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Introduction:

As we convert ecosystems to our uses other plants and animals either adapt to the new conditions, or move to another area. Failing that, they die. Over exploitation of natural resources, be they fish or trees, is comparatively easy to deal with. Habitat loss for non human species is relentless, diffuse, and proving difficult to stop. The scale of what we are letting slip away was recognized 100 years ago by non other than a conservative Republican president, Theodore Roosevelt.

Scientists who engage in the politics of conservation have to resolve a professional conflict. Scientists are trained to be objective, to guard against their own preconceptions and let the facts fall into place. Once a scientist crosses the line to become an advocate, even if it's for a modicum of restraint, their objectivity is open to question. However, the attitude that scientists must remain above the fray or else compromise their objectivity is in our opinion a false dichotomy. Scientists must of course strive for objectivity when they do science. That does not excuse them from our common obligation as caretakers of our natural heritage to work in politics on behalf of endangered species and conservation in general.

We spoke with John Stinchcombe about how science is being applied on behalf of endangered species. Using information from a review of 136 recovery plans he and his co-authors evaluated the flow of scientific information to the people who write and implement recovery plans; for example, how advances in genetics are being applied to real world conservation problems.

ER: Dr. Stinchcombe, what is your training?

JS: I received a Bachelor of Arts degree in biology at Bucknell University. I had a broad background in biology as well as the social sciences and humanities. My Ph.D. training at Duke University was not as a conservation biologist, but as an evolutionary biologist/ecologist. I'm interested in how the relationships between plants and animals evolve.

ER: Co-evolution?

JS: That's right. Most of my dissertation work explored co-evolution between plants and the animals that eat them. But conservation biology remained an interest both for personal reasons and having some connection to organisms, and for ethical reasons: I feel we should be trying to save species and protect biodiversity. I also felt like the graduate training in biology with the math and statistics and a broad background offered a lot of tools to make some contributions other than doing pure science.

ER: You're at Brown now?

JS: Yes. I finished my degree at Duke in 2001, and since then I've been a postdoctoral research associate at Brown University. My research here is on the evolution of life history traits in plants; for instance, the timing of reproduction, growth trajectories, and things of that sort.

ER: How did you become interested in recovery plans?

JS: As far as this paper is concerned, I originally got involved in the data collection of a big project on reviewing recovery plans as part of a graduate seminar I took at Duke University. A group of scientists designed a questionnaire to extract as much information as possible out of a large sample of recovery plans. Then they sent the

plans and the questionnaires to a variety of graduate seminars where we all went through the plans with a fine-tooth comb to record data on the plans in a systematic way.

ER: There were students here at the University of Washington involved in that project.

JS: Right. I was one of the original data takers for our group, reading a plan and recording the basic biology: what taxa the species was, where it was, what are the major threats to it, and so on. Once these data were compiled from all these different graduate seminars— there were probably over 300 graduate students working on this nationwide — we realized we could we use these data to ask some general questions. It struck us that there's all this scientific literature that's being generated, wouldn't it be good to see if the findings of this literature are influencing or directly being put into how species are managed?

ER: I would assume from the language of the Endangered Species Act that it would be.

JS: We didn't go in assuming that there was either a connection or a disconnect between the academic science and the recovery work. From reading the plans we recognized that a recovery plan is a practical working document, a public planning document; that is different from what you read in the scientific literature. We decided that rather than assuming that there is a direct flow of information, we would figure out what we could measure and let the data tell us what the flow of information is.

ER: Did your 136 plans concentrate on any species?

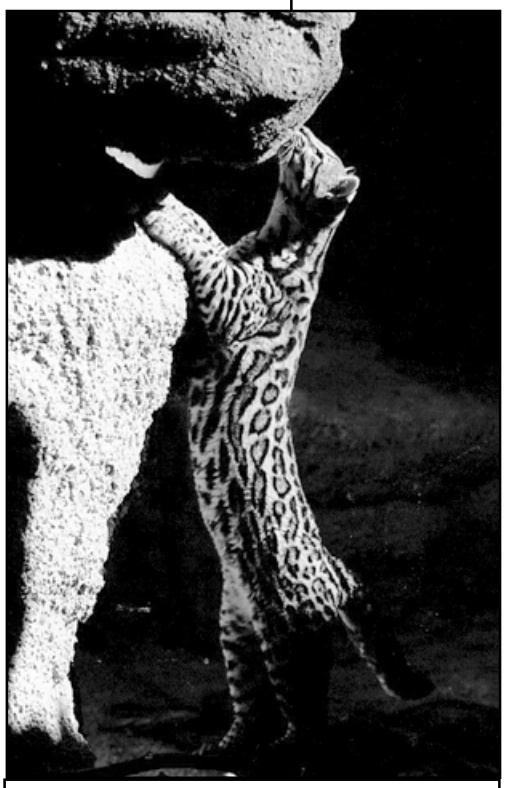
JS: The database has a variety of plant, vertebrate, and invertebrate groups, which we looked at to get a broad, sample of what the endangered species are in this country and what the recovery plans are like.

