

BIODIVERSITY ISSUES AFFECTING PRIMATES

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Biodiversity conservation issues affecting primates include: setting priorities, hot spots, mega diversity countries, wilderness areas, and other strategies are critically important to understand. By starting with the basics and being concerned about conserving biodiversity in general terms many different environmental problems become evident around the world. Biodiversity conservation is the single most critical issue that we face in our time. Biodiversity is the sum total of all life on Earth. It's our living natural resource space. It's biological capital in the global bank. The big issue right now is loss of species. Besides loss of species, we're losing entire communities and entire ecosystems upon which we ourselves ultimately depend on for survival. We are on the verge of or already in the midst of an extinction crisis unlike anything seen since the loss of the dinosaurs some 65 million years ago.

There are a few key points about biodiversity that need to be fully understood because they set the context for some of the issues that we face over the next few decades. They relate largely to our ignorance about biodiversity. Firstly, we have about 1.5 million total species of everything described by science to date, including plants, animals, and microorganisms. The total estimate of diversity is between 5 and 15 million species. The actual may be more than 100 million species (Mittermeier, personal communication). Although we can send spaceships to the farthest reaches of the solar system, and put millions of bits of information on tiny computer chips, we're still in the dark ages in terms of our understanding of other life forms. We potentially do not know how much is out there to within two orders of magnitude. That's not so surprising when you look at rain forest canopy beetles, soil microorganisms or nematodes living in the mud along the shore. But it also relates to our closest living relatives, the nonhuman primates. There is a species of dwarf marmoset that was described last year from the Central Brazilian Amazon and was recently announced in the media. Previously unknown to science, it is possibly a distinct genus, not just a distinct species. This very interesting animal is about half the size of the regular marmosets and about twice the size of the pygmy marmosets, *Cebuella*. On Earth Day, two other more "normalized" *Callithrix* marmosets were just described—the Acari and Manicore marmosets. These are two completely new species from the Central Brazilian Amazon region. About half of the animals from this region were described just in the past decade. Since 1990, nine new species of Brazilian primates were described with another six to twelve in the process of being documented. There are not yet adequate materials to describe them fully.

With regards to taxonomy we need to have solid scientific understanding of what's out there. What are the units? What are the species? What are the subspecies we're actually trying to conserve? In February 2000 at the Disney Institute, 25 people met, including experts on primate classification, primate taxonomy, molecular taxonomy, field experts, and museum professionals. This meeting may have been the first of its kind for any group of organisms. Over a week's time, each scientific group's opinion was reviewed. The con-

clusions are in the process of being synthesized. It was decided that there were 13 different taxa of great apes. The gorillas were split into two species and five taxa: the mountain gorilla (*beringei*), the Bwindi population which is distinct, and *graueri* from East Zaire were put into the mountain gorilla species. The other two, *Gorilla gorilla gorilla*, and the recently re-recognized Cross River Gorilla from Nigeria and Cameroon were also recognized as part of the lowland gorilla complex. Taxonomists have been going back and forth for a while on whether the Sumatran and the Bornean orangutans are distinct species. Apparently the genetic data indicate that the Sumatran and Bornean orangutans are almost as distinct from one another genetically as are the gorilla and the chimpanzee. Colin Groves is recognizing among Bornean orangutans three distinct subspecies, two of which have names and the third one is not yet named. With the concept of subgenera (using gibbons as a model) it was decided that subgenera, given the level of diversity of primates, was not a particularly useful concept. It was decided to recognize the subgenera of gibbons as distinct genera, (including *Bunopithecus*, *Hylobates*, *Nomascus*, and *Symphalangus*) and 28 taxa of lesser apes were identified. These results should be available for publication within the next three to six months. This gives us a more solid underpinning as we did this for all the primates. If we don't have a solid understanding of what the entities are that we're trying to conserve, where they occur, and what populations remain for each of them, it's very difficult to come up with any kind of sensible conservation strategy over the next decade. This idea originated from conversations that John Oates, Anthony Rylands, and others had a few years ago.

