Hi Matt -

Here is the Chapter From E.O. Wilson - 'Biophilia And the Environmental Ethic'

From

In Search of Nature!

BIOPHILIA, IF IT EXISTS, and I believe it exists, is the innately emotional affiliation of human beings to other living organisms. From the scant evidence concerning its nature, biophilia is not a single instinct but a complex of learning rules that can be teased apart and analyzed individually. The feelings molded by the learning rules fall along several emotional spectra, from attraction to aversion, awe to indifference, and peacefulness to fear-driven anxiety. These multiple strands of emotional response are woven into symbols composing a large part of culture. When human beings remove themselves from the natural environment, the biophilic learning rules are not replaced by modern versions equally well adapted to contemporary technological features of life. Instead, they persist from generation to generation, atrophied and fitfully manifested in the artificial new environments. It is no accident of culture that more children and adults visit zoos than attend all major professional sports combined (at least in the United States and Canada), that the wealthy continue to seek dwellings on prominences above water amidst parkland,

and that urban dwellers continue to dream of snakes for reasons they cannot explain.

Were there no evidence of biophilia at all, the hypothesis of its existence would still be compelled by pure evolutionary logic. The reason is that human history did not begin a mere 8,000 or 10,000 years ago, with the invention of agriculture and villages. It began hundreds of thousands or millions of years ago, with the origin of the genus *Homo*. For more than 99 percent of human history people have lived in hunter-gatherer bands intimately involved with other organisms. During this period of deep history, and still farther back, into paleohominid times, they depended on an exact learned knowledge of crucial aspects of natural history. That much is true even of chimpanzees today, who use primitive tools and have a practical knowledge of plants and animals. As language and culture expanded, humans also used living organisms of diverse kinds as a principal source of metaphor and myth. In short, the brain evolved in a biocentric world, not a machine-regulated one. It would therefore be quite extraordinary to find that all learning rules related to that world had been erased in a few thousand years, even in the tiny minority of humans who have existed for more than one or two generations in wholly urban environments.

The significance of biophilia in human biology is potentially profound, even if it exists solely as weak learning rules. It is relevant to our thinking about nature, about the landscape, the arts, and mythopoeia, and it invites us to take a new look at environmental ethics.

How could biophilia have evolved? The likely answer is biocultural evolution, during which culture was elaborated under the influence of hereditary learning propensities while the genes prescribing the propensities were spread by natural selection in a cultural context. The learning rules can be inaugurated and fine-tuned variously by an adjustment of sensory thresholds, by a quickening or blockage of learning, and by modification of emotional responses. Charles Lumsden and I have envisioned biocultural evolution to be of a particular kind, gene-culture coevolution, which traces a spiral trajectory through time: a certain genotype makes a behavioral response more likely, the response enhances survival and reproductive fitness, the genotype consequently spreads through the population, and the behavioral response grows more frequent. Add to this the strong general tendency of human beings to translate emotions into myriad dreams and narratives, and the necessary conditions are in place to cut the historical channels of art and religious belief.

Gene-culture coevolution is a plausible explanation for the origin of biophilia. The hypothesis can be made explicit by the human relation to snakes. The sequence I envision is the following, drawn principally from elements established by the art historian and biologist Balaji Mundkur:

- Poisonous snakes cause sickness and death in primates and other mammals throughout the world.
- Old World monkeys and apes generally combine a strong natural fear of snakes with fascination for these

animals and the use of vocal communication, the latter including specialized sounds in a few species, all drawing attention of the group to the presence of snakes in the near vicinity. Thus alerted, the group follows the intruders until they leave.

- Human beings are also genetically averse to snakes. They are quick to develop fear and even full-blown phobias with very little negative reinforcement. (Other phobic elements in the natural environment include dogs, spiders, closed spaces, running water, and heights. Few if any modern artifacts are as effective, including even those most dangerous, such as guns, knives, automobiles, and electric wires.)
- In a manner true to their status as Old World primates, human beings are also fascinated by snakes. They pay admission to see captive specimens in zoos. They employ snakes profusely as metaphors and weave them into stories, myth, and religious symbolism. The serpent gods of cultures they have conceived all around the world are furthermore typically ambivalent. Often semihuman in form, they are poised to inflict vengeful death but also to bestow knowledge and power.
- People in diverse cultures dream more about serpents than about any other kind of animal, conjuring as they do so a rich medley of dread and magical power. When shamans and religious prophets report such images, they invest them with mystery and symbolic authority. In what seems to be a logical consequence, serpents are

also prominent agents in mythology and religion in a majority of cultures.

