Reith Lectures 2000: Respect for the Earth

Lecture 2: Biodiversity - Tom Lovejoy - Los Angeles

From the moment of our birth we grow up in a world of difference. Very early we learn we share this world not just with our family but with other living things. "Every child has its bug period" as the great Harvard biologist E. O. Wilson says. We discover that not only are there different kinds of plants and animals-- which scientists call species --but also that there can be lots of difference between individuals of any one kind. This genetic variation we discover first in our parents. And unless we live in an urban setting far from a park, we soon learn that different kinds of animals and plants live together in different places: camels in deserts, whales in the seas, gorillas in tropical forests. The totality of this diversity from the genetic level, through organisms to ecosystems and landscapes is termed collectively biological diversity.

I chose to come to California to give this lecture rather than somewhere else, because of an exciting experiment with biological diversity. I believe it may well help us in the global quest to maintain the biological underpinnings of sustainability, but I will turn to the story of the California Gnatcatcher later in this talk.

It is another fact of life that no organism can exist without affecting its environment. To be alive requires energy so all organisms need to eat: even green plants which use the energy of the sun have to take in nutrients to both live and grow. Similarly all organisms produce wastes. While they are biodegradable -- and it is nothing short of astonishing what some organisms will "feed" upon -- the wastes do alter the environment and potentially affect other organisms.

Consequently the choice confronting humanity is not whether it affects the environment or does not. Rather the choice is about how we affect the environment, that is, in what ways and to what extent. Our planet is very much a living planet and it's incredibly rich web of life is central to how it functions and therefore to sustainability of the human enterprise.

Understanding and attaining sustainability is therefore very complex and does not admit of many simple solutions.

At the moment it is clear that we are far from sustainability. We are in deep trouble biologically and already into a spasm of extinction of our own making unequalled since the one which took the dinosaurs. It is not a peaceable kingdom. The rate at which species disappear is about 1,000 to 10,000 times normal, and a quarter or more of all species could vanish within a couple of decades. There is a major problem with biological diversity. That really is a given. What is far more important is to recognize why it is happening and how we might arrange our lives so our grandchildren can enjoy a sustainable existence on a biologically rich planet.

Biological diversity lies at the heart of sustainable development. The quality of our lives is entwined with it so much more deeply than most of us ever notice, that our fate depends on how well we provide for the future of other forms of life. This goes way beyond the obvious and essentials of food, fiber and shelter, to medicines and

complex industrial processes. Biological diversity is essentially an incredibly vast library for the life sciences which is drawn upon to improve critical biologically based enterprises like agriculture and medicine.

Just recently, a sample from a Zambezi riverbank of an obscure group of organisms called slime molds yielded promising new compounds to fight tumors resistant to taxol. Taxol, a key element in the arsenal against breast, ovarian and lung cancer, loses effectiveness in some cases. Taxol itself originally came from the Pacific Yew, considered by foresters just a few years ago to be a trash tree in the forests of the northwest United States. The effective molecules in both cases came from natural defenses of the two wild species in interactions with other species. Sometimes the link is less direct but nonetheless very real as, for example, the development of the ACE inhibitors for treating high blood pressure they arose from the discovery of a unknown system of regulation of blood pressure in the course of a study of the venom of a tropical viper.

The structure of ecosystems is made up of diverse kinds of plants, animals and micro-organisms, and their combined metabolisms constitute ecosystem function.
In this day of quick resort to technological fixes, it is notable that New York City elected to restore the ecosystem function of its degrading watershed rather than construct a water treatment plant. When I grew up in that city it was famous for the quality of its water: when I would return after being away I remember noticing how delicious the water tasted. It even won in blind tastings over fancy European bottled waters. But changes in land use in the watershed led to deteriorating water quality until our Environmental Protection Agency was about to require the city to build a multi billion dollar water treatment facility. Instead a bond issue at a tenth the cost made it possible to restore the watershed, its biological diversity, and therefore its functions. It was a natural and a permanent solution.

What we often call natural disasters are not always natural. They often happen where a little recognized ecosystem service, namely that of disaster prevention has broken down. The horrifying floods and mudslides Hurricane Mitch brought Honduras and the even more ghastly events in December following heavy rains in Venezuela demonstrate this well. Equally heavy rains in Venezuela in 1952 had much lesser consequence because the poor - the ultimate victims -- had not then deforested critical slopes. In Honduras there are anecdotes of adjacent hillsides in which the one with intact forest remained stable and also released less floodwater. Often characterized as "natural disasters" these are only partly so, and the devastating humanitarian and economic blows make a strong argument for maintenance of ecosystems and their services. And, right now we are seeing this happen once again in Madagascar.
About 50 years ago, American freshwater ecologist Ruth Patrick began a line of research subsequently recognized by the U.S. National Medal of Science. Ruth, has been essentially a den mother for a couple of generations of scientists and is in my personal Pantheon. Fifteen years ago when I chose her to speak at a particularly important meeting on the environment, someone asked me "Why did you choose someone so old?". My reply: "When your grandmother tells you have cooties or head lice, you take it more seriously."