The value of biodiversity is another emergent issue. People have vague notions that we get certain products from the rain forest and that wild relatives of certain crops are important for upgrading genetic diversity and resistance to disease, but if we look a little more carefully we see that natural ecosystems provide ecosystem services on the order of trillions of dollars. One study done on the value of ecosystem services a few years ago indicated that its value is on the order of \$37 to \$51 trillion. This gives some indication of how important these natural ecosystems are to us. When we look closer we find that certain species like the poison dart frogs have very interesting compounds that can be useful for modern medicine. The poison dart frogs are now being studied in a number of laboratories and one of their compounds is more than 200 times more effective than morphine and another is a powerful aphrodisiac. *Medicine Quest* by Mark Plotkin gives outstanding review of some of the values of poisons in particular and other natural products from the living world.

In terms of primates, we really haven't been all that successful at understanding their value. We know that they've had value in biomedical research in the past but we need to start thinking about how we value them. How we put clear values on their importance in ecosystems, and their importance to us in aesthetic and spiritual terms. If we don't start coming to grips with a much better articula-

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tion of what these animals are actually worth to us, not just in dollars, but in many ways, it will be hard to make an argument for their conservation over the long term.

Primate diversity, the primate extinction risk, threats, primate hot spots, and the whole entire “hot spots concept” will direct primate conservation priorities and the action steps to be taken in the next few years, including solutions to maintaining primate diversity in the twenty-first century. So why primates? They’re our closest living relatives. Particularly the bonobo or pygmy chimpanzee which has fascinated not just this culture but many other cultures for a long time. Sometimes the fascination gets a little carried away, but the message is that these animals, in fact, can teach us a great deal about ourselves. We now have the Human Genome Project and their interest in genetic material of the apes in particular. As I understand it, the Human Genome Project is looking for genetic material from some of the apes and the scientific community needs to look at how we address these requests. Another key role of primates is their importance as flagship species, in particular as flagship species for the tropical rain forests of the world. More than 90% of all primates are found in tropical forest systems, and for thirty years have been used as symbols for getting people who otherwise wouldn’t pay much attention to tropical forest conservation excited about the importance of these ecosystems. They put a face on tropical forest conservation. I think they make it much easier to sell. When I saw people in golden lion tamarin costumes in the Carnival in Rio de Janeiro I really felt we were making some progress at least in Brazil.

One of the real reasons that primates are studied is they can teach us something about human evolution, besides being really cool, exciting, and interesting animals. Although I’m able to justify studying primates scientifically, I work with primates because I like them, which is probably true of almost all of the conference delegates. They are also an extremely interestingly diverse group of mammals that are very often unappreciated in terms of diversity. Primatologists tend to focus on a handful of species that we are involved with. Primates are a tremendously diverse group, including 175 to 250 different kinds. However, there may be more than that. They have one of the greatest size ranges of any group of mammals, from the tiny mouse lemurs all the way up to a full grown male mountain gorilla. That’s several orders of magnitude range in size which is unusual in and of itself within the mammals. The number of primate families has increased as a result of the Florida meeting to 17 families, with 3 being recently added this year.

Due to the incredible diversity of New World monkeys two families were split into five. There are now 66 genera of primates, including two new ones for New World primates and the splitting of gibbons into four genera. There are 303 primate species which is about a 15% increase over the past few years.

The real number that is important is the number of taxa or the number of named, clearly identifiable different kinds of primates. This is the basic unit for conservation action. There are more than 600 taxa, and as more research is done over the next few years this number is going to creep upward. We will not know the final number of taxa for another 20 to 30 years and it may be on the order of seven to eight hundred. It’s important to recognize that although the apes are the most well-known, they’re also very important because of their closeness to humans, although they represent a relatively very small percentage of the order Primates. Great and lesser apes comprise 11% of the primate genera and 7% of the primate taxa. The lesser apes alone comprise 4.5% of all primate taxa, and the great apes 2%. Obviously no one denies how important apes are, and how closely they are related to us. But they are just a small part

of a very big order, all of which needs to be conserved with maximum enthusiasm and maximum efficiency.

Primates are found mainly in four regions of the world: the neotropics, South and Central America, Africa, Asia, and Madagascar (which is considered to be a region in its own right because of its uniqueness). Based on discussion from the latest meeting in February, 210 taxa are found in the neotropics and 54 in Madagascar. Madagascar has less because it’s a tiny area, but there are 14 different genera and five families there. There are 170 taxa in Africa and about 184 in Asia; the large continental regions have very similar numbers. They all have the same number of families and are similar in number of genera. Madagascar, because it’s so small, has a smaller number of primate species and subspecies. Now in terms of concentrations, biodiversity is by no means evenly distributed on our planet, which is certainly true of the primates as well. The last time a census was done, 92 wild primate populations were found. In just four countries, Brazil, Democratic Republic of Congo, Indonesia, and Madagascar 181 species are found. The number of species is probably closer to 200 in these countries for a total 303. In summary, about two-thirds of all primates are packed into four countries, and have a very high level of endemism. These clearly are focal conservation areas, and two of the four countries have ape populations.