ER: How well do recovery plans reflect endangered populations? The naïve reader might think every endangered species has a recovery plan.

JS: It is mandated that every endangered species will have some form of recovery plan eventually. I do know there is a substantial lag and that there are numerous species that are still waiting for their plans to be written.

We acknowledged in our paper that not all the topics we wanted to investigate would necessarily apply equally well to every species. But the benefit of working with this large a database is that it lets you get a sense of the trends for the species that are in this sample. If you have a broad sample of plants, fish, mammals, birds, it allows you to make some general inferences about the average endangered species.

ER: What is a Population Viability Analysis. Where does that idea come from?



The ocelot was once common in North America. It is now very rare and listed as endangered throughout its range.

JS: A PVA takes information about the number of individuals of a species, their age, the reproductive rates, the mortality rates, and try to arrive at a quantitative projection of how viable that population is. Is it going up or down? If the population has a certain number of individuals that are reproducing and dying at a certain rate, what's the probability that this population will still be here or at some desired number in fifty or 100 years?

ER: This sounds like the actuarial tables that insurance companies use to calculate their life insurance payouts.

JS: It's not all that dissimilar, with the

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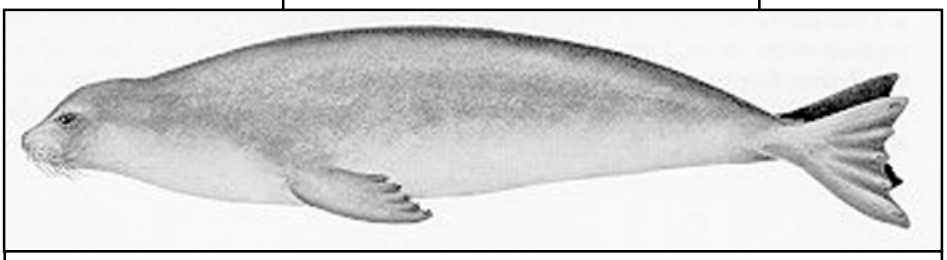
unfortunate caveat that we always have much less information to work with in endangered species. PVA has become a robust field in conservation biology and I'm by no means an expert on it, but the input for a PVA is some of the basic demographic features of organisms — how many of them are there, how their survival and reproductive probabilities change over the age of the organisms. From that basic information it's possible to arrive at some mathematical projections about how they'll do.

The development of PVAs has become a useful tool for managers. For instance, if we were forced by budget constraints to place a priority on saving young individuals versus older, or non-reproductive individuals, how would that affect the viability of this population? And because a PVA is a quantitative set of estimates, you can model alternative management scenarios.

People did this for an endangered shrub in North Carolina that was under a degree of threat from not being burned and also some threat from trampling that kills young individuals. They used modeling to look at different conservation scenarios. If we were to return fire to the landscape, how would that change the long-term persistence of this species? If we were to protect the seedlings from trampling, how would that work itself out? If we could only do one, which of these might be a better option to pursue?

ER: When did PVAs start percolating into the field from academia? I didn't hear about it until the 1990s.

JS: I believe PVA got its start in the eighties and has been gradually building momentum. In the academic literature it's been going strong for some time. It's been a major topic, and I think it undoubtedly will remain so, and it seems like it's gradually sinking in to the recovery planning process, but it's still pretty rare in recovery plans. Some other work we've done suggests that PVA is called for in less than half the plans that have been approved since 1991. PVA hasn't quite gotten to the point where it can be readily and widely applied.



The Caribbean monk seal was probably extinct before it was listed as an endangered species.

I think it can sound intimidating, but there are a variety of software packages and routines that one can do to do a PVA and make it user friendly. More important, a lot of the raw data that goes into a PVA is basic demographic information that you might want to know anyway.

ER: Number of young, age at reproduction, death rates, that sort of thing.

JS: Right. One thing with PVAs is that the data you need to use are not easy to get for many of these species, especially if it's rare, which often happens once it's endangered. At the same time, once you get that information it can serve a dual purpose in that you can do some PVA, but also you can use those data for more traditional, less quantitative monitoring.

ER: What about conservation genetics?

JS: Conservation genetics uses genetic data to figure out aspects of an organism's population biology. For instance, it can tell you the effective population size, which is going to be less than the overall population size because some individuals are going to be closely related. You can use conservation genetics to assess inbreeding depression and things like that. Basically, you sequence a stretch of DNA from a decent sample of organisms and you can then use the information to determine if all the samples are members of the same species or whether they are actuality members of another species, and so on.

ER: How is conservation genetics being applied in recovery plans?

JS: First of all, there's been debate about how much we should worry about genetic issues in species conservation. A classic example is the cheetah. There is low genetic diversity in cheetah because there are so few of them left. But some people have argued we shouldn't be so worried about the genetics of the cheetah, we should be more worried about some of the broad-scale ecological things, like preserving enough habitat for them, and trying to minimize human-caused mortality, things that might affect cheetahs before their population got small enough for the genetic issues to become relevant.

