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is a small, minor crime, the cost is very high. The bail bond is very high, and for an indigenous leader it is very hard to pay the fine. Therefore they stay imprisoned until the communities in many cases form a cooperative to raise enough to pay the fine and have them released. But often these fines multiply, making it very difficult for the communities to economically support one of their leaders who has been fined for minor crimes.

Another obstacle we face is the recruitment of leaders. The responsibility of the press for violating human rights continues in full force in Guatemala, in complicity with the state. One sees how they capture the loyalty of the community leaders with trips and handouts. For us this is an obstacle that can ultimately mean that the communities' struggles are stopped short. We have also faced aggression aimed at male and female leaders. We hope that in the future this will no longer be an obstacle, so we can exercise our rights freely. Thank you very much.

Translated from Spanish by Gabriela Berinstein

PHILIP FEARNSIDE



I'm Philip Fearnside, from the National Institute for Research in the Amazon in Manaus. Before I start, just let me point out this website [<http://philip.inpa.gov.br>], where you can find much more information about everything I'll talk about today, plus a lot of other controversies—

hydroelectric dams and so forth. So, highly recommended.

As Marina Silva last night and Barbara Bramble said very well, Chico Mendes was unique in the way he was able to reach out to different groups to put together the coalition that he had. And one of those groups was the scientific community. I had the honor of having a certain role in that. It's very important, because part of the argument for creating extractive reserves and defending the people who are defending the forest is exactly the environmental services. The forest provides something very valuable, and that is the extra value that has made that particular movement so successful.

There are many, many groups in the world, there are social struggles and environmental struggles where human rights are being trampled, and so forth. But what's different about seringueiros [rubber tappers] in Brazil is that they are defending the Amazon forest. The Amazon forest has a tremendous value for Brazil and for the world. So that adds an additional interest, and that's why so much effort has gone in from all these various groups, internationally and from different parts of the Brazilian government, to expand extractive reserves and so forth. It's very important to understand some of this part of the story.

I was with Chico Mendes on various occasions. The last time was just nine days before he was killed, and the

danger was really palpable. He had two guards with him at all times, but that wasn't going to stop him from doing what he was doing. I think it's very important to maintain his legacy, because there's a tendency to reinterpret in various ways that have been mentioned here. I would just point out that at the end of last year, at a meeting of the Brazilian branch of the International Society of Environmental Economics, of which I'm one of the founders, there was an economist from the World Bank who was asking me, "Isn't it true that Chico Mendes was just a labor leader who was trying to get more money for his constituents, not really worried about the environment?" Of course, I was able to testify otherwise, but it's very important what has been brought up by Marina and also by Barbara, that he had all of these different aspects. He was indeed defending labor rights, but he also was a genuine environmentalist. I think it's important to make that clear.

Environmental services is an idea that I've been pushing since early 1985, coincidentally just a few months before the National Council of Rubber Tappers was formed and the proposal for extractive reserves. This is the idea that natural ecosystems like the Amazon forest have roles in maintaining climate stability, maintaining biodiversity and so forth. These have a tremendous value; the problem is that no one is paying for them. But they're worth much more than what you get by destroying the forest, selling the timber and planting pasture. There's no mechanism to transform that service that they're providing into a financial flow that can sustain the population and compete with all those other uses of the land. And basically, all the economy in Amazonia is based on destroying the forest: sell the timber, plant cattle, pasture and so forth. What should be happening is to have the system based on its major value in maintaining the environmental services.

From 1992, that turned into a proposal as an alternative basis for the economy. There are some tiny steps that have happened since then, but certainly the other side is way ahead. I'm responsible for the National Institute for Science and Technology of the Environmental Services of Amazonia, which is really just a big project, but the Ministry of the Environment has this name for it. And there's a lot more information on the website here.

First of all, this is a map of tropical forests that were still standing in 1990. Today it's a little bit smaller, but still you get the idea that Amazonia is way ahead of any other part of the world in terms of tropical forest. The Atlantic Forest in Brazil doesn't even show up on the map at this scale, much less what's in Central America and other places. Anyway, this has various roles. You have the tremendous stock of biodiversity in Amazonia. To maintain that is an environmental service. But also this has a role in climate stability that is much greater than in other places, because of it having such a large area, and the forest is still there. It's

very important in water cycling that is essential for rainfall, not only in the Amazon but also in the rest of Brazil and neighboring countries. And it also has a tremendous stock of carbon that is important in avoiding global warming, in two different ways. One, in reducing the emission every year of greenhouse gases. And the other thing is the huge stock that's there that could be released, either from deliberately cutting down the forest or from climate change, killing the forest. So these are important things to avoid.