There are many threats to primate populations. Habitat destruction obviously is the biggest, and this takes many different forms. Logging is a 19th century-type activity, and logging of primary forest in my opinion should stop immediately. Unfortunately that’s not going to happen in certain areas right away.

Bushmeat is another serious threat to ape populations. We now have a Bushmeat Task Force that Heather Eves is leading. The bushmeat issue is not unique to Africa, but is also an issue in the Amazon region. The primate bushmeat problem in Southeast Asia is, in many ways, even more serious because the populations of many of the animals that are being hunted not only for food but also for medicinal purposes. This is especially impacting primates found in China, whose numbers are at a more critical level than many of the Central African species. Some of the animals that are really heavily impacted by this are the Douc langurs of Viet Nam, Cambodia and Laos. They’re down to very small numbers in the wild. So clearly this is not just an African issue. This is a global issue as far as primates are concerned, and one for which there are no easy solutions.

The Primate Specialist Group has provided information on the primate extinction risk. This group is one of approximately 100 specialist groups of the Species Survival Commission (SSC). The SSC was chaired extremely well by George Rabb for about eight years and is the largest volunteer network in the world dealing with biodiversity conservation issues. It’s one of the six commissions of the World Conservation Union’s, International Union for the Conservation of Nature (IUCN). The Primate Specialist Group has had maintenance of the current diversity of the order of primates as its principal focus over the past 20 odd years. There has been dual emphasis on ensuring the survival of endangered species wherever they happen to occur including small fragmented populations. An equally important focus is providing effective protection for large numbers of primates in areas of high primate diversity and abundance, such as some of the large wilderness areas in Amazonia and Congo. In the 20th century there were no primate extinctions. There are a few that may be extinct but haven’t been confirmed. Ms. Waldron’s Red Colobus, the subspecies of the red colobus from West Africa is already gone. There are still a few places to be surveyed before it is declared extinct. Even if one or two species did disappear it’s still impressive that of those 600 plus species and subspecies that exist,

very few were lost. This is an enviable record when you compare it to most other comparable size larger or somewhat smaller groups of mammals and other vertebrates, most of which have lost quite a few species and subspecies in the 20th century. However, as we come into the 21st century and as we've done this analysis of how many units, how many taxa we actually have out there, our numbers of critically endangered and endangered primates have increased rather dramatically. The last Red List analysis of the World Conservation Union in 1996 had 33 critically endangered species. These are the ones that are really at the edge of extinction and down to a few hundred, or at best a few thousand individuals. This number has now increased to 50 out of the 618. Almost 10% of primates are in the critical category which means they could become extinct in the future if we don't put in place the right kinds of conservation measures. The endangered primates (88 species or 14% of the total primate population) are a little better off but still at risk of disappearing sometime in the next few decades. If you combine these two statistics, it shows that almost one in every four currently recognized species and subspecies of primates are in some danger of extinction.

So what kind of actions are needed to be effective in conserving primates over the next few decades? Our objective always has been and continues to be zero extinctions, although a few may be lost due to the processes already in place. We should do everything possible as long as there's anything reasonable remaining to conserve everything that's out there. Primates, after all, are a very special group of animals. In order to achieve this we have to be very good at setting priorities. Where do we put limited resources to be most effective in our conservation activities?

We can use several different categories and approaches for setting priorities. Two principal ones used by Conservation International are threatened hot spots and major tropical wilderness areas. The concept of hot spots was first developed by British ecologist Norman Meyers back in 1988. Conservation International adopted it immediately and made it the basis of their first conservation organizational strategy (when it was just three years old) and by the Chicago-based MacArthur Foundation. This was a convenient partnership because it put a large amount of resources into conservation throughout the 1990s. Conservation International used this concept for about seven years, and in 1996 and 1997 launched a fund-raising campaign for the hot spots. A reanalysis is needed to determine whether this concept is a valid including review of potential areas that may have been missed and a rigorous review of the quantitative criteria used for hot spots. A 3½ year study of hot spots is summarized in the book *Hot Spots* and in a recent article in the February, 2000 issue of *Nature*.

