and others have further provided convincing documentation of the importance of natural symbols in myth, fairy tale and legend for confronting young people with fundamental issues of personal identity and selfhood.

One might speculate that the modern, technological capacity for fabrication could constitute an effective substitute for the traditional symbolic use of nature for facilitating communication and thought. The unlikelihood of this possibility is suggested by the extraordinarily short time period of the modern industrial era relative to the long course of human evolution where nature constituted the sole environment for our species mind to develop (Shepard 1978). Additionally, the dependence of the human psyche on clearly refined distinctions and taxonomies would only seem to be sufficiently matched by the extreme diversity, complexity and vividness of the natural world as a highly rich developmental system. Plastic trees, stuffed animals and their fabricated kin represent a limited and meager substitute for symbolic thought, more likely to result in a stunted capacity for metaphor and communication than a rich tapestry of expressive language and illusion.

Humanistic

The humanistic relationship to nature reflects feelings of deep emotional attachment for individual elements of the natural environment. This focus, like the aesthetic, is usually directed at larger vertebrates, although humanistic feelings can occasionally be extended to natural objects lacking the capacity for reciprocity such as trees, particular landscapes or geological forms. The humanistic inclination to express strong affection, attachment and even, at times, what some call 'love' for nature is typically directed at individual animals, usually large vertebrates and domesticated companion animals.

Companion species are especially likely to be "humanized" in the sense of achieving a relational status not unlike other people might assume, even family members. The therapeutic value of the companion animal has been identified in various studies, and at times reported to result in important emotional and physical healing benefits (Katcher and Beck 1983, Rowan 1989, and Anderson *et al.*, 1984).

The humanistic perspective entails strong feelings of affection, attachment, care, nurturence, and even love for individual natural elements. From an adaptational viewpoint, the group-oriented character of the human animal, dependent on extensive cooperative and affiliational ties, could have benefitted from the development of humanistic tendencies. An enhanced capacity for bonding, altruism and sharing have all been identified as potential values associated with the humanistic relationship to nature. Additionally, the use of companion animals in a variety of hunting and protection roles almost certainly possessed instrumental importance. An intimate relationship with other creatures may have further enhanced an understanding of the natural world, as Lopez' description (1978, p. 282) of his interaction with semi-domesticated wolves suggests:

> The wolves moved deftly and silently in the woods and in trying to imitate them I came to

> walk more quietly and to freeze at the sign of slight movement. At first this imitation gave me no advantage, but after several weeks I realized I was becoming far more attuned to the environment we moved through. I heard more...and my senses now constantly alert, I occasionally saw a deer mouse or a grouse before they did...I took from them the confidence to believe I could atune myself better to the woods by behaving as they did—minutely inspecting things, seeking vantage points, always sniffing at the air. I did, and felt vigorous, charged with alertness.

Moralistic

The moralistic relationship to nature involves a profound affinity and even spiritual reverence for the natural world. This perspective often reflects a belief in a fundamental order and harmony in nature and a strong feeling of ethical responsibility for protecting the natural environment. These sentiments of ethical and spiritual connectedness with nature have been traditionally articulated through poetry, religion and philosophy, but even, today, can be discerned in the modern discourse of scientific conservation. Leopold captures this contemporary moralistic perspective in his notion of (1966, pp. 222, 231, 240):

> Conservation [as] a state of harmony between men and land...Land is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals...A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.

The moralistic tendency to revere nature spiritually is often associated with the views of preliterate and indigenous peoples. Booth and Jacobs (1990), for example, describe the moralistic perspectives of native Americans as including a fundamental belief in the natural world as a living and vital being, a conviction of the fundamental reciprocity between humans and nature, and a perspective of an inextricable link between individual and collective identity and the natural landscape. The possible moralistic identification with nature among native Americans is powerfully expressed by Luther Standing Bear (1933, p. 45):

> So this land of the great plains is claimed by the Lakota...We are of the soil and the soil is of us. We love the birds and beasts that grew with us on this soil. They drank the same water as we did and breathed the same air. We are all one in nature. Believing so, there was in our hearts a great peace and a willing kindness for all living, growing things.