Here then is the ophidian version of biophilia hypothesis expressed in briefest form: constant exposure through evolutionary time to the malign influence of snakes, the repeated experience encoded by natural selection as a hereditary aversion and fascination, which in turn is manifested in the dreams and stories of evolving cultures. I would expect that other biophilic responses have originated more or less independently, by the same means but under different selection pressures and with the involvement of different gene ensembles and brain circuitry.

Of course, this formulation is fair enough as a working hypothesis, but we must also ask how such elements can be distinguished, and how the general biophilia hypothesis might be tested. One mode of analysis, reported by Jared Diamond, is the correlative analysis of knowledge and attitude of peoples in diverse cultures, designed to search for common denominators in the total human pattern of response. Another, advanced by Robert Ulrich and other psychologists, is the precisely replicated measurement of the physiological responses of human subjects to both attractive and aversive natural phenomena. This direct psychological approach can be made increasingly persuasive, whether for or against a biological bias, when two elements are added. The first is the measurement of heritability in the intensity of the responses to the psychological tests used. The second element is the

tracing of cognitive development in children to identify key stimuli that evoke the responses, along with the ages of maximum sensitivity and learning propensity. For example, the slithering motion of an elongate form appears to be the key stimulus producing snake aversion, and preadolescence may be the maximally sensitive period for acquiring the aversion.

Given that humanity's relation to the natural environment is as much a part of deep history as social behavior itself, cognitive psychologists have been strangely slow to address its mental consequences. Our ignorance could be regarded as just one more blank space on the map of academic science, awaiting genius and initiative, except for one important circumstance: the natural environment is disappearing. As a consequence, psychologists and other scholars are obligated to consider biophilia in more urgent terms. What, they should ask, will happen to the human psyche when such a defining part of the human evolutionary experience is diminished or erased?

There is no question in my mind that the most harmful part of ongoing environmental despoliation is the loss of biodiversity. The reason is that the variety of organisms, from alleles (differing gene forms) to species, once lost, cannot be regained. If diversity is sustained in wild ecosystems, the biosphere can be recovered and used by future generations to any degree desired and with benefits literally beyond measure. To the extent it is diminished, humanity will be poorer for all generations to come. How much poorer? The following estimates give a rough idea:

- Consider first the question of the amount of biodiversity. The number of species of organisms on Earth is unknown to the nearest order of magnitude. About 1.5 million species have been given names to date, but the actual number is likely to lie somewhere between 10 and 100 million. Among the least-known groups are the fungi, with 69,000 known species but 1.6 million thought to exist. Also poorly explored are at least several million and possibly tens of millions of species of arthropods in the tropical rain forests; and millions of invertebrate species on the vast floor of the deep sea. The true black hole of systematics, however, may be bacteria. Although roughly 4,000 species have been formally described, recent studies in Norway have indicated the presence of from 4,000 to 5,000 species, almost all new to science, among the 10 billion individual organisms found on average in each gram of forest soil, and another 4,000 to 5,000 species, different from the first set and also mostly new, in an average gram of nearby marine sediments.
- Fossil records of marine invertebrates, African ungulates, and flowering plants indicate that under natural conditions each clade—a species and its descendants—lasts an average of 500,000 to 10 million years. The longevity is measured from the time the ancestral form splits off from its sister species to the time of the extinction of the last descendant. It varies according to the group of organisms. Mammals, for example, are shorter-lived than invertebrates.

Bacteria contain on the order of a million nucleotide pairs in their genetic code, and more complex (eukaryotic) organisms from algae to flowering plants and mammals contain one to 10 billion nucleotide pairs.