There are two principal criteria for determining hot spot status. The first is endemism (i.e., species that are found only in a particular place and nowhere else), particularly plant endemism. Endemic species in particular were chosen because these have a more restricted range and are more specialized species. For the most part, these species will be lost when extinction episodes hit and are the ones to be most concerned right now. The second criterion and layer of analysis was the degree of threat. To qualify as a hot spot, an area would have had to lose 75% or more of its original extent leaving 25% or less still remaining more or less intact. This is a terrestrial analysis with some fresh water diversity included (although not classified as a fresh water analysis), and by design it is not a marine analysis. We're now in the process of working on a marine hot spot analysis. This study resulted in 25 areas (more than originally identified by Meyers) distributed largely but not exclusively over the tropics.

Tropical rain forests are the richest biomes in the terrestrial realm, but are not the only important biomes. If you look at the biome types represented in the hot spots, tropical rain forests only number a part of other biomes including dry forests, temperate forests and grasslands, tropical dry forests, an arid system and five Mediterranean-type systems like Southern California and the Mediterranean itself. The original area of the hot spots was on the order of 17 million square kilometers and occupied about 12% of the land surface of the planet, or an area about the size of Russia. Cumulatively the hot spots have lost 88% of their area, leaving only 12% intact. This 12% is about two million square kilometers. This is an area a little bit larger than Alaska, and a tiny bit larger than Mexico. A small area in global terms; 1.4% of the land surface of the planet. Nonetheless in this 1.4% you have as endemics found nowhere else, 44% of all plants. Ten thousand vertebrates are endemic to this 1.4%, which is approximately 35% of all vertebrates. Birds and the mammals comprise around 30%, and reptiles are approximately 40%, while the amphibians are off the charts. Amphibians are tremendously concentrated in these hot spot areas and that number is going up. Every time we go out into a tropical rain forest to do a survey, new frog species are found. Fifty-four percent of the known frog species are concentrated in this 1.4% of the land surface. If you look at the endemics plus the nonendemics, the total diversity represented in these areas is approximately 60%. This 60% is a guess because there was no time to do the analysis of overlapping ranges, although it needs to be done in the future. If you look at the most endangered species you will find that about 60% of mammals in the IUCN Red List and more than 80% of the birds are also found in the hot spots. If you look at species that have already gone extinct since 1800, you see that about 80% of the birds were from hot spot areas. Hot spot areas have significant concentrations of biodiversity which makes the whole concept of a biodiversity crisis somewhat marketable and manageable. Instead of saying conserve everything everywhere, which is very difficult for people to put their arms around, say conserve a significant part. We can conserve a significant part by focusing on hot spots and hot spot fragments. This will be critical in order to squeeze through the demographic bottleneck that Ed Wilson talks about in this century. How much diversity can we squeeze through this bottleneck and come out at the end of this century with a reasonable representation of life on Earth still with us?

The simple conclusion is that if you have 60% or more of all terrestrial biodiversity in the most threatened 1.4% of Earth's land surface it's hard to avoid the conclusion that we should be focusing a lot of attention on these areas. Conversely, even if we are extremely successful everywhere else outside of the hot spots, but fail miserably in the hot spots, we're still going to lose a part of biodiversity.

The other major priority category that we use to determine conservation priorities are major areas of tropical wilderness. These are areas that also have very high biodiversity and endemism, but in striking contrast to the hot spots, are largely intact. In most cases 70 to 75% or more of these areas are still standing. They're mainly found in the Amazonian region of South America, the Congo Basin and the Island of New Guinea. They're tremendously important to us for a variety of reasons. They're major storehouses of biodiversity, major watershed areas and a big chunk of the world's fresh water flows through these areas (water will also be a big issue in this century). They're controls against which we can measure what's going on in the hot spots. They're going to have increasing recreational, aesthetic and spiritual value on an evermore overcrowded planet. They're really the only places where traditional people, tribal, in-

digenous people, are going to have any hope of maintaining their traditional lifestyles, including the Kyapo Indians, the Trio Indians from South Surinam, and the Hooly Wagiman from the highlands of Papua, New Guinea. They're the only places where we're likely be able to maintain what are called intact assemblages of large mammals. Very rarely, nowadays, can you find places that still have all the big mammals that existed at the beginning of the last century. The Odzalla National Park in Congo, Brazzaville, still has large populations of gorilla, forest elephant, and forest buffalo. As the bushmeat issue becomes more serious, the large mammals are going to become increasingly special.