A more Western, scientifically oriented articulation of this moralistic belief in nature's ultimate order is suggested in the words of Loren Eisley (1946, pp. 209–210):

> It is said by men...That the smallest living cell probably contains over a quarter of a million protein molecules engaged in the multitudinous coordinated activities which make up the phenomenon of life. At the instant of death, whether of man or microbe, that ordered, incredible spinning passes away in an almost furious haste...
>
> I do not think, if someone finally twists the key successfully in the tiniest and most humble house of life, that many of these questions will be answered, or that the dark forces which create lights in the deep sea and living batteries in the waters of tropical swamps, or the dread

cycles of parasites, or the most noble workings of the human brain, will be much if at all revealed. Rather, I would say that if "dead" matter has reared up this curious landscape of fiddling crickets, song sparrows, and wondering men, it must be plain even to the most devoted materialist that the matter of which he speaks contains amazing, if not dreadful powers, and may not impossibly be, as Hardy has suggested, "but one mask of many worn by the Great Face behind."

From the perspective of our inquiry into the biophilia phenomenon, the fundamental question is what possible biological advantage may have been associated with the moralistic perspective of nature. It may be sufficient to identify advantages stemming from enhanced feelings of psychological well-being and self-confidence associated with a sense of profound order and meaning in the universe. It might also be supposed that moralistic understandings articulated in a group context could nurture sentiments of kinship and affiliation more likely to foster cooperative, altruistic and helping behavior. One can further speculate that a strong moralistic affinity for nature might enhance the tendency to protect natural objects of perceived spiritual significance, such as Gadgil (1990) has described for the sacred grove in India. Apart from these possible biological advantages, one is struck by the pervasive occurrence of the moralistic sentiment in human affairs, as powerfully expressed by John Steinbeck (1941, p. 93).

It seems apparent that species are only commas in a sentence, that each species is at once the point and the base of a pyramid, that all life is related...And then not only the meaning but the feeling about species grows misty. One merges into another, groups melt into ecological groups until the time when what we know as life meets and enters what we think of as non-life: barnacle and rock, rock and earth, earth and tree, tree and rain and air. And the units nestle into the whole and are inseparable from it...And it is a strange thing that most of the feeling we call religious, most of the mystical outcrying which is one of the most prized and used and desired reactions of our species, is really the understanding and the attempt to say that man is related to the whole thing, related inextricably to all reality, known and unknowable. This is a simple thing to say, but a profound feeling of it made a Jesus, a St. Augustine, a Roger Bacon, a Charles Darwin, an Einstein. Each of them in his own tempo and with his own voice discovered and reaffirmed with astonishment the knowledge that all things are one thing and that one thing is all things—a plankton, a shimmering phosphorescence on the sea and the spinning planets and an expanding universe, all bound together by the elastic string of time. It is advisable to look from the tide pool to the stars and then back to the tide pool again.

Dominionistic

The dominionistic relationship to nature emphasizes its mastery, physical control and dominance by humans. This perspective may have been more prevalent in the past, its expression today often depicted as destructive and characteristic of an age of profligate waste and despoliation of the natural world. Yet, even life in the modern era can be viewed as a tenuous enterprise, with the struggle to survive necessitating some measure of nature's dominance, the proficiency to subdue, and skills and physical prowess honed by an occasionally adversarial and competitive relationship to the natural

world. Rolston's insight (1986, p. 88) is helpful in this regard:

> The pioneer, pilgrim, explorer, and settler loved the frontier for the challange and discipline...One reason we lament the passing of wilderness is that we do not want entirely to tame this aboriginal element...Half the beauty of life comes out of it...The cougar's fang sharpens the deer's sight, the deer's fleet-footedness shapes a more supple lionness...None of life's heroic quality is possible without this dialectical stress.

Beyond an enhanced capacity to subjugate, conquer and master nature, the dominionistic relationship may facilitate increased knowledge of the natural world. It is likely the predator recognizes and appreciates its prey to a degree no mere external observer could obtain, and this tendency may be as true for the human hunter of deer or mushrooms as it is for the wolf stalking its moose or the deer its forage. While the survival value of the dominionistic perspective may be less evident today than in our evolutionary past, one suspects the possiblity of a false arrogance in the denial of inclinations toward nature's mastery in favor of only strong emotional bonds of affection and kinship with life. The dominionistic relationship, like all reflections of the biophilia tendency, appears to possess both the potential for functional advantage as well as the possibility for exaggerated distortion and destructive expression.