- Because of their great age and genetic complexity, species are exquisitely adapted to the ecosystems in which they live.
- The number of species on Earth is being reduced by a rate from 100 to 1,000 times higher than in prehuman times. The current removal rate of tropical rain forest, over 1 percent of cover each year, translates (if we use the most conservative parameter value) to approximately 0.3 percent of the species extirpated immediately or at least doomed to much earlier extinction than would otherwise have been the case. Most systematists with global expressions believe that more than half the species of organisms on earth live in the tropical rain forests. If there are 10 million species in these habitats—a conservative estimate—the rate of loss may be 30,000 a year, 74 a day, 3 an hour. This rate, though horrendous, is actually a minimal estimate, in the sense that it is based on the area-species relation alone. It does not take into account extinction due to pollution, disturbance short of clear-cutting, and the introduction of exotic species.

Other species-rich habitats, including coral reefs, river systems, lakes, and Mediterranean-type heathland, are under similar assault. When the final remnants of such habitats are destroyed in a region—the last of the ridges

on a mountainside cleared, for example, or the last riffles flooded by a downstream dam—species are wiped out en masse. The first 90 percent reduction in area of a habitat lowers the species number by one-half. The final 10 percent eliminates the second half.

It is a guess, subjective but very defensible, that if the current rate of habitat alteration continues unchecked, 20 percent or more of the Earth's species will disappear or be consigned to early extinction through human action taken during the next thirty years. From prehistory to the present time humanity has probably already eliminated 10 or even 20 percent of the species. The number of bird species, for example, is down by an estimated 25 percent, from 12,000 to 9,000, with a disproportionate share of the losses occurring on islands. Most of the megafaunas—the largest mammals and birds—appear to have been destroyed in more remote parts of the world by the first wave of hunter-gatherers and agriculturists millennia ago. The loss of plants and invertebrates is likely to have been much smaller, but studies of archaeological and other subfossil deposits are too few to permit even a crude estimate. The human impact, from prehistory to the present time and projected into the next several decades, threatens to be the greatest extinction spasm since the end of the Mesozoic era, 65 million years ago.

Assume, for the sake of argument, that 10 percent of the world's species that existed just before the advent of humanity are already gone, and that another 20 percent are destined to vanish quickly unless drastic action is

taken. The fraction lost—and it will be a great deal no matter what action is taken—cannot be replaced by evolution in any period that has meaning for the human mind. Following each of the five previous major spasms of the past 550 million years, life required about 10 million years of natural evolution to recover. What humanity is doing now in a single lifetime will impoverish our descendants for virtually all time to come. Yet critics often respond, "So what? If only half the species survive, that is still a lot of biodiversity—is it not?"

The answer most frequently urged right now by conservationists, myself among them, is that the vast material wealth offered by biodiversity is at risk. Wild species are an untapped source of new pharmaceuticals, crops, fibers, pulp, petroleum substitutes, and agents for the restoration of soil and water. This argument is demonstrably true—and it certainly tends to stop anti-conservation libertarians in their tracks—but it contains a dangerous practical flaw when relied upon exclusively. If species are to be judged by their potential material value, they can be priced, traded off against other sources of wealth, and—when the price is right—discarded. Yet who can judge the *ultimate* value of any particular species to humanity? Whether the species offers immediate advantage or not, no means exist to measure what benefits it will offer during future centuries of study, what scientific knowledge, or what service to the human spirit.

At last I have come to the word so hard to express,

spirit. With reference to the spirit we arrive at the connection between biophilia and the environmental ethic. The great philosophical divide in moral reasoning about the remainder of life is whether or not other species have an innate right to exist. That decision rests in turn on the most fundamental question of all, whether moral values exist apart from humanity, in the same manner as mathematical laws, or whether they are idiosyncratic constructs that evolved in the human mind through natural selection, and thus of the spirit. Had a species other than humans attained high intelligence and culture, it would probably have fashioned different moral values. Civilized termites, for example, would support cannibalism of the sick and injured, eschew personal reproduction, and make a sacrament of the exchange and consumption of feces. The termite "spirit," in short, would have been immensely different from the human spirit, horrifying to us in fact. The constructs of moral reasoning, in this evolutionary view, are the learning rules, the propensities to acquire or to resist certain emotions and kinds of knowledge. They have evolved genetically because they confer survival and reproduction on human beings.