How do we apply the hot spot concept to the primates? You can subdivide the hot spots into 25 categories, eight of which are very special. Among the 25, you can select eight that are truly super stars in terms of biodiversity. Five of these also happen to be the top hot spots and the top areas for endangered primates. These are Indo-Burma or mainland Southeast Asia, the Guinean Forests of West Africa, Sundaland which is the fancy name we use for Western Indonesia and Malaysia, Madagascar and the Atlantic Forest Region of Brazil. Together these areas have 37 of the 50 critically endangered primates and 75% of these are in trouble. They have 61% of the endangered primates. If you lump the two together you're looking at two-thirds of the primates that are at greatest risk over the next few years concentrated in five hot spots which together occupies only approximately 0.3% of the land surface of the planet. If conservationists are concerned about preventing primate extinctions in these areas it must be a very strong focus. Three of these areas that contain apes include: the Guinean forests, Indo-Burma and Sundaland.

The Atlantic Forest Region extends from the nose of South America to the State of del Norte to del Sul, the southernmost Brazil states and once occupied an area about three times the size of California. It has some of the most beautiful forests anywhere on Earth. It's the industrial and agricultural center of Brazil. This area has two of the three largest cities in South America within its borders: Rio de Janeiro and São Paulo which is one of the two or three biggest cities on Earth. It's been a focus of development, especially over the past 30 to 40 years. The State of São Paulo, in the middle of the Atlantic Forest Region, is symbolic of what's happening in hot spots overall. The original forest cover of the state was extensive in the year 1500 when the Portuguese discovered Brazil. Not much happened over the next 350 years. But, as we entered the twentieth century, the forest cover declined drastically.

Conservation is the single most critical issue that we face in our times and biodiversity is the sum total of all life on Earth. Muriquis, found only in Brazil, are in the top 25 most endangered primates on the planet. Madagascar has the same type of situation. Forests in Madagascar are down to only approximately 5% of its original extent. There are lemurs which range in size from the pygmy mouse lemur (the smallest living primate, weighing 30 grams and was not recognized as a distinct taxon until the first half of the 1902) up to the indri, which is the largest of the living lemurs. The monotypic family of primates, the aye-aye (*Daubentonia*) which is certainly the most bizarre primate and one of the most bizarre mammals on Earth is also found in Madagascar. This country has some of the most critically endangered primate species, including the critically endangered Tattersal sifaka which was not described until 1996 or 1997. Although it is not yet protected in any park or reserve, plans are being developed to get a park established for it. The primates in Madagascar are 100% endemic. Studies carried out by Jörg V. Ganzhorn and some of his Malagasy colleagues on the mouse and dwarf lemurs have increased the total number of lemur species to at

least 67. This is an increase of approximately one third of the number of recognized taxa for Madagascar. There is a tremendous amount of information lacking on these animals in spite of the fact that they have been studied for the better part of 30 to 40 years now. Madagascar is also an example of primate extinctions not being a figment of our imagination. In the past thousand to two thousand years Madagascar has already lost a major portion of its primate diversity, including all of the giant lemurs. This was megaladapis, which looked like koala and grew to be about the size of a calf. All the giant species have gone extinct in the past 200 to 2,000 years. Primate extinctions can happen and if we're not careful they may happen again.

John Oates produced the first action plan for the Species Survival Commission in 1986. He was the first one to do a revision of the plan and an analysis of what impact the first plan had. Ardith Eudy produced the second SSC Action Plan and there presently are more than 50 of these action plans produced for many different groups of organisms. There is an action plan for lemurs and there have been a number of other much more taxon-focused action plans including one for the bonobo. A global action plan is being developed for the world's most endangered and critically endangered primates, and may be launched at the Adelaide Meeting of the International Primatological Society in January, 2001. This plan could be a very important fund raising tool for conservation as we go forward in the early years of this new millennium.