Negativistic

The negativistic relationship to nature is characterized by sentiments of fear, aversion and antipathy toward aspects of the natural world. Most advocates of nature's preservation regard sentiments of fear and alienation from the natural world as inappropriate and often leading to the destruction and repression of the source of these antipathies. Yet, the potential biological advantage of avoiding, isolating and even, on occasion, harming threatening elements in nature can be recognized. A disposition to fear and even destroy aspects of nature may be among the most basic motive characteristics found in the animal world. As Ohman suggests (1986, p. 128): "Behaviors that can be associated with fear are pervasive in the animal kingdom. Indeed, one could argue that systems for active escape and avoidance must have been among the first functional behavior systems that evolved."

A possible human predisposition to avoid nature has been associated with such reptiles as snakes and arthropods like spiders and certain insects. Fear and avoidance of particular arthropods and reptiles may have represented an adaptive advantage during the course of human evolution and resulted in its statistically greater manifestation. This potential has been described in the scientific literature as suggested by Ulrich *et al.* (1991, p. 206): "conditioning studies have shown that nature settings containing snakes or spiders can elicit pronouced autonomic responses...even when presented subliminally." Schneirla (1965) further noted the occurrence of "ugly, slimy, erratic" moving animals, such as many snakes and invertebrates, provoked withdrawal responses among vertebrate neonates in the absence of overt or obvious threat. Our studies of human attitudes toward invertebrates (Kellert 1992a), as well as the research of Hardy (1988) and Hillman (1991), identified important motivational factors in the human tendency to dislike and fear certain insects and spiders. First, many people are

alienated by the vastly different ecological survival strategies, spatially and temporally, of most invertebrates in comparison to humans. Second, the extraordinary "multiplicity" of the invertebrate world seems to threaten the fondly cherished human concern for individual identity and selfhood. Third, invertebrate shapes and forms appear "monstrous" to many people. Fourth, invertebrates are often associated with presumptions of mindlessness and an absence of feeling, and the link between insects, spiders and madness is a common metaphor in human discourse and imagination. Fifth, many people appear challenged and even infuriated by the radical "autonomy" of invertebrates from human will and control.

These sentiments of fear and alienation from nature can often foster the human tendency to inflict unwarranted and excessive harm and even cruel behavior on many species. Singer (1977) referred to this phenomenon as "specicide" involving a human inclination to destroy entire species, such as may have occurred in relation to wolves in North America (Lopez 1978), or toward particular rodents like rats and many insect and spider species. Referring to the latter, Hillman ruefully remarked (1991), "what we call the progress of Western Civilization from the ant's eye level is but the forward stride of the great exterminator."

Certainly these destructive tendencies toward nature, given our modern technical prowess and geographic reach, has often exceeded the limits of either rationality or self-interest. Yet, the extent of today's onslaught on the natural world should not preclude us from recognizing its possible evolutionary origins or its continued biological advantage expressed at a far more modest and rational level. Fear of injury or even violent death in nature is and will continue to be an integral part of the human repertoire of responses to the natural world, and a realistic tension with the unknown and threatening in nature is part of the challenge of survival. One could even suggest this fear of nature is a central element in the human capacity to perceive nobility, wonder and awe in the natural world. Certainly the wilderness and its power to inspire and challenge appears to require considerable elements of fear and danger to affect its extraordinary impact on human physical and mental development.

DISCUSSION

The presentation of nine fundamental, presumably biologically-based, human relationships to nature has hopefully provided support for the biophilia hypothesis. Each category of the typology is thought to represent our basic need for and dependence on nature, indicative of some measure of adaptational value in the effort not just to survive but to thrive and attain personal fulfillment as well. Brief summary definitions and common functional expressions of each of the biophilia categories are presented in Table One.

This paper has largely relied on conceptual and descriptive presentation to delineate basic elements of the biophilia hypothesis. It was suggested at the outset that a limited empirical exploration of the typology was provided by the results of various studies of diverse cultures and demographic groups, human perceptions of varying taxa, and