This is hotly debated, and it's probably a combination of both; that is, it's not either genetic problems or broad-scale problems of habitat and

ecological factors but it's a combination of the two. That's why we chose this topic to include in the publication because it's been something that there is not a firm consensus yet about how helpful or useful it is.

ER: It's being applied in salmon conservation in a big way.

JS: Salmon conservation is incredibly complicated. I'd be willing to bet that the majority of the data that we analyzed was not about using genetics to diagnose species units. Probably the majority of it was about things like inbreeding depression and genetic bottlenecks and things like that.

ER: What is a genetic bottleneck?

JS: A genetic bottleneck occurs when the population of a species is reduced to a small number of individuals. As individuals are lost, the population is losing the genetic diversity those individuals carried, the number of different variants of any given gene in the population is going down. If the population subsequently expands from this small group, the genetic diversity in this population is reduced, reflecting only the genetic variants of the survivors that manage to breed.

It's not that difficult to figure out how this applies to endangered species. Imagine a widespread species that becomes endangered and starts losing genetic diversity; then we intervene to try to save it and the population starts to expand, initially it could have less genetic diversity than before because it went through this bottleneck. One of the ways people try to address this, especially in captive breeding programs, is to pair individuals to breed in such a way as to maximize or spread out the remaining genetic variation.

ER: That's what they're doing with the condors. I would expect there to be a high degree of penetration for this from the literature into the recovery plans.

JS: This whole topic of genetics exploded in the academic literature in part because genetic data is becoming steadily easier to gather. There's an upsurge in plans that provided the information about genetics or stated that it would be useful to have genetics.

The number of plans that also assigned tasks and stated that this is something they wanted to do also increased. More of them after genetics became a real topic in the academic literature assigned tasks to get genetic information. We see that there is increasing awareness of this in that there is an increasing desire to assign management tasks to address genetic diversity.

Loss of habitat and human-caused mortality might affect cheetahs before their population gets small enough for the genetic issues to become relevant.

The area where it is somewhat inconsistent is what priorities should these management tasks be assigned. It's impossible to do everything full priority all the time, and we noticed less evidence that tasks relating to genetics became top priority.

ER: Here in your paper it says 73.5 percent compared to 54 percent before.

JS: That was probably before versus after 1995.

ER: Seventy-three percent, that's a majority of the plans.

JS: That shows that the awareness of this issue is increasing. One of our suggestions in our paper is that a valuable service for academic conservation biologists would be to try to arrive at some priority scheme. If you have a limited amount of money, should you invest that money in doing a population viability analysis or get detailed genetic information on a rare species?

ER: What are metapopulations?

JS: Metapopulations is an idea that's been known of in some form or another for quite awhile. At its simplest it's a population made up of subpopulations. The easy way to think about this is butterflies or caterpillars that eat only a specific plant. Within the context of an ecosystem or a broad expanse of land there might be many patches of this plant for the caterpillar. You could view each patch of plants as a subpopulation of these butterflies, and then any other patch that the adult could potentially fly to is another subpopulation. Collectively all of these subpopulations are a metapopulation.

The key insight gained from taking this perspective is that individual subpopulations might go extinct, but if individuals can migrate between patches, the metapopulation can persist even when subpopulations go extinct. Returning to the caterpillar-butterfly example, you could imagine a severe frost one year or a fire kills them all, but if there are other subpopulations within flying distance that patch can be recolonized.

ER: How is this applied to a recovery plan?

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In the coming months it will contain a complete archive of all back issues dating back to 1994.
The archive is searchable and available free to the public.

JS: If you know the number of subpopulations and the migration rate between them, and the turnover; that is, how frequently any one subpopulation might go extinct, you can start to figure out if this species will be able to be maintained or if these subpopulations are so separated that individuals will never get across to recolonize that area. That's how it would play out in an endangered species recovery plan.

One way to think about this is with forest birds. As the forest is logged, some birds are going to be avoiding flying through open habitat. So it's important to know how far apart you can space the remaining tracts of forest and still have migration and the potential for recolonization of different forest patches.

ER: That fits the spotted owl's life history. They get picked off by predators if they spend too much time out in the open.

JS: There's been some classic work on the spotted owl and migration in this context.

ER: Did references to metapopulations increase in recovery plans?

JS: There was an increase, but a lot of the plans had already called for collecting these sorts of data. That's probably because some of the early work on metapopulations started in the 1960s, so I think this is something that biologists and other people had become aware of before even the Endangered Species Act. I think this is one of those topics where you would be less likely to see a before and after difference because people were already aware of the importance of dispersal, fragmentation, and the spatial arrangement of populations.

ER: That was a more mature area of thinking, then?

We've found little use of corridors in our overall sample of recovery plans.

JS: I think so.

ER: What about corridors?