A critical piece of this plan is protected areas. These are absolutely fundamental, and have taken a bad rap over the years. Critics say they don't work or they're paper parks, but without them we're dead in the water. The Center for Applied Biodiversity Science carried out a study of "paper parks" showed that paper parks are better than nothing. If you look at the hot spots and the 1.4% of the land surface that still remains in the hot spots, it turns out that about 40% of that is already protected in one form or another. It may not be well protected, but at least it's declared as a protected area. Sixty percent is still unprotected. In certain places like the Philippines or New Caledonia, that 60% actually has at least as much and sometimes more biodiversity in it than the 40% that is protected. It is a challenge to ensure that the missing 60% also gets protected or at least the most important parts of it. One of the first things to do is ensure that existing parks are maintained, upgraded, and managed as effectively as possible. This is one of the easier jobs that we have ahead of us. One example of a very important park of this kind is the Odzalla National Park in Congo.

Another key issue, especially for the hot spots which are very fragmented (existing as islands in oceans of degraded land), may be that over the medium to long term they have questionable ecological and genetic integrity. We need to take these fragments, as important as they are right now, and link them to the broader landscapes through whatever means possible. This is the concept of conservation corridors and is a topic of discussion right now in the conservation community. Conservation International is trying to implement conservation corridors in the key areas. In the central part of the Atlantic Forest Region of Brazil there are possibilities to link many protected areas of various kinds including, state, federal, and private land. We need to determine how to link them in broader landscapes so they have long term ecological and genetic integrity.

Another key issue is that of creating new protected areas in big wilderness blocks. This is easier and cheaper than in the hot spots because much of this land is still in the hands of governments. It is not highly valued by the countries. Very significant areas can be set aside for relatively very little money. Surinam is a good example of this. Surinam is a small country in northeastern South America,

which used to be called Dutch Guinea. It has the highest percentage of rain forest cover of any country left on Earth. Ninety percent of the country is still in forest. In 1988 and 1999, responding to threats from Malaysian and Indonesian logging companies that were moving in, Conservation International made an offer to the Surinam government of \$1 million to set aside an area linking three of the most important protected areas in the interior. This land covered an area of 1.6 million hectares or 4 million acres; an area almost the size of the State of New Jersey. This was accomplished with \$1 million of private money and has since been leveraged into an \$18 million trust fund. This is an extremely pristine area containing eight monkey species. These kinds of opportunities exist in many parts of the world. There are about 20 deals like this in progress in tropical areas; some cost more than Surinam, some cost less. There are many opportunities like this in big wilderness blocks and the opportunity costs are extremely low at this point in time (pennies or dollars per acre).

Now what is the role of zoos and aquariums in conservation? One example is their role in the bushmeat crisis. The Bushmeat Crisis Task Force was put together to look at this problem. This initiative was created by the American Zoo Association (AZA) and led by Mike Hutchins. This is not an easy problem to solve and in fact is one of the most difficult problems that conservation will face in the next few years. One of the potential pressure points is looking at how one can impact logging companies that are opening up many new areas and are doing nothing about bushmeat hunting in their concessions. In fact they are stimulating it because they don't have to pay their workers as much if they let them hunt.

More research on primates is needed, because of the information it will provide for us, as well as to establish a research presence. A research presence in a given protected area is one of the most powerful forces for conservation. We also need to demonstrate how much income foreign researchers coming into a country provide to the country. This is being done for the field sites. We're doing that with Pat Wright from Stonybrook and Karen Strier who is working on the muriqui in Brazil. There is a study underway looking at the income that came into Madagascar over the past decade through Pat Wright's lemur studies. In some of the more visited countries this can be a very significant foreign exchange earner. It will only work as a conservation bargaining tool with governments if it can be demonstrated what revenues are generated.

Another initiative underway is the issue of heightening public awareness and using primates as flagships for their own intrinsic interest and as symbols for tropical forest conservation. This is a topic in which zoos have played a very significant role and which they will continue. Since zoos have huge visitation coming into their facilities, they are well-positioned to do awareness building. The public visitation factor gets people excited about animals and about the habitats they occupy, and demonstrates their value.

Ecotourism is another method to generate income for range countries. Not everyone is thrilled with ecotourism but it's hard to find a better income generating alternative in most of these regions, especially if it's done properly. Many of these countries have huge untapped ecotourism potential. Places like Madagascar are not even generating 5% of their potential tourism revenues. In the Odzalla National Park (Congo), one can see gorillas out in open areas or bays as if they were cattle on a New England pasture, which is truly amazing observation conditions. This is an animal that a few years ago was considered almost impossible to view in the wild. Another aspect of promoting ecotourism could be the idea of stimulating life listing for primates. In the 1930s, Roger Conant made it possible for this explosion of bird watching with his first field guide to Ameri-

can birds. Having the best possible field guides available for primates in some key areas would help promote primate watching. Jatna Supriatna is just finishing a field guide to Indonesian primates in Bahasa, Indonesia. Production of field guides for primates should be able to stimulate a great movement of primate watching and ecotourism.