Table one. A Typology of Biophilia Functions

Term	Definition	Function
Utilitarian	Practical and material exploitation of nature	Physical sustenance/security
Naturalistic	Satisfaction from direct experience /contact with nature	Curiosity, outdoor skills, mental /physical development
Ecologistic-scientific	Systematic study of structrure, function and relationship in nature	Knowledge, understanding, observational skills
Aesthetic	Attractiveness, physical appeal and beauty of nature	Inspiration, harmony, peace, security
Symbolic	The use of nature for metaphorical expression, language and expressive thought	Communication, mental development
Humanistic	Strong affection, emotional attachment, "love" for nature	Group bonding, sharing, cooperation, companionship
Moralistic	Strong affinity, spiritual reverence, and ethical concern for nature	Order and meaning in life, kinship and affiliational ties, altruism
Dominionistic	Mastery, physical control, dominance of nature	Mechanical skills, physical prowess, ability to subdue
Negativistic	Fear, aversion and alienation from nature	Security, protection, safety

historical shifts in perspectives of nature. Although methodological problems preclude one from too strongly asserting the "validity" of this evidence as proof, these findings offer a restricted suggestion of the typology's universal expression. While these results do not constitute "proof" of the perspectives as fundamental aspects of our dependence on nature, their empirical demonstration in a wide variety of circumstances suggests the possibility of their universal expression. What appears to be relative is not the occurrence of these perspectives of nature among different cultures, in relation to varying species and across time, but rather the content and intensity of this expression and their functional impact.

It has been argued that each category of our species basic relationship to the natural world represents a potential evolutionary advantage. Additionally, the cumulative interaction of the biophilia perspectives may be argued as providing the possibility for a more fulfilling existence. This diverse and largely positive valuational relationship to nature may, in other words, be the basis for a "good life," in Aristotle's sense of the term, thus, representing the increased likelihood of a happier, more productive and

meaningful existence.

The conservation of nature is rationalized, therefore, not just for the potential physical and material benefits it may provide, but also because it represents the greatest chance for an emotionally, psychologically, cognitively and even spiritually satisfying and fulfilling existence. Our ethical responsibility for protecting nature, from this perspective, is derived from far more than any altruistic sympathy for protecting nature. It is motivated, more importantly, by a profound sense of self-interest and biological imperative. As Wilson suggests (1984, p. 131), "we need to apply the first law of human altruism, ably put by Garrett Hardin: never ask people to do anything they consider contrary to their own best interests." We should conserve nature's diversity and variety, in other words, because it represents our best chance for a more satisfying and personally meaningful existence at both the personal and collective level. The pursuit of the "good life" is through our broadest valuational relationship to nature. This deeper foundation for a conservation ethic is powerfully suggested by Rene Dubos (1969, p. 129):

> Conservation is based on human value systems; its deepest significance is the human situation and the human heart...The cult of wilderness is not a luxury; it is a necessity for the preservation of mental health...Above and beyond the economic...reasons for conservation, there are aesthetic and moral ones which are even more compelling...We are shaped by the earth. The characteristics of the environment in which we develop condition our biological and mental being and the quality of our life. Were it only for selfish reasons, therefore, we must maintain variety and harmony in nature.

The converse of this rationalization for a conservation ethic is the increased likelihood that a degraded relationship to nature may lead to diminished material, social and psychological existence. This paper has intimated several possibilities in this regard, and it may be relevant to note a research finding of one study we conducted (Kellert and Felthous 1985, and Felthous and Kellert 1987) of a far higher rate of cruel and willfully harmful conduct toward animals in the childhood of adults with a history of repeated violent and aggressive behavior toward other persons. Even socially acceptable forms of destructive conduct toward nature are increasingly regarded by some as potentially constituting a false and short-term pursuit of self-interest. Leopold's lament over the last of the passenger pigeon's reflects this emerging realization (1966, p. 109):

> We grieve because no living man will see again the onrushing phalanx of victorious birds, sweeping a path for spring across the March skies, chasing the defeated winter from all the woods and prairies...There will always be pigeons in books and in museums, but these are effigies and images, dead to all hardships and to all delights. Book-pigeons cannot dive out of a cloud to make the deer run for cover, or clap their wings in thunderous applause of mast-laden woods...Our grand-fathers were less well-housed, well-fed, well-clothed than we are. The strivings by which they bettered their lot are also those which deprived us of pigeons. Perhaps we now grieve because we are not sure, in our hearts, that we have gained by the exchange. The gadgets of industry bring us more comforts than the pigeons did, but do they add as much to the glory of the spring?

There will be those who skeptically suggest the assertion of a biologically-based human need for nature is but the outgrowth of a bias motivated by culture and class. This argument suggests that what is trumpeted here is but a romantic ideology, paraded in the guise of biology, promoted for essentially elitist political and social purposes. This critique may argue the biophilia notion condemns, by implication, all those mired in poverty and trapped within urban walls to another stereotype of a less realized and fulfilled human existence.