JS: The easiest explanation of corridors is that if you have two big patches of habitat and if you have species that are not going to cross a barrier between them, perhaps because the intervening habitat is not suitable for a plant species to grow, and so then you're going to get plant population A and plant population B that are separated by some distance. If there's no suitable habitat in between, they're stuck. If you can either acquire or buy land that would connect up all these populations in which there's suitable habitat, then there's a possibility of a corridor for movement of either individual animals or step-by-step movement of plants and other less mobile organisms through dispersal. The presence of these corridors should increase the potential migration between them.

We've found little use of corridors in our overall sample of plans. That's not to say they're not important components of conservation of some species, but in our sample we weren't able to detect much evidence of it.

ER: That probably speaks to the accuracy of your sampling methods because corridors are difficult both politically and logistically.

JS: I think that's right. You've interviewed Paul Beier about some of his big cat work. The political, logistic, and even financial complications of setting up corridors, especially for big animals like mountain lions, are daunting.

This is one of those concepts where there is not a clear consensus that pursuing conservation corridors is the best thing to do. This has been debated amongst the scientific community. One of the potential examples of why this may not be a good thing to do is if you have two populations and for some reason disease gets into one and they're connected, then that disease can spread through both of them; but if they're isolated, the second population might be insulated from the disease.

ER: The idea of connecting habitat has gotten a good head of steam here

among people working for forest conservation in the Northwest. There's quite a bit left of our high country here, not nearly enough, but people are liking this idea. It's appealing, not so much the scientific rationale behind it, but the idea of putting the pieces back together.

These concepts are melding together. Conservation genetics leads into metapopulations, which leads into the idea of wildlife corridors.

JS: They do all have some bearing on each other. It helps us sometimes to think of them separately, but in reality they're not occurring separately. Things about the population viability in terms of demography, those are going to affect the genetic characteristics of a species. The genetic characteristics of a species are going to be affected by how much migration there is between different subpopulations and how much genetic mixing there may be between isolated groups, and how much mixing there is in some ways going to depend on how connected the landscapes are with suitable habitat. They are all related.

ER: How can academics contribute more?

JS: I think academic biologists can make a two-fold contribution. One is to try to come up with some rules of thumb or guidelines about the priority of these different topics. That is given limited time, money, and energy, which of these issues is likely to be the most important to address? I think that would be helpful for people charged with managing species and trying to figure out what to do and when. You can't do everything for them all at once, especially if you're in a climate of limited funding.

Then the other thing I think the academic scientist can do is to serve on recovery teams and to lend their expertise and their love of biology for participating in the public process and trying to save species. I think there are benefits for all parties for doing this and that this is an end in itself that we should be pursuing and valuing.

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The Value of Tropical Forests to the People Who Live There

Introduction:

In an effort to slow deforestation in the Tropics conservationists have begun to document some of the non-timber economic values of forests. In a seminal paper Peters et al. argued "... that tropical forests are worth considerably more than has been previously assumed, and that the actual market benefits of timber are very small relative to the non wood sources."[1]

Ten years later Godoy et al. surveyed market prices in two villages in Honduras (Peters worked in Amazonian Peru) and came up with a value about one-tenth that of Peters[2]. These two numbers probably represent the upper and lower boundaries and what the actual non timber values are in any given place will depend upon local conditions.

The evolution of the argument about the relative values of timber versus non timber products is a good example of the give and take of science in action. The heat that has been generated by these arguments is a good indication that this is an important topic.

We spoke with Douglas Sheil about his attempts to involve local people in Indonesia in this debate.

ER: Doctor Sheil, what is your training?

DS: I trained in biology and forestry, and took my doctorate in forest ecology. The main emphasis of my recent work has been to look at conservation and the biodiversity of tropical forests trying to see where the views of local people have been presented within the debate. Many people are concerned about loss of biodiversity from tropical forests but for the most part it's a Western, developed-country voice. Where are the local views in that discussion? My point is that those local views can be quite constructive, quite helpful.

I'm Irish by nationality, but my undergraduate training was in Cam-

bridge in Britain. I did a Master's in forestry at Oxford, and after that I got some experience doing conservation survey work in Tanzania in East Africa. From that I moved to working for IUCN, *[The World Conservation Union. Ed.]* in East Africa. Then I did my doctorate based on the ecology of the forests in Uganda.

ER: How does one do a doctorate in tropical forestry? What did you do?

DS: People tend to look at forests as if they're unchanging, relatively stable entities and that the only things that make them change is people. In fact that's not true.

The opportunity I had was to look at some old plots that dated back to the 1930s where areas of rainforest had been measured and species had been identified. Those same sites were still being maintained and protected up until the 1990s, so I was able to go back and re-measure them and investigate the factors that were causing the forest to change, showing that the system was not as stable or static as many people had thought.

ER: After your doctorate what did you do?

DS: I worked as a consultant for a couple of years, but then I had an opportunity to work for CIFOR. That's where I'm based now. My previous boss in East Africa became the director of CIFOR, the Center for International Forestry Research based here in Bogor, on Java, in Indonesia. They recruited me as an ecologist to work with them.