Ruth Patrick began a systematic study of rivers and their biological diversity which demonstrates that the numbers and kinds of species in a river -- its biological diversity

in our current parlance -- reflect the basic ecology of the river and the environmental stresses to which it is subject. In other words, biological diversity integrates the effects of all environmental problems affecting an ecosystem. This is essentially the fundamental, if often unrecognized, principle on which all environmental science and management is based. It applies everywhere not just in freshwater.

Taken at the level of the entire globe, the Ruth Patrick Principle, means that biological diversity can be considered the single measure of how humanity is affecting the environment. Think of that: instead of contemplating the welter of impacts society is generating, we now can measure the sum in a single number - a real measurable key to achieving and recognizing sustainability.

At the scale of an ecosystem such as South Florida, the coastal sage scrub of California's five southern counties, or even as ambitious a one as the Amazon basin, the key consists of maintaining two elements -- measurable elements -- that are characteristic of the particular ecosystem. One is maintenance of ecosystem functions, such as the sheet flow of water in South Florida, and the other is maintenance of the biological diversity of the ecosystem. The latter can be thought of as managing so that the species list a hundred or five hundred years from now will be pretty much the same as it is today. It certainly does not mean that this has to be true of every spot within the ecosystem although there do need to be areas of strict preservation. There certainly can be locations (cities for example) where there is very intense use and low biological diversity. It does mean enough wild places and enough connections between them so all the species can make it in the long term.

These two measurable goals provide an operational definition for sustainable development within that piece of geography. It is, of course, seriously challenging because it means taking on all environmental problems intrinsic to the area as well as those like acid rain and climate change which are extrinsic. While this might seem to ignore the social and economic elements of sustainability, in the end it certainly does not, because otherwise they will begin to affect the two measurable standards: ecosystem function and biological diversity. Consequently the other aspects of this lecture series, for example good governance and health, are also vital for success. If not applied late in a history of environmental degradation, this ecosystem management approach allows for considerable flexibility and creativity in addressing human aspirations.

South Florida provides an instructive case. A large ecological unit, it extends from the Kissimmee River and Lake Okeechobee about half way up the Florida peninsula down through the Everglades Park and includes Florida Bay, the Florida Keys and the coral reef beyond. It is essentially a single system dependent upon the sheet flow of water from north to south known as the "River of Grass". Over a half century or more individual isolated decisions -- each presumably reasonable in their own context and time -- for flood control, water supply, and agricultural purposes, have drastically altered the flow. Not a drop of water flows naturally without a valve being turned, and only a quarter to a half of the natural flow reaches Florida Bay depending on the year. Subterranean flow through the limestone underpinnings is so reduced the freshwater upwellings in Florida Bay have ceased. The result is a degrading ecosystem, reproductive failure of water birds, endangered species, hypersalinity in Florida Bay, loss of seas grass beds, algal blooms and additional stresses on an already stressed

reef system. Ecosystem function and biological diversity are measurably impaired. I had no inkling of this when I first visited the Everglades as a teenager and the problems were not blatantly obvious at that point. In 1993, however, when I served as Science Advisor for the Department of the Interior, the problems were so obvious I could pick out some of them on satellite images of the peninsula.

If the above is the consequence of ad hoc and uncoordinated decision making, then the resolution of such problems, or better yet their avoidance, depends on the converse: on integrated and consultative decision making that integrates society's decisions within the ecosystem framework. When it works best it takes the decision making back to where people live. This is the essence of the multibillion dollar program to restore the natural plumbing of south Florida as much as possible. It will take decades and makes a good case for avoiding such problems to begin with. It also is not easy with so many players with differing vested interests. For example the state recently refused to implement part of the plan, namely to buy out people who had encroached on some sensitive areas. Scientifically the plan needs some significant improvement. Nonetheless, the degradation is beginning to be reversed and the overall trend seems positive.

Southern California where we are tonight presents a different example. Home to Los Angeles, San Diego and some of the worst urban/suburban sprawl in the United States, its native habitat had become reduced to the point, that America's most powerful environmental legislation, the Endangered Species Act was invoked on behalf of a jaunty little bird, the California gnatcatcher -- which just happens to inhabit some of the priciest real estate in the nation. The powers of the Endangered Species Act have tended to be used only once a species is listed (an indication that its habitat and constituent biological diversity was on the verge of being endangered itself). So the exercise was not just about the gnatcatcher but an array of other species like a tiny arboreal salamander, a lizard known as the orange-throated whiptail and the San Diego Thornmint. Southern California , in fact, has a concentration of species found nowhere else: you are all living in this biodiversity "hotspot". If nothing is done until a species reaches the brink of endangerment, inevitably there are economic interests squared off against a species with an obscure name. So even though this really is a signal that the region is beginning to unravel biologically, the situation is easily caricatured as people vs. biological esoterica. A famous example is the Tellico Dam in Tennessee is a little minnow called the snail darter.