Captive breeding of certain primate species can play an important adjunct, although zoos should play a significant role in efforts to conserve these animals in the wild. No one will be able to keep all of the critically endangered and endangered primates in captivity. For certain selected species it is possible that captive breeding will play some role as it has for the lion tamarins in Brazil and the lemurs at the Duke Primate Center, Jersey Wildlife Preservation Trust and others.

A great deal of emphasis has been placed by the Primate Specialist Group on the need to establish and maintain networks of primate conservation professionals. This has been accomplished through a series of different primate conservation publications. These newsletters include *Asia* (Ardith Eudy, editor), the *Neotropics* (Anthony Rylands, editor), *Africa* (Tom Butinski, editor), and *Lemur News* (Jörg V. Ganzhorn, editor).

The bottom line is that these conservation initiatives cost money. This is the most critical issue in primate conservation. This is a field where we have the man and womanpower and the technical expertise that is needed. We can identify the key areas for primate conservation, however there need to be major increases in funding. Realistically it needs to increase perhaps two orders of magnitude especially in resources brought to bear on the key areas for primates in the next decade but hopefully in the next five years. Zoological institutions can play a key role in all of this if they're not already. Wildlife Conservation Society, World Wildlife Fund, Jersey (now the Durrell Wildlife Preservation Trust), and the IUCN Conservation Breeding Specialist Group are a few examples. The Columbus Zoo, which is not one of the biggest zoos in the country, has done a tremendous job of focusing efforts in the field and this is a very fine example of what can be done by virtually every zoo in the country.

Presently, there are new partners emerging in biodiversity conservation, including the World Bank and its Global Environment Facility. There are also multi-lateral development banks like the Inter-American Development Bank. Other bilateral aid agencies (such as the European Union) won't focus on primate conservation per se, but will work in some of these areas that are key for maintaining primate diversity in the future.

The big opportunity for fund raising is the private sector. There's a great deal of disposable income in the United States with a strong stock market. In order to achieve our conservation goals we have to be very good at setting priorities and knowing how to use limited resources to be the most effective. How do we capture donors and ask them to offer the resources that we need? Conservation International has been successful to some extent with this. They have launched a \$200 million campaign to save the hot spots and have identified some flagship species that have contributed to this. Harrison Ford is a member of their Board of Directors and has made a \$5 million challenge grant as part of this campaign. This is just tip of the iceberg; there's more disposable income out there. We need to determine how to bring it to bear on the issues that we are most concerned about.

The Tropic Wilderness Protection Fund (which was based on the Surinam example) was started out as a \$5 million fund that has enabled the seeding of about 20 different deals. This includes the Surinam project, all the way around the tropical world to Cardamon

Mountains (in the former Khmer Rouge area in Cambodia), to parts of the Amazon and parts of Central Africa. The land is not purchased, but established as a capital fund venture for land set aside. We can develop with governments different mechanism to set aside large areas across the wilderness blocks that still exist and in some of these key hot spots.

The Margot Marsh Biodiversity Foundation is a dedicated fund for primate conservation, giving out about half a million dollars a year for very focused primate conservation activities with no bureaucracy. Bringing money to bear on these problems without having it burdened by layers of bureaucracy makes it more effective.

The issue of the moral high ground is very important. It's essential that we develop a value system that values life on Earth as much as we value the creations of our own species. How do we get society to embrace more fully the importance of other life forms? If

someone went out and burned down the Louvre in Paris, the Metropolitan Museum in New York, blew up the pyramids or the Taj Mahal, everybody would be horrified. It would be front page news for weeks or months. However, every time a piece of forest in Madagascar, the Atlantic Forest of Brazil or Indonesia gets burned to the ground, at least as much is lost, but nobody pays attention and it happens just about every day. How do we, through our institutions and through our personal interactions, get people to widen their value system a little bit without changing it completely? That's going to be difficult. Attitudes need to be changed in small increments so that others share our strong beliefs that other life forms, especially primates, have an intrinsic right to exist and are a very special part of our planet. If we can be successful in this then I see no reason why we shouldn't be successful in turning our conservation dreams into conservation reality.