ER: How long have you been in Indonesia?

DS: I've been working for CIFOR now for five years. Our main funders by the way, are ITTO (International Tropical Timber Organisation) and the European Union.

A major emphasis of my work has been looking at the extent to which we can use local people to help guide our conservation work. Whenever we're talking about conservation or choices relating to conservation we're generally talking about how to make choices, how to weigh various preferences, various values.

It seems to me that the views of many people have been neglected, particularly within Indonesia. Until President Suharto was forced to step down in 1998, Indonesia was under a relatively centralized, relatively non-democratic government for quite a long time. The people who live on the islands outside of Java have in many ways been ignored by the government in Indonesia. Areas of forest were given out as concessions to logging companies as areas on a map. Sitting in the capital city, Jakarta, people were drawing lines on maps, giving areas out to companies without regard to the people who lived in those areas. So those people who were living in the forest thinking that they owned the land around them suddenly found that the land no longer belonged to them; companies were moving in, logging around them. There's a lot of common interest between those local people and the people who have conservation interests there, the same problems, the same risks and threats.

These people (the Dayak) get almost everything they need for their livelihoods from the forest.

ER: You are working at the interface between science and human values.

DS: One of the challenges for me as an ecologist is that the kinds of choices that people are faced with are not purely scientific choices, they involve preferences, they involve value judgments. So how do I as an outsider know what is a preferable outcome? What are the choices that I'm trying to support or understand? In thinking about that — and I'm not an economist — I started to review these various papers on what methods economists had used to understand the value of tropical forests to the people who live in or close them, and what approaches they had used.

ER: What got you interested in the economic issues of forest conservation?

DS: What triggered my interest in writing the paper with Sven (my co-author) was when this recent paper by Godoy et al. came out saying that the value of forests to local people was quite low, at least if you measured it as a value per hectare.

I looked at that skeptically because that's not my experience in our work in Borneo, so I tried to see how they came up with something which wasn't consistent with my own experience. When Sven and I reworked the published data and looked at it as income per household rather than per hectare, we immediately got a different picture. These people were poor and we found that a very significant proportion of their income was coming from the forest.

ER: Godoy was responding to what they thought was wrong with Peters' work.

DS: There was this insistence in the early part of the 1990s that if we were thinking about how we could protect tropical forests against the land-clearing effects of local communities, any options that we looked at would have to recognize that the local people could extract a lot of value by harvesting various non-timber products from the forest. This view could be traced in large part to a previously published study by Peters and his colleagues.

Again, that didn't fit well with my own experience living in East Africa. In many of the communities that I was seeing the people were recent immigrants to the area; they didn't necessarily have much interest in the forest from a traditional point of view. They probably looked at the forest more as a source of potential land for cultivation rather than as a source of vital products or medicinal plants.

The Peters et al. paper was a groundbreaking and exciting paper, and I wouldn't want to give the impression that it was not. It definitely had good effects. I'm sure it woke people up to the fact that these forests could be important to local people.

ER: What were they trying to say?

DS: The main idea of their study was to take one hectare of forest in Amazonian Peru and show that if they looked at the quantities of fruiting trees and trees that produce latexes and other useful products, that people can collect these and they have value in markets, and the values that accrue year by year outweighed the timber value of the forest. So they were saying that from a local perspective it was much better to keep the forest standing because the potential values of these non timber products outweighed the value of the timber. It was saying don't look at forests in terms of timber, but look at all these other values they provide.



Indonesia consists of 17,000 islands straddling the Equator with a population of 240 million and a total land mass three times the size of Texas.

ER: Their agenda was to find some way to protect biological diversity.

DS: Exactly, and I think on that level of course it was a welcome contribution. It was published a couple of years before the Rio Summit, and there were a lot of people looking hard to find good arguments. I think many people then and still now think that conservation is best pursued with economic arguments and that you need to have dollar prices on things or decision makers won't listen.

The danger there is if you develop all your arguments based on a study like that and then people begin to realize the flaws and the doubts about it, what happens to your credibility?

ER: But the Peters paper changed the ground rules for tropical forestry almost immediatelly.

DS: The value of a study like that was that it did lay down a challenge that these non-timber values were high and hadn't been properly recognized previously. What I would have hoped for is perhaps a more honest recognition of the doubts. I think for scientists we all know we're supposed to doubt everything. We're supposed to question everything and be willing to look at all the sources of errors, the various assumptions and biases that come in. But I think when we present the message in a short, succinct, and clear way to decision makers we often neglect to do that.

That's where the danger comes because if we don't underline the assumptions, say if we generalize one hectare of forest in Peru to the entire world, that's not acceptable. We owe it to ourselves also to communicate more of the uncertainty associated with our conclusions.