Maslow's (1954) notion of a hierarchy of human needs represents one possible "escape" from this cultural critique, implying the pursuit of self-realization through nature is a higher order of human functioning. One might reasonably concede the biophilia tendency as primarily manifest once more basic needs for survival, protection and security are realized. This assumption, while superficially appealing, probably reflects a naive understanding of human reality. Humans, more typically, pursue a wide range of simple to complex needs, if not overwhelming confronted by the sheer absence of any material basis for survival.

The presumption of nature's relative unimportance among the less socioeconomically advantaged and/or urban dwelling may in itself be an elitist and false characterization. As Leopold noted (1966, p. 266): "The weeds in a city lot convey the same lesson as the redwoods... Perception...cannot be purchased with either learned degrees or dollars; it grows at home as well as abroad, and he who has a little may use it to as good advantage as he who has much." Nature's potential for providing the means for a more personally satisfying existence may be less obvious and apparent among the poor or urban than rich and rural, but this seeming deprivation represents more a challenge of design than any fundamental irrelevance of the natural world for a class of individuals. An intimate experience with nature's extraordinary variety and diversity can be the possession of all but the most deprived and found in any but the most degraded concrete jungles. Society's obligation is not to bemoan the apparent "absence" of nature in the inner city but to render its possibility more readily available. The presumption that only the materially advantaged and conveniently located can realize nature's value is, in itself, an arrogant elitism.

A fundamental question still remaining is the extent to which people in modern society recognize and appreciate the human need to affiliate deeply and positively with life's diversity and variety. This is, of course, a very complicated question difficult to answer here in great detail or thoroughness. A very limited and partial response is provided by reviewing the results of previously cited studies conducted in the United States and Japan. While this data only indirectly explored the biophilia hypothesis, focusing attention primarily on perspectives of animals, it does offer some relevant information regarding modern relationships to the natural world, at least among persons living in highly urban, technologically-oriented, industrial societies. Insufficient space precludes all but a very brief summarization of these results, although more detailed information on the methodology and results of these studies can be found elsewhere (Kellert, 1979, 1981, 1983, 1991c, and 1993).

Both American and Japanese cultures have occasionally been characterized as revealing pronounced concern and appreciation for the natural world. Americans, for

example, have been depicted as especially supportive of nature conservation, with nearly 10% of the American public being a member of at least one environmental organization (Dunlap 1978), and American wildlife legislation, particularly the Endangered Species and Marine Mammal Protection Acts, described as the most comprehensive and protective wildlife statutes in existence (Bean 1983). Extensive outdoor recreational activity among Americans has been reflected in figures indicating 300 million annual visits to U.S. national parks, and three-fourths of the American public participating in some form of wildlife-related outdoor recreational activity (Foresta 1984, and USFWS 1990).

Japanese culture has also been described as encouraging a strong appreciation of nature (Higuchi 1979, Minami 1970, Murota 1986, and Watanabe 1974). Often cited expressions include the traditions of shintoism, flower arranging, plant cultivation, the tea ceremony, certain poetry forms, rock gardening and various celebrations of the seasons. Higuchi (1979, p. 19) described a Japanese view of nature "based on a feeling of awe and respect," and Watanabe (1974, p. 280) identified a Japanese "love of nature...resulting in a refined appreciation of the beauty of nature." Murota (1986, p. 105) further concluded: "The Japanese nature is an all-pervasive force...Nature is at once a blessing and friend to the Japanese people."

Despite these suggestions of an especially refined appreciation for nature in the United States and Japan, the results of our investigations revealed only limited concern for the natural world among the general public in both countries. Citizens in the United States and Japan did express strong interest in certain preferred species and landscapes typically appreciated for aesthetic, cultural and historical reasons. On the other hand, most respondents expressed a strong inclination to exploit nature for various practical purposes despite the likelihood of major environmental damage, and a majority, especially in Japan, revealed considerable indifference toward elements of the natural world lacking any traditional aesthetic or cultural value. Additionally, very limited knowledge and understanding of nature was found in both countries, particularly in Japan.