Now let me just explain the water role of the forest. This is something that's very important for Brazil. This is an experiment that's responsible for various parts of the Amazon. This is in Rondônia. We also studied in Amazonas and Roraima and Pará, a series of plots like this, in a cleaned cattle pasture, a plot that's 10 meters long and 2 meters wide. It has a trough at the bottom of the hill, and the water runs down the hill when it rains, goes into the trough and into a pipe like that. It takes four of those 200-liter barrels just to receive the water from that plot, just so it doesn't overflow, to study soil erosion here. And in the forest usually one barrel is enough to catch the water from that kind of plot. Usually it's just a bucket like that, hanging inside the barrel. It's very obvious that there's much more water, much more than 10 times as much water runs over the surface in the cattle pasture as compared to the forest. So what's happening there?

If it's in the forest it hasn't gone into the barrel and so is sinking into the soil, where it's sucked up by the roots of the trees, and then it's returned to the air through the stomates, the little holes in the back of the leaf. That adds up to a tremendous amount of water. If it falls on the pasture, it goes into the streams and then into the Amazon River and out into the Atlantic Ocean.

Just to give an idea of how much water is involved, this is the meeting of the waters in Manaus that is several kilometers wide. It's about 60 meters deep. The current is enough that you can't swim against the current. There's a tremendous amount of water. That's 3.8 trillion cubic meters per year that passes this point. Just to give you a point of reference, if you look at the water balance for the Amazon Basin, the winds in the Amazon blow from East to West. So they're bringing water that's evaporated from the Atlantic Ocean into the Amazon Basin. And they're estimated bringing 10 trillion cubic meters of water per year. Now what goes out the mouth of the Amazon is 6.6 trillion cubic meters. So it's about twice what you saw in the meeting of the waters there.

What falls as rainfall is 15 million, about half as much as what came in. That means the water's falling more than once as rain. The evapo-transpiration that's come out through the trees is 8.4 trillion cubic meters, and if you turn the Amazon into a giant cattle pasture, that won't be there. Now the difference between 6.6 and 10 is 3.4 trillion cubic

meters that has to be going somewhere else if it's not going out the Amazon River. That's almost as much as you saw in the meeting of the waters there near Manaus. So that amount is going someplace else. Here's a simulation by Wagner Correia that shows that half of the water that comes in from the Atlantic makes a turn to the South. So that's a tremendous amount of water that is making this route to other parts.

There have been advances in the mapping of the winds coming in from the Northeast, the evapo-transpiration from the forest. Then the wind can't get over the Andes, so it turns to the South. Then it hits the coastal mountains in the state of Minas Gerais, for example, in Brazil and falls as rainfall. So that is the backbone of Brazil's energy system. It goes out rivers on both sides, through the São Francisco River to Northeastern Brazil, or through the other side to the Rio Paraná and La Plata and goes out in Buenos Aires, ending in Itaipu in Brazil.

You have a series of hydroelectric dams on those rivers that are the main source of electricity in Brazil and also supply water for the big cities. We are really on the edge of that water supply. As you can see right now, there's a tremendous drought in Brazil, and the reservoirs are all practically empty, including the ones that supply water to São Paulo. And it's the end of the rainy season. So that means that they're not going to fill up unless there's some very unusual rain. If they don't fill up during the rainy season, they aren't going to fill up during the rest of the year, because you're always using more water than is coming in.

This depends very much on the time of year. If it's June, July, and August, only the very southern part of the Amazon has the wind making this turn to the South, and the rest is leaking over the Andes in Colombia, where the mountains are lower. These black areas are more than 700 meters in altitude. If it's December, January, and February—that's rainy season in southern Brazil—all of the wind is making this turn, and about 70 percent of the water is coming from the Amazon. So if you turn the Amazon into a giant cattle pasture, where you don't have that water being transported, it's a tremendous loss that no one's paying for.

Let's talk about global warming. When the forest is burned or when trees rot if they aren't burned, half of the dry weight of those trees is carbon. It will become carbon dioxide or methane or other greenhouse gases. And when it's converted into a cattle pasture, you can see there's much less biomass there. The difference has gone into the atmosphere, in one form or another, as greenhouse gases.