With economics that definitely has

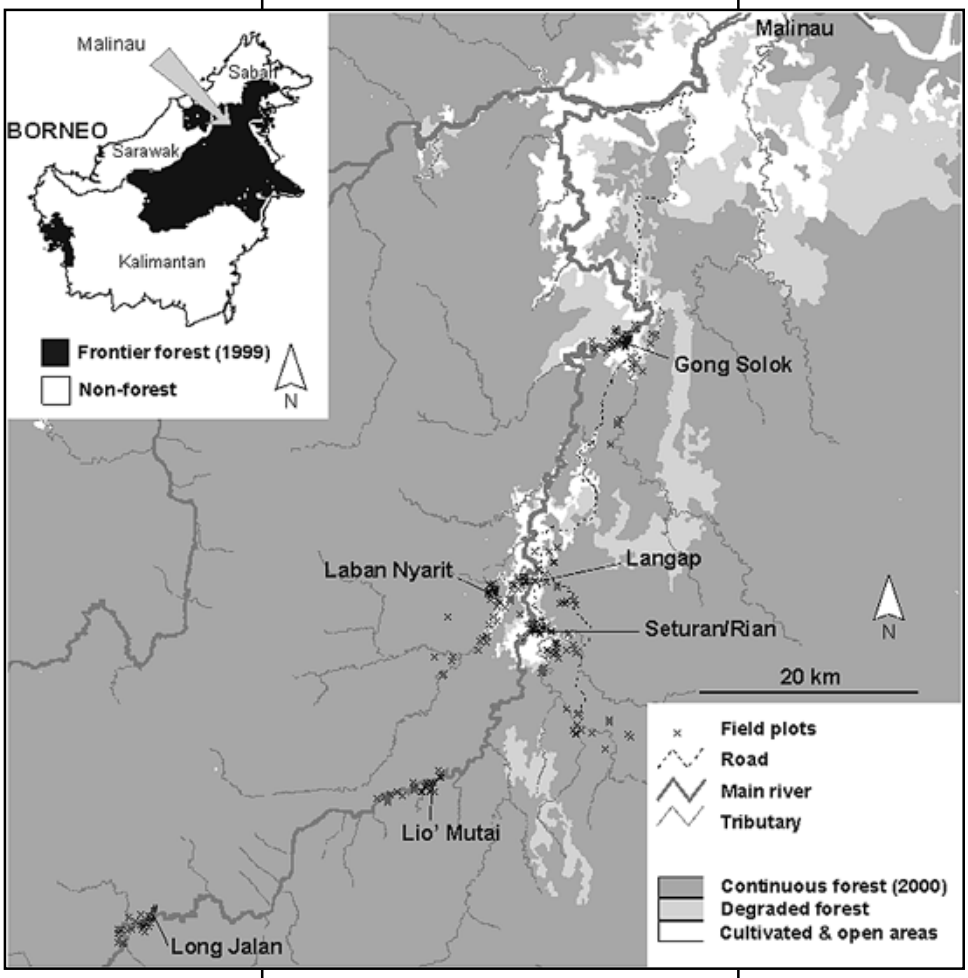
to be true, especially with something as complex as the economics of tropical forests: where you are and whom you're working with is hugely influential on the results. Even if it was a perfect study, we can't necessarily generalize results from one time and place to other times and places.

ER: That paper was done in Amazonian Peru. I would think the context is crucial in this kind of work.

DS: Exactly, it depends on many factors. Peter's et al's site in the Amazon, for example, was relatively close to the market so that had a big impact on the values they recorded because they didn't have to include high transport costs. They recorded the standing inventory, the standing number of fruit trees, and made a prediction of the amount of the fruit that's produced. In reality, when you're trying to harvest fruits, you don't manage to bring every single fruit you could harvest to the market. A lot of it is lost to wastage, either naturally within the forest or during transportation.

Another thing is in this region a lot of the fruit trees are either male or female. They're not all females; they're not all fruit-producing trees. That means that only about half the trees are producing fruit at best.

But even worse, the local people tend to harvest larger fruit trees by cutting them down, so this is not a particularly sustainable practice. If we were going to say that these are the fruit values of the forest and people were going to cut the fruit trees down, this is quite a significant caveat on the description of the fruit production. Finally it could also be questioned whether the actual abundance of fruit trees in that site were typical or not. I understand that they were not particularly typical.



To me – also on the economic side – what was a fundamental problem was that they were talking about value to local people without even asking local people. If these high values were there, why weren't there lots of fruit millionaires walking around? There are good reasons for that. You can't flood a limited market with fruit and expect the price to stay high.

ER: Wouldn't it make sense to make the people who benefit from this resource responsible for it?

DS: I think there are opportunities in that direction. There are specific opportunities in specific places which should take that kind of direction, where people have a long-term interest in maintaining the system as a productive system or as a forest. Those are the opportunities that we need to see, where we have these win-win opportunities for conservation and local people. We can't say that they're general everywhere, but I genuinely believe those opportunities exist.

ER: Do you think the Godoy paper was a useful counterbalance to the Peters paper, or did it overcompensate?