So when I was at the Department of the Interior, the situation here was turning into a classic test case for a new approach. I came out to California and thanks to colleagues at the Department of Natural Resources, I had the chance to see the situation firsthand, from the air, on the ground and with the people seeking a resolution. This time the state of California together with the federal agencies and the five county governments undertook to deal with the problem proactively while there was still some flexibility biologically and legally. Industry and civil society, especially the Nature Conservancy, were active participants. The idea was to plan conservation of entire natural communities before it was so late that costs and consequences became impossibly high. Large landowners such as the Irvine Company, were major players, agreeing to land exchanges which worked for both nature and their business interests. At Camp Pendelton in San Diego County the United States Marine Corps worried that the military might have to shoulder a particular heavy burden and were delighted to

discover that when all engaged in the plan this was not so. The Commandant even took particular pride in beach management to favor a nesting seabird.

Through the regional program some 400,000 acres have been identified for eventual protection, a network of conservation which is now more than 60% complete. True, endangered species listing of the gnatcatcher in one sense drove the process, but the result was considerably better than otherwise would have been the case using regulatory powers of the Endangered Species Act alone. Just two weeks ago California voters approved a four billion dollar bond issue for securing critical conservation land, with at least $150 million of this dedicated to southern California. I go to the Amazon with such frequency that I have given up explaining. I just say I am always on my way to the Amazon. In fact, I wrote this lecture on my laptop while I was there. As important as it is from a conservation point of view I confess I also just like to go to this place of perpetual biological surprise and listen to howler monkeys and other jungle noises from my hammock. As complex as South Florida or Southern California are, an even more complex challenge is presented by ecosystem management of the Amazon. Comprising eight nations, for none of whom the Amazon is a major priority, it nonetheless operates ecologically as a single system. In an extraordinary interaction between biological and physical elements, the Amazon literally generates half of its own rainfall. If too much forest is cleared in the wrong places, the hydrology would begin to change and affect the biology of this, the largest of the world's forests, the largest wilderness and the world's single greatest repository of biological diversity. In its vast river system which contains 20% of all the river water in the world reside around 3000 species of fish (more than the entire North Atlantic) some of which migrate from estuary to headwaters and back in the course of their life spans.

Each Amazonian nation finds it hard enough to integrate the various elements of government decision making into a comprehensive policy resembling something like ecosystem management for their piece of the Amazon. Is there any possibility that there could be coordination at the level of the Amazon as a whole? The optimistic answer is that there is certainly a greater chance today with some enlightened national leaders and ministers. The Treaty for Amazon Cooperation provides a possible framework, but it will require leadership especially by Brazil which holds two thirds of the real estate. I believe it could happen and I know that multilateral agencies like the World Bank, the InterAmerican Development Bank , UNDP and UNEP plus civil society would jump at the chance to support such an effort. Sustainable development takes good governance as well as good science.

All three examples must be considered works in progress not final solutions because environmental problems arise continuously like dragons' teeth. One of the most important extrinsic factors for ecosystem management is that of climate change. This is in large degree because when biological diversity is protected by isolated parks and reserves, the ability of species to move and to track required ecological conditions is impeded by an obstacle course of human dominated landscapes.

All will be for naught if society fails to address the greenhouse gas problem. The threat is also much more imminent than most people realize. The world is literally melting: tropical glaciers will be gone in twenty years and new data on the Arctic ice cap indicate that it too is likely to break up in the same time period.

The good news is that there are things we can do about that right now. Some involve energy substitution and conservation. Others involve trees and forests because they play an enormous role in the global carbon cycle. A major effort to stem deforestation, reforest, and to protect natural forests will ward off further greenhouse gas emissions and also make a major contribution to conservation of biological diversity.

The moment is at hand to take the right steps to underpin a sustainable future biologically. Certainly, the challenge is highly complex, and it must work locally everywhere so that it all adds up to sustainable development. Yet it could be summed up by saying we need to live within nature rather than think of it as something which is taken care of, almost in token fashion, with fenced off areas while humanity operates without restraint in the rest of the landscape.

As powerful and imperative as I believe the practical arguments for conservation are, a change in perception and value about our place in nature could achieve vastly more. Classical conservation is not in fact enough. Honoring the Patrick Principle through ecosystem management means we have to live in ways that won't degrade the biology of areas of strict preservation, but also won't degrade that of the landscapes in which we live. That is why sustainable development is so important. It is also why it is so complex to grasp. Fortunately in biological diversity, we not only have wonderful resources we also have a very real measure of sustainability. I am frequently reminded of a long discussion with British naturalist Gerald Durrell when he turned to me with tears in his eyes and said: "There is so little time".

The natural world in which we live is nothing short of entrancing -- wondrous really. Personally, I take great joy in sharing a world with the shimmering variety of life on earth. Nor can I believe any of us really want a planet which is a lonely wasteland.