This is deforestation in Mato Grosso. Two tractors here are pulling a chain. That's forest being cleared, not cerrado [savannah]. It's very important because there's a tremendous myth that there's no deforestation for soybeans, that it's only planted in old cattle pastures. Actually you can see this happening, this is in the municipality of Santa Carmen,

which is always on the black list of IBAMA [Brazilian Institute for the Environment and Renewable Natural Resources]. In this municipality this is what happens in the preparation for soybeans. Obviously, biodiversity is practically zero, and the carbon stock is also practically zero.

We've been talking about this for years, about how cattle are being pushed into the Amazon by the soybeans, and finally this group from Imazon in Belém showed statistically—anyway, these red points—the soybeans are pushing the cattle that can be shown statistically to be very significant.

Now in terms of the impact on global warming, this is our current map of biomass—[courtesy of] Helen Ergueiro, who works with my group in INPA—not only the forest but also the savannahs and other kinds of vegetation with new estimates for how much biomass there is. This is directly proportionate to the impact when you clear it. It's a tremendous amount of carbon. The peak of deforestation in 2004 was 472 million tons of carbon—not CO₂ but carbon—here. And the last year, with much less deforestation, it was still almost 100. Those who follow these numbers, these are astronomical numbers. All of Brazil's fossil fuels are approximately 100 million tons of carbon.

Now, understanding what can be done about this—there are various problems we're looking at. This is a famous map by Bertaldo Mendes Filho of the University of Minas Gerais, projecting deforestation out to 2050. If you look at the first of the projects, the red patches, reducing emissions, deforestation and degradation, which is the Juma Reserve in the state of Amazonas, there are some problems. What was used was this: just cutting out of that map from Bertaldo's simulation of how much deforestation would take place in the reserve, you see practically the whole reserve is deforested. Now simulation by our group . . . shows much less deforestation. It's very important to understand why. But if you keep going for another 50 years, you get just about as much deforestation. It's a matter of time, but there's an important difference there.

What's happened—this is from Bertaldo's simulation. He divided up the Amazon, including the other Amazonian countries, into 49 sub-regions. One of them, number 27, is huge. It includes all the state of Amazonas, part of Pará, and part of Mato Grosso. And of course this Juma reserve is in there. So going back to that map, you see there's this huge area of forest, and all the deforestation is down in this corner. So when you calculate how much deforestation is going to take place, it's a percentage of the forest that's there, which is multiplied by this huge area. And then you want to know where that takes place, it takes place near previous deforestation. There are highways, which are all down in this corner, so all of it gets thrown into one corner, on top of these reserves, which is why it's so high. There are more details in this paper you can get from the website.

Here's another example: the Surui carbon forest project

in Rondônia—very little deforestation inside the reserve so far, with a tremendous amount on the outside. Using Bertaldo's simulation, there's little deforestation but it does make a significant difference to have this project. Here's more information on that.

This question of REDD is very controversial, everything from thinking it's a savior to saving the forest to tremendous moral sin. Look at the website for discussion and debate.

Now on the national scene, the federal government wants to reduce deforestation by 72 percent. That's Brazil's national climate plan being launched. The plan exists, deforestation would go down, and you get credit for this decrease. What has happened is this: Deforestation has decreased, and it's been for various reasons. One is the control program mentioned by Marina Silva last night, but there are other things involved. Between 2004 and 2008, you had various things at the same time. You had the price of beef going down, you had the price of soybeans going down, parallel with the deforestation.

Also the exchange rate was changing, so it was becoming less and less favorable for exporting these things. This study shows that you can explain practically all the decrease through 2008 by the decline of the commodity prices, but after that deforestation kept going down and the commodity prices went back up.

Something happened. The main thing was this: the Central Bank resolution that links financing to having a clean slate with IBAMA. This is something that has real teeth that isn't something you can appeal over and over, like the fines they get. Unfortunately, the ruralists, this big lobbying group from the landowners and agribusiness, is working to repeal that. The unfortunate thing is that, as was shown in 2011, by the vote on the Forest Code, they are in control. This is something that went on for decades, this debate, but they have gained control. This has been shown by the vote, which is a vote ratio of 7 to 1 against the environment, 7 votes against the environment for every 1 in favor, even though 85 percent of the Brazilian population lives in cities and has no direct financial stake in being allowed to deforest more. Also, public opinion polls show . . . 85 percent against any reform.