Japanese appreciation of nature was especially marked by a restricted focus on a small number of species and natural objects, often admired in a context emphasizing control, manipulation and contrivance. This affinity for nature was typically an idealistic re-creation or artistic rendering of valued aspects of the natural environment and usually lacked an ecological or ethical orientation. This appreciation was described by one Japanese respondent as "a love of semi-nature," representing a largely emotional and aesthetic interest in using "the materials of semi-nature to express human feelings." Other respondents described it as a perspective of nature dominated by a preference for the artificial, abstract, and symbolic rather than a realistic experience of the natural world; a motivation to "touch" nature but from a controlled and safe distance; an adherence to strict rules of seeing and experiencing nature intended to express only the centrally value aspect of the natural world; and a desire to isolate favored aspects of nature in order to "freeze and put walls around it." Environmental features falling outside the valued aesthetic and symbolic boundaries tended to be ignored, regarded as irrelevant, or judged unappealing. As Saito concluded (1983, p.

192): "Nature is not...respected for its own sake but because it allows one to escape...This appreciation of nature not only implies an anthropocentric attitude...but also suggests an ineffectiveness in generating an ethically desirable justification for protecting nature."

American respondents tended to reveal a somewhat more generalized interest and concern for the conservation of nature, especially highly educated and younger Americans in comparison to similar demographic groups in Japan. On the other hand, nature appreciation among most of the American public was largely restricted to particularly valued species and landscapes, and other aspects of nature were usually subordinated to stronger utilitarian interests. The great majority of American respondents indicated little appreciation of "lower" life forms, tending to restrict their appreciation to the larger vertebrates. Moreover, considerable demographic diversity occurred in the United States, with especially limited naturalistic, ecological and moralistic interest found among lower socioeconomic, elderly and rural groups.

In conclusion, most people in the United States and Japan expressed a pronounced interest and concern for only a limited number of species and natural objects. The biophilia tendency, as described in this paper, was evident among a small segment of the population, typically better educated and younger adults in the United States.

CONCLUSION

A theoretical and empirical argument has been offered in support of the biophilia hypothesis. The available evidence suggests a variety of basic relationships to nature is consistent with the presumption of increased evolutionary fitness both at the individual and species level. It has been suggested that the broadest valuational experience of nature can enhance possibilities for a more personally fulfilling and rewarding existence. Each relational perspective to nature—the aesthetic, dominionistic, ecologistic-scientific, humanistic, moralistic, naturalistic, symbolic, utilitarian, and even negativistic—has been described as representing the potential basis for a deep and profound development of self. A range of adaptational advantages were described as emanating from these relationships including enhanced physical skills, greater awareness, increased protection and security, opportunities for emotional gratification and relaxation, expanded kinship and affiliational ties, improved knowledge and understanding, greater communication and expressive capacities, among others.

An ethic of care, respect and concern for nature was regarded as depending upon the conviction that in our most varied relationship to the natural world exists the potential for a more personally rewarding and fulfilling life. As Iltis suggests (1980, pp. 3, and 5), our mental and physical well-being may be a far more compelling basis for the conservation of nature than mere material security:

> Here, finally, is an argument for nature preservation free of purely utilitarian considerations; not just clean air because polluted air gives cancer; not just pure water because polluted water kills the fish we might like to catch;...but preservation of the natural ecosystem to give body

> and soul a chance to function in the way they were selected to function in their original phylogenetic home...Could it be that the stimuli of non-human living diversity makes the difference between sanity and madness?

Iltis' final question intimates the still tenuous state of our understanding of the biophilia phenomenon. We remain somewhat like the blind men certain of the elephant's existence but confused regarding its exact shape, character, form and structure. This inquiry will have succeeded if it stimulates future research of this extraordinarily rich potential in the human body and spirit. The sophistication of subsequent exploration may hopefully prove the measure of Iltis' prediction (1973, p. 7).

> We may expect that science will [someday] furnish the objective proofs of suppositions about man's needs for a living environment which we, at present, can only guess at through timid intuition; that one of these days we shall find the intricate neurological bases of why a leaf or a lovely flower affects us so very differently than a broken beer bottle.

A more discouraging conclusion was derived from studies of the general publics in the United States and Japan. For the most part, only limited appreciation and concern for nature was revealed among the citizenry of these two contemporary industrial superpowers. Most respondents in the United States and Japan showed limited concern or knowledge of wildlife species and the ecosystems that support them. Moreover, the general public in both countries appeared to be largely aloof from the biological matrix of presumably "lower" life forms, restricting their concern to a narrow segment of the biotic and natural community.

