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Introduction: A Perspective on Sustainable Pathways Toward Preservation of Biodiversity

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"Look deep into nature, and then you will understand everything better."—Albert Einstein

The Problem: Loss of Biodiversity

Biodiversity describes the vast variety of all species of life on Earth. Ecosystems are where species live, and the health, size, and nature of intact ecosystems directly affect their biodiversity. The structure, complexity, inhabitant species, organism interactions, and fragility of ecosystems vary. Tropical rainforests, for example, are the most complex and diverse ecosystems on earth, and more than half of all species live in tropical forests.

Biodiversity has steadily increased on Earth since life began some 3.2 billion years ago, but now it is on a precipitous decline due to human activity. The biologically diverse ecosystems on earth constitute our life support system—they are responsible for our atmosphere, our clean water, our medicines, and the food we eat. If ecosystems collapse and biodiversity continues to decline at the current rate, humans will be at great risk.

There are many ways to describe the accelerating loss of biodiversity on earth and the difficulty humans have in grasping the depth of the problem. The most rapid changes in biodiversity in history have occurred in only the last 50 years. The major human created threats to ecosystem health and biodiversity are:

1. invasive species that out-compete and cause extinction of native species,
2. climate change due to increased carbon dioxide in the atmosphere,
3. habitat[1] change or destruction,
4. over exploitation of ecosystems such as removing top carnivores or over-fishing of oceans, and
5. nutrient loading and pollution from nitrogen and phosphorous fertilizer.

According to the International Union for the Conservation of Nature ("IUCN"):

> Loss of biodiversity - the variety of animals, plants, their habitats and their genes–on which so much of human life depends, is one of the world's most pressing crises. It is estimated that the current species extinction rate is between 1,000 and 10,000 times higher than it would naturally be. The main drivers of this loss are converting natural areas to farming and urban development, introducing invasive alien species, polluting or over-exploiting resources including water and soils and harvesting wild plants and animals at unsustainable levels.[2]

The Ecological Footprint has been calculated globally on the basis of United Nations statistics and other well-established data. It shows the ratio between humanity's demand and the Earth's productive capacity, or biocapacity (the ability of the flora, fauna, water and atmosphere to sustain the balance of life on Earth), in each year, and how this ratio has changed over time. Humanity has moved from using, in net terms, about half the planet's biocapacity in 1961 to 1.2 times the biocapacity of the Earth in 2001. The global demand for resources thus exceeds the biological capacity of the Earth to renew these resources by some 20%—in other words, it takes the biosphere one year and nearly three months to renew what humanity uses in one year. This "ecological deficit" or "overshoot" means ecosystem assets are being liquidated and wastes are accumulating in the biosphere, and the potential for future biocapacity is reduced. Overshoot is possible because, for example, forests can be cut faster than they grow, fish can be harvested faster than their natural replacement rate, water can be withdrawn faster than aquifers are replenished, and carbon dioxide ("CO_2") emitted faster than it is sequestered. We must stop cutting down our forest and earnestly support global reforestation efforts.[3]

Humans need to better understand the nature of the elegant organismal interactions that sustain life on Earth, including their own—we need to realize we are an integral and powerful part of nature. But, it seems that humans and their institutions don't see themselves as part of ecosystems. Perhaps this is because we move from one ecosystem to another so easily and quickly, and we manipulate the natural world so effortlessly and profoundly. In fact, we have the single greatest effect of any species on the health and welfare of ecosystems on Earth and we have executed our influence on Earth's biodiversity with devastating effects.

From the tundra of Alaska, to the desert in Death Valley, to the Choco-Manabi Bioregion in Ecuador, every species has a job to do, and they take their work very seriously. Bees, for example, pollinate most of the plants that provide food for humans and terrestrial animals, which makes the current Honey Bee Colony Collapse Disorder very troubling. There is currently a widely disseminated view that if the bees disappear from the surface of the earth, humans would have no more than four to five years to live.

In another poignant example, recent field research of John Terborgh at Duke University shows that ecosystem integrity is often dependent on the functional presence of large carnivores. And yet we are losing top carnivores at an alarming rate in

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oceans and on land. Humans, acting as "ultra carnivores," are solely responsible for these losses. The kind of predation that we engage in is not ecologically sustainable and results in ecological imbalance of the highest order.

The Earth's oceans, which cover 71% of the surface of the Earth, may be the most threatened ecosystems of all. We are over-fishing our oceans, driving many species of fish to extinction and disrupting complex ocean food chains. There are large masses of plastic in the Pacific, Atlantic, and Indian Oceans. Beaches all over the world are covered with plastic trash, medical waste, and fishing nets. Run-off into the oceans, especially from industrialized nations, is polluted with pesticides, herbicides, fertilizers, pharmaceutical wastes, and other pathogens that are creating large dead-zones in the oceans.

Given this ecological context, many questions arise: Where on Earth are the large, intact ecosystems that need urgent attention? What must we do to restore the health of our oceans? What legal and policy tools can promote solutions to biodiversity loss?

The Solution: Sustaining Biodiversity

The global path to sustainable perpetuation of biodiversity must involve as many people, institutions, businesses, and governments as possible. As Albert Einstein put it "Our task must be to free ourselves by widening our circle of compassion to embrace all living creatures and the whole of nature and its beauty." Fortunately, there are dedicated, intelligent people working on the problem all over the world. Below are a few examples of progress.