Now the power has shifted to places like Mato Grosso, away from labor unions and industrialists around São Paulo and so forth. This is tremendously important. China is a major influence. This study shows that exports to China, soybeans and cattle and so forth, [are] very statistically significant influence[s] on deforestation in Mato Grosso. You can get this off the website. This affects all sorts of social issues in Brazil, in addition to the environment, but it directly affects indigenous peoples and forest peoples in general. Now the other aspect, in addition to the gain in the ruralists, is the infrastructure—these black areas are the last year's deforestation, and especially this area that's

not deforested would be opened up by the BR319 highway that would link Rondônia to Manaus. So this is the controversy that is at the center of a lot of that.

So just let me end here by reminding you that it's the environmental services of the forest that can be the key factor in changing this scenario. There's a lot more information on the website. Thank you.

BARBARA ZIMMERMAN



Phil gave you a lot of background, so I would like to point out—I believe I'm correct in saying that most of my colleagues, biologists, tropical biologists, tropical ecologists, conservationists, believe that the future of the Amazon forest lies mostly in the hands of the indigenous peoples and other traditional people, such as the descendants of rubber tappers and extractivists' reserves.

This satellite shot really dramatically illustrates the phenomenon or the fact that indigenous territories in the Brazilian Amazon are serving as large, or very large in many cases, protected areas and barriers against the forces of deforestation. This satellite shot here was taken in July 2004, and the big block of green is an indigenous territory that belongs mostly to the Kayapó indigenous people that I've worked with for many years.

You can see the white plumes of smoke. This was in the dry season of July, of ranchers burning off remnant bits of primary forest. But you'll notice from their shot the intactness of Kayapó land, the intactness of their forest, and the fact that virtually everything outside of their land was just light brown. It's been deforested for ranching and, more to the South, for soybeans. This is a real phenomenon, and fairly well documented now in the Brazilian Amazon is how these indigenous areas and indigenous peoples present this barrier to deforestation, which has become very apparent to the conservation community. We as conservationists had better work toward empowering this process, whatever it might be, because it seems to be where large-scale conservation is going to happen.

The Kayapó are a particularly striking example because of the size of their area, the size of Kayapó land, which is officially demarcated, officially ratified. Indigenous peoples gained their land rights in the Brazilian Constitution of 1988, in which the Kayapó people did play a big part, by the way. But these official lands of the Kayapó, 50 percent of the world's countries are smaller than this Kayapó area, which measures about 11 million hectares or 110,000 square kilometers. So certainly from a conservationist point of view, from a forest conservation point of view, they're a very significant-sized area, large enough to conserve populations of virtually all of the Amazonian endangered

species, populations of tree species which do require very large areas to protect this population. And it's very apparent from the satellite shot, I think, that if the Kayapó had not been there this area would be gone.

The work started in the 1990s. We began to be able to work with all the Kayapó, at their request, around 2000. By "we" I mean environmental NGOs; I work for one but others are involved. What we have done is really forge an alliance with the Kayapó, to help them navigate our outside capitalist culture in the twenty-first century and to help empower them to continue to protect their land in the twenty-first century. In the Amazon frontier the pressure, the threats are intense. I may be talking about the Kayapó as a particularly striking example because of the size and the fact that [their reserve is] embedded right in the middle of the burning zone of the southeastern Amazon.

Although these areas are allotted to the Indians under the law, they're not protected in practice. This area of the southeastern Amazon where the Kayapó are located is lawless. I don't think that there's anything that has changed since Chico Mendes was assassinated. It's the same scene as back then. The ranchers and the loggers and the gold miners run things according to the way they want to run things. Assassination is still commonplace. It's dangerous to stand up to these people, although nobody messes with the Kayapó, because if you mess with the Kayapó there will be retaliation. They do command this respect, but they do need other types of support in the twenty-first century—to help them with surveillance of at least 2,000 kilometers of border; to help them with developing sustainable economic, non-timber alternatives within their communities, so that they can earn their own cash to buy the things that they want and have come to depend on and need from the outside society.

Third, and just as important as the other two, is to help them set up and administer their own associations, their own NGOs that can obtain, administer and implement outside support for this capacity building. I do think that the conservationist community is working with the Kayapó.

I was just going to end by saying that I do think that the alliance with the conservation organizations is quite successful, because these borders are still holding within this lawless frontier. There's immense pressure to access the timber, access the gold on Kayapó land. I do think a big role that the NGOs play with the Kayapó is to help them navigate, understand our culture. That's done mostly through their own NGOs. I say NGOs because their territory is so large that they can't really operate out of just one geographically, so there's one located in the northwest, one located on the east of their territory and one in the southwest. These are the NGOs that receive the outside support for these surveillance and development programs. But they also have become poles of organization that the Kayapó