DS: The Godoy et al. study is in many ways a much better study. Of course,

they have the advantage of an entire decade of seeing the criticism of the Peters et al. study and others. Many of the papers Godoy himself has written previously have been good technical methods papers. Technically the study is of high quality compared with most others.

The lesson that they didn't learn — and I should make this a gentle criticism because it is a good study — is that the conclusions they drew from the study, to my mind, were not appropriate conclusions.

ER: What forests were they looking at?

DS: They were looking at two villages in the forest in Honduras. They came up with quite a low value per hectare, and I believe they're saying that this is closer to the general reality.

They show this low value per hectare, and then they come up with three conclusions saying that this low value per hectare might explain why people convert forest to other uses. But in their paper, as in the Peters et al. paper, they don't look at what the local people are doing. They don't discuss with local people why they do what they do. This is not based on any kind of research basis at all. It's speculation not a robust conclusion.

They also talk about how local people receive few forest benefits compared with outsiders. But as we show, if we switch the numbers around and we look at family's income from the forest, the income is relatively high and they seem to receive quite good forest benefits. The people depend upon the forest for their livelihood, so I think it's misleading to say local people don't receive benefits. It's their livelihood.

They also claim that the security values of the forest are low, yet they were only working there for only a year and a half and they may not have witnessed instances where people were short on food. So I was uncomfortable with those conclusions.

The technical side of the overall study, the values per hectare, etc., that's pretty good but the conclusions are, I think, misleading.



How do local people choose what sites are good for agriculture?

ER: You came up with different conlusions.

DS: That's using their data. We recalculated and showed that the actual income per household is relatively high.

ER: How does that compare to the earlier work by Peters?

DS: Peters et al. never presented anything in terms of household because they didn't even deal with people at all. In a sense we're seeing a swing from trying to look at values from the local people's perspective without even thinking about the people (in Peters et al.) to at least recognizing that there are people doing things in the forest and looking at what they extract (in Godoy et al.), so that's a major improvement. It's only in the Godoy et al. article where you start to be able to say what's the actual income per household because you've looked at individual people, so we don't have the comparable data from Peters et al. An additional step to take is to move beyond both studies and actually talk to the people who use the forest to see what values they themselves consider significant.

The kinds of sums per household we're talking about in the Godoy et al. study are between $1,000 and $2,000 per year. If we're concerned about poverty and poor people, this is quite a reasonable amount of money. If we're talking about dependency on the forest, this seems to be quite a significant economic benefit.

ER: As long as there aren't too many people trying to do this.

DS: That's right. What I've been trying to do is look first at local people and their choices, motivations, preferences, and try not to make too many assumptions. If we want to know what's important to local people, it seems to me that rather than going in and measuring fruits or latex, that a good starting point is to ask the local people what's important to them. When we do that we get long lists of products as you might expect, but we also get some less obvious values on those lists of preferences. I should point out that I don't do

this alone: I work with a small team of mostly young Indonesian scientists, and involve various other collaborators such as the national herbarium.

ER: Who are you working with in Indonesia?

DS: The groups that we're working with are Dayaks. These are the indigenous people who still live in the interior of Borneo. They're people who've been living with the forest and to a large extent have been dependent on the forest for centuries, so they have a complex, sophisticated culture which is intertwined with their relationship with the forests and the landscapes that surround them.

If you come in as an outsider you cannot begin to understand that complexity unless you make a specific effort to do so. But within that complex series of relationships we find all kinds of benefits and values perceived by the people. Many of these benefits would serve the interests of conservationists also. If we only focus on the kinds of values that Peters et al. and Godoy et al. are looking at, we forget the cultural values that are associated within landscapes. I think that's normal everywhere in the world. We shouldn't be surprised that these people have cultural values in their landscapes.

If we look at something as simple as graveyards, these are not productive values, but obviously we don't want to convert all our graveyards to other land uses just because it's more profitable. That's not a choice any of us make, and it's the same with people in Borneo. We have people there who've been living in a forest landscape for centuries. Obviously there are many graveyards scattered throughout these forests. When logging companies come in they tend to destroy these sites, which upsets the local people. It's unnecessary. It's a simple thing to rectify, and I can't imagine anybody arguing a moral case against rectifying it. Conservationists, at least in Indonesia so far, have not recognized that that could be an opportunity, to go in and work with the local communities to identify special sites. All these gravesites are in forested areas, and even when the local people clear small areas for cultivation they never clear the grave areas, there's a taboo about them. They tend to be relatively pristine forest areas where all harvesting and all collection of forest products are prohibited.



Koopasia trees are protected because they are good for honey bees.

We could imagine using these sites as a basis for a protected area network on a small, local scale perhaps. It would be acceptable to local people and at least in the sites in Indonesian Borneo I think people would welcome that because it would be a reflection of their own culture, which is something that hasn't happened for decades. That would be one example, but there are many more.

ER: How did you prioritize their values?

DS: A main focus of my own work has been trying to identify what is important, and how important. We're asking about various aspects of the landscape and of the natural species it contains. We're dealing with more than 1,000 species we have information on that have some use and some value and we're trying to identify the significant threats to each of these values, or at least the main values.