The leadership of the United States and Japan will be critical in the evolution of a more environmentally responsible and enlightened global perspective of nature based on a recognition and cultivation of the biophilia tendency in the human species. There two countries collectively exert an extraordinary influence on the world's economy and biota. It behooves the two industrial superpowers to assume a more creative and ethical leadership in the evolution of a global consciousness capable of countering the ominous drift toward large-scale species extinctions and environmental impoverishment. A narrow and restricted emphasis on only selected species and landscapes is clearly an insufficient basis for cultivating the human dependence on nature for our species emotional, cognitive, material and even spiritual growth and fulfillment.

REFERENCES

Anderson, R., B. Hart, and L. Hart (1984): *The pet connection*. Univ. Minnesota Press, Minneapolis, MN.

Bean, M. (1983): *The evolution of national wildlife law*. Praeger, New York.

Bettelheim, B. (1977): *The use of enchantment*. Vintage Books, New York.

Booth, A., and H. Jacobs. (1990): Ties that bind: Native American beliefs as a foundation for environmental consciousness. *Env. Ethics,* **12**: 27–43.

Campbell, J. (1973): *Myths to live by*. Viking Press, New York.

Driver, B. and Brown, P. (1983): Contributions of behavioral scientists to recreation resource management. In, I. Altman and J. Wohlwill (eds.), *Behavior and the Natural Environment*.

Plenum Press, New York, pp. 307–340.
Dubos, R. (1969): *Ecology and religion in history*. Oxford, New York.
Dunlap, R. (1978): *Environmental concern*. Vance Bibliographies, Monticello, Ill.
Eiseley, L. (1946): *The immense journey*. Random House, New York.
Felthous, A., and Kellert, S. (1987): Childhood cruelty to animals and later aggression against people. *Amer. J. Psychiat.* **144**: 710–717.
Forest, R. (1984): *America's national parks and their keepers*. Johns Hopkins Univ. Press, Washington, DC.
Gadgil, M. (1990): India's deforestation: patterns and processes. *Soc. Nat. Res.*, **3**: 131–143.
Hardy, T. (1988): Entomophobia: the case for Miss Muffet. *Entom. Soc. Amer. Bull.* **34**: 64–69.
Heerwagen, J., and Orians, G. (1993): Environmental assessment, habitability, and esthetics. in, Kellert, S. and Wilson E. O. (eds.): *The Biophilia Hypothesis*. Island Press, Washington, DC.
Higuchi, K. (1979): *Nature and the Japanese*. Kodansha international, Tokyo.
Hillman, J. (1991): *TGoing bugs*. Spring Audio, Gracie Station, N.Y.
Iltis, H. (1973): Can one love a plastic tree? *Bull Ecol. Soc. Amer.* **54**: 5–7; 19.
_____. (1980): Keynote address. *Trans. Symp.: The urban setting: man's need for open space*. Connecticut College, New London, CT.
Jung, C. (1959): *The archetype and the collective unconscious*. Pantheon Books, New York.
Kaplan, R. (1983): The role of nature in the urban context. In: Altman, I., and Wohlwill J. (eds.), *Behavior and the Natural Environment*. Plenum Press, New York.
Kaplan, R., and Kaplan, S. (1989): *The experience of nature: a psychological perspective*. Cambridge Univ. Press, Cambridge, Eng..
Katcher, A. and Beck, A. (1983): *New perspectives on our lives with companion animals*. Univ. Penn. Press, Phila, PA.
Kellert, S. (1976): Perceptions of animals in American society. *Trans. N.A. Wild. & Nat. Res. Conf.*: 553–546.
_____. (1978): Characteristics and attitudes of hunters and anti-hunters. *Trans. N.A. Wild. & Nat. Res. Conf.*:412–423.
_____. (1979): *Public attitudes toward critical wildlife and natural habitat issues*. U.S. Govt. Printg. Off., #024–010–00–623–4, Washington, DC.
_____. (1980): *Activities of the American public relating to animals*. U.S. Govt. Printg. Off., #024–010–00–624–2, Washington, DC.
_____. (1981): *Knowledge, affection and basic attitudes toward animals in American society*. U.S. Govt. Printg. Off., #024–010–00–625–1, Washington, DC.
_____. (1983): Affective, evaluative and cognitive perceptions of aniamls. In, Altman I., and Wohlwill, J. (eds.): *Behavior and the Nautral Environment*. Plenum, New York.
_____. (1984a): Public attitudes toward mitigating energy development impacts on western mineral lands. *Proc. Issues & Tech. Mang. Impacted Western Wildlife*. Thorne Ecol. Instit., Boulder, CO.
_____. (1984b): Urban American perceptions and uses of animals and the natural environment. *Urb. Ecol.* **8**: 209–228.
_____. (1985b): Attitudes toward animals: age-related development among children. *J. Env. Educ.* **16**: 29–39.
_____. (1985a): Birdwatching in American society. *Leis. Sci.* **7**: 343–360.
_____. (1985c): Historical trends in perceptions and uses of animals in 20th century

America. *Env. Rev.* **9**: 34–53.