In December 2009, the 190 nations that are party to the UN Framework Convention on Climate Change ("UNFCCC") met in Copenhagen, Denmark. Part of the meeting dealt with Reduced Emissions from Deforestation and Degradation, or REDD, which is a program that would compensate countries that possess large forests if they reduce their rates of deforestation. Reducing deforestation reduces carbon emissions, and carries the added benefit of maintaining and enhancing the health of large intact ecosystems and the biodiversity they contain. The details of exactly how to implement REDD have not been carefully elaborated and "the devil is in the detail," but great potential exists to protect biodiversity through REDD.

The United Nations declared 2010 to be the International Year of Biodiversity. It is a celebration of life on earth and of the value of biodiversity for our lives, as well as a unique opportunity to increase understanding of the vital role that biodiversity plays in sustaining life on Earth. The world is invited to take action in 2010 to safeguard the variety of life on earth. The UN declares that:

> You are an integral part of nature; your fate is tightly linked with biodiversity, the huge variety of other animals and plants, the places they live and their surrounding environments, all over the world. This is vital for current and future human well being. We need to do more. Now is the time to act. You rely on this diversity of life to provide you with the food, fuel, medicine and other essentials you simply cannot live without. Yet this rich diversity is being lost at a greatly accelerated rate because of human activities. This impoverishes us all and weakens the ability of the living systems, on which we depend, to resist growing threats such as climate change.[4]

The GLOBIO consortium is a collaboration between the Netherlands Environmental Assessment Agency ("PBL"), UNEP GRID-Arendal, and UNEP-World Conservation Monitoring Centre ("UNEP-WCMC"). The consortium started in 2003. The main output of the consortium is the GLOBIO modeling framework, with the aim to support integrated global assessments and to calculate the impact of five environmental drivers on land biodiversity for the past, present, and future. The five drivers are: land cover change, land-use intensity, fragmentation of ecosystems, atmospheric nitrogen deposition and infrastructure development. This is a powerful, science-based tool that will help researchers, institutions, and governments around the world in their efforts to monitor the global state of ecosystems and biodiversity.[5]

The Center for Conservation Biology at Stanford was established by Paul Ehrlich in the Department of Biological Sciences in 1984, and is one example of an academic institution tackling the challenge of biodiversity.[6] Gretchen Daily, Director of the Center, is an ecologist and a conservation heroine with the admirable goal of developing a scientific basis—and political and institutional support—for managing Earth's life support systems. Her recent book, *The New Economy of Nature*, written with Katherine Ellison, a Pulitzer-prize winning journalist, is an informative and engaging examination of what they call the "new economy," an economy that recognizes the economic value of natural systems and the profits in protecting them. Daily describes her work as:

> …developing the field of countryside biogeography to forecast changes in biodiversity and ecosystem services in human-dominated landscapes, using both theoretical and empirical approaches, including remote sensing. I am also developing a scientific framework for characterizing ecosystem services and incorporating their value into decision-making. Finally, to investigate new conservation finance mechanisms and policy options, I am collaborating extensively with economists, legal scholars, mathematicians, and leaders of non-government organizations and in the public and private sectors.[7]

Even with these examples of progress, there is much more that can be done. It would be wise, for example, for governments to educationally empower young people all over the world to become actively involved in preservation of biodiversity. I propose offering high school and college student's government paid sabbaticals from school to do conservation work in biologically critical ecosystems. It would certainly be a life-changing educational experience.

Concluding Remarks: A Call to Action

It is fair to say that there is a lot of "bad news" about the environment, and that how humans respond to these challenges will define us as a species. Our unique ability to communicate abiotically via language and symbols comes with the responsibility to make choices as individuals and members of society that do not diminish the ability of the planet to renew itself. Prior to global industrialization there was a balance that has been altered unsustainably by the demands of an ever-increasing human population.

Now, during the International Year of Biodiversity, it is more important than ever that biodiversity be put at the forefront, and discussed widely by all kinds of people, from government officials, to conservation professionals, to academics, to average citizens. The time for action is now. This issue of Sustainable Development Law & Policy provides a forum for such discussion.

Endnotes: Introduction: A Perspective on Sustainable Pathways toward Preservation of Biodiversity

[1] A habitat is the unique space and time occupied by a particular species in an ecosystem.

[2] Int'l Union for Conservation of Nature, Biodiversity, http://www.iucn.org/what/tpas/biodiversity/ (last visited May 3, 2010).

[3] GreenFacts.org, *Scientific Facts on Biodiversity*, http://www.greenfacts.org/en/global-biodiversity-outlook/index.htm#6 (last visited May 5, 2010).

[4] UN Convention on Biological Diversity, Messages, http://www.cbd.int/2010/messages/ (last visited May 3, 2010).

[5] Globio, Home, http://www.globio.info/ (last visited May 3, 2010).

[6] Center for Conservation Biology, http://www.stanford.edu/group/CCB/About%20CCB.html (last visited May 3, 2010).

[7] Center for Conservation Biology, Gretchen Daily, http://www.stanford.edu/group/CCB/Staff/gretchen.htm (last visited May 3, 2010).