The first of the two alternative propositions—that species have universal and independent rights, regardless of how else human beings feel about the matter—may be true. To the extent the proposition is accepted, it will certainly steel the determination of environmentalists to preserve the remainder of life. But the species-right argument

alone, like the materialistic argument alone, is a dangerous gambit on which to risk biodiversity. Its reasoning, for all its directness and power, remains intuitive, aprioristic, and lacking in objective evidence. Who but humanity, it can be immediately asked, gives such rights? Where is the enabling canon written? And such rights, even if granted, are always subject to rank-ordering and relaxation. A simplistic adjuration for the right of a species to live can be answered by a simplistic call for the right of people to live. If a last section of forest needs to be cut to perpetuate the survival of a local economy, the rights of the myriad species in the forest may be cheerfully recognized but given a lower and fatal priority.

Without attempting to resolve the issue of the innate rights of species, I will argue the necessity of a robust and richly textured anthropocentric ethic apart from the issue of rights, one based on the hereditary needs of our own species. In addition to the well-documented utilitarian potential of wild species, the diversity of life has immense aesthetic and spiritual value. The ideas outlined below are already familiar to many conservationists and ethicists, yet the evolutionary logic is still relatively new and poorly explored, and therein lies the challenge to scientists and other scholars.

Biodiversity is the Creation. Ten million or more species are still alive, each defined by up to billions of nucleotide pairs and a far larger, in fact astronomical, number of possible genetic recombinants. These constitute the arena in

which evolution continues to occur. Despite the fact that living organisms compose a mere one ten-billionth part of the mass of Earth, biodiversity is the most information-rich part of the known universe. More organization and complexity exist in a handful of soil than on the surfaces of all the other planets combined. If humanity is to have a satisfying creation myth consistent with scientific knowledge—a myth that itself seems to be an essential part of the human spirit—the narrative will find its starting point in the origin of the diversity of life.

Other species are our kin. This perception is literally true in evolutionary time. All higher eukaryotic organisms, from flowering plants to insects and humanity itself, are thought to have descended from a single ancestral population that lived about 1.8 billion years ago. Single-celled eukaryotes and bacteria are linked by still more remote ancestors. This distant kinship is stamped by a common genetic code and elementary features of cell structure. Humanity did not soft-land into the teeming biosphere like an alien from another planet. We arose from other organisms already here, whose great diversity, conducting experiment upon experiment in the production of new life forms, eventually hit upon the human species.

The biodiversity of a country is part of its national heritage. Each country in turn possesses its own unique assemblages of plants and animals, including, in almost all cases, species and geographic races found nowhere else. Those

assemblages are the product of the deep history of the national territory, extending back long before the coming of man.

Biodiversity is the frontier of the future. Humanity needs a vision of an expanding and unending future. That spiritual craving cannot be satisfied by the colonization of space. The other planets are inhospitable and immensely expensive to reach. The nearest stars are so far away that voyagers would need thousands of years just to report back. The true frontier for humanity is life on Earth—its exploration and the transport of knowledge about it into science, art, and practical affairs. The circumstances that validate the proposition are, to repeat briefly: 90 percent or more of the species of plants, animals, and microorganisms lack even so much as a scientific name; each of the species is immensely old by human standards and has been wonderfully molded to its environment; life around us exceeds in complexity and beauty anything else humanity is ever likely to encounter.

The manifold ways by which human beings are tied to the remainder of life are very poorly understood, crying for new scientific inquiry and bold aesthetic interpretation. The portmanteau terms "biophilia" and "biophilia hypothesis" will serve well if they do no more than call attention to psychological phenomena that rose from deep human history, stemmed from interaction with the natural environment, and are now quite likely resident in the

genes themselves. The search is rendered more urgent by the rapid disappearance of the living part of that environment, creating a need not only for a better understanding of human nature but for a more powerful and intellectually convincing environmental ethic based upon it.