_____. (1986a): The contributions of wildlife to human quality of life. In, Decker, D., and Goff, G. (eds.): *Economic and Social Values of Wildlife*. Westview Press, Boulder, CO.

_____. (1986b): Marine mammals, endangered species, and intergovernmental relations. In, Silva, M. (ed.): *Intergovernmental relations and Ocean Resources*. Westview press, Boulder, CO.

_____. (1986c): *Social and perceptual factors in the preservation of species*. In B. Norton, preservation of species, Princeton: Princeton University Press.

Leopold, A. (1966): *A Sand Country almanac*. Oxford Press, New York.

Levi-Strauss, C. (1970): *The raw and the cooked*. Harper and Row, New York.

Lopez, B. (1978): *Of wolves and men*. Charles Schribner's Sons, New York.

Luther Standing Bear (1933): *Land of the spotted eagle*. Univ. Nebraska Press, Lincoln.

Maslow, A. (1954): *Motivation and personality*. Harper & Row, New York.

McVay, S. (1987): A regard for life: getting through to the causal visitor. *Phil. Zoo Rev.* **3**: 4–6.

Minami, H. (1970): *Psychology of the Japanese people*. East-West Center, Honolulu.

Mordi, R. (1991): *Attitudes toward wildlife in Botswana*. Garland Publishing, New York.

Murota, Y. (1986): Culture and the environment in Japan. *Env. Mgt.* **9**: 105–112.

Myers, N. (1978): *The sinking ark*. Pergemon Press, New York.

Ohman, A. (1986): Face the beast and fear the face: animal and social fears as prototypes for evolutionary analyses of emotion. *Psychophysiol.* **23**: 123–145.

Orians, G. (1980): Habitat selection: general theory and applications to human behavior. In, Lockard, J. (ed.): *The Evolution of Human Social Behavior*. Elsevier, New York.

Prescott-Allen C. & R. (1986): *The first resource*. Yale Univ. Press, New haven, CT.

Rowan, A. (1989): *Animals and people sharing the world*. Univ. Press of New England, Hanover, NH.

Saito, Y. (1983): *The esthetic appreciation of nature: Western and Japanese perspectives and their ethical implications*. Doctoral thesis, Univ. of Michigan. Univ. Microfilms, Ann Arbor, MI.

Schaller, G. (1982): *Stones of silence*. Viking Press, New York.

Schneirla, T. (1965): *Principles of animal psychology*. Prentice-Hall, New York.

Schulz, W. (1986): Attitudes toward wildlife in West Germany. In, Decker, D., and Goff, G. (eds.): *op. cit.*: 352–355.

Seielstad, G. (1989): *At the heart of the web*. Harcourt, Brace, Jovanovich, Boston, MA.

Shepard, P. (1978): *Thinking animals: animals and the development of human intelligence*. Viking Press, New York.

Singer, P. (1977): *Animal liberation*. Avon Books, New York.

Steinbeck, J. (1941): *Log from the Sea of Cortez*. P.P. Appel, Mamaroneck, NY.

Ulrich, R. (1983): Aesthetic and affective response to natural environment. In, I. Altman, and Wohlwill, J. (eds.), *op. cit.*

Ulrich, R. *et al.* (1991): Stress recovery during exposure to natural and urban environments. *J. Env. Psych.* **11**: 201–230.

U. S. Fish and Wildlife Service. (1990): *1990 national survey of hunting, fishing and wildlife-associated recreation*. Department of the Interior, Washington, DC.

Watanabe, H. (1974): The conception of nature in Japanese culture. *Science*, **183**: 279–282.

Wilson, E. O. (1984): *Biophilia: the human bond with other species*. Harvard Univ. Press. Cambridge, MA.

Wohlwill, J. (1983): The concept of nature: a psychologist's view. In, Altman, I., and

Wohlwill, J. (eds.): *op cit.*: 5–38.