One example would be that the main fish species people most prefer, the fish that most people would like to catch if they go out fishing, is a forest-dependent species that eats fruit from the forest. When you lose the forest you lose the fish. It's also sensitive to sedimentation, which happens when you log or you build roads: a lot of sediment gets washed into the rivers. That's one example out of more than 1,000 species.

Once you build up this picture, it's useful to hand it back to the people and they can recognize what they're going to lose. This fish is not only a food, but it's culturally important. It might sound funny, but it's true that people are sometimes named after this fish. When you tell people that when they lose the forest they're going to lose this fish, they'll look at losing the forest differently. It's not just species: there are all kinds of different sites that are important to local people. If we want to look at a map and say what's important, we can talk about the areas where the sago is grown and where the gravesites are. We have sites where birds nest. These are swiftlet colonies that produce bird nests that are used in Chinese soups. These nests have a high value, and generally these areas are in limestone cave areas. Local people are keen to conserve the forests around those areas, so that's also obviously a key

point: there should be recognition of the potential to protect forests around these bird nest areas.

There's a whole set of other sites that haven't been recognized properly by outsiders. For example, we find in our area that the average densities of wildlife are relatively low, the soils are poor, and nutrients like calcium are probably quite limiting to wildlife. We find that salt springs are important for wildlife and that most wildlife visit salt springs. Local hunters know this and often focus on the salt springs to improve the efficiency of their hunting. But these salt springs are not recognized by logging companies, so they bulldoze and destroy them. Again, we could think about mapping these sites for wildlife with local people because they have that knowledge. We could think about saying, Where are the key places where the salt springs occur? Where is it that we need to protect to maintain the wildlife in this system? That would be a shared interest. We want to protect the wildlife and so do the local people.

ER: How much do they depend on the forest to make a living?

DS: To a large extent these people get almost everything they need for their livelihoods from the forest. They generally have some small-scale agriculture, some communities more than others, but it's fair to say the majority of their livelihood is derived from the forest.

If we ask people to weight the importance of different landscape types: forests; agricultural lands; gardens where perennial crops like coffee or cocoa grow; fallow areas that regrow after cultivation or clearance, if we ask people to score these land-cover types in terms of what's important for them, almost every type of value that we can think of, whether it's food, whether it's building material, whether it's medicinal plants, even recreation, when they score the different land types for their values, forests almost always — I'd say 99 percent of the time — come out top.

ER: What are some of the other forest products they use?

DS: People hunt. The main food they're looking for is the wild pig, which is relatively abundant. Whether it has a huge impact on the animals it's hard to say. There hasn't been much research done on that.

ER: Are pigs native to the island?

DS: Yes. There's also an exotic pig, Sus scrofa, but the bearded pig, Sus barbatus, is native. They are a migratory species, and they're moving across a huge area, often in quite large numbers. If this forest gets highly fragmented by oil palm plantations and other land uses, we have little idea what the impact of that will be on the abundance of these pigs.

The sums per household we calculated from the Godoy study are between $1,000 and $2,000 per year. For poor people who are dependent on the forest, this is a significant economic benefit.

ER: The pigs are following the wild fruit?

DS: That's right. If the pigs decline, then what else are people going to eat? If they start to eat other animals such as monkeys, then that's a conservation issue too. So in many ways the system hinges on trying to maintain pigs in these landscapes.

ER: What are the taboo animals?

DS: I think this is also a key point. One of the reasons that it's not always easy to find out what's important to local people is once you get into culturally deep issues — even things like grave sites — it's not always easy for people to give you clear answers. In many of these cultures it's bad luck or it's almost taboo to talk about it. They protect the sites, but they don't necessarily want to explain to you why.

I think it's a little bit the same with these taboo animals, and sometimes we don't pursue it too hard. In my mind the key issue that I'm trying to address most of the time is what's important to local people and how important it is.

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Once we know it's important we don't have an excuse for ignoring it or neglecting it any more. Once we say why it is important, if it's a spiritual or a cultural thing, will I ever be able to understand it? Perhaps not. The point is, they care deeply about it; that makes it important.

ER: Are some monkeys a taboo food?

DS: Yes. But I think the situation is changing. The impact of Christianity has come in since the 1960s. There's been a lot of missionary activity and a lot of people are happy to call themselves Christians. I think the older people hold to the taboos, but many of the younger people who are Christians say that it's okay to eat monkeys now. We'd see somebody eating a monkey somewhere and I've had older men come up to me and say, Why don't you try it? I would say, Well, why don't you try it? and he would say, It's taboo for me but it wouldn't be taboo for you because you're a Christian. Then I explain that I am a vegetarian.



Local people are scoring the importance of different forest plants.

ER: A different taboo altogether.

DS: Right. So these things are breaking down, but some of them are still quite important. I think a good example of values that are unclear is the example of the sago palm. These are palms that have large reservoirs of starch in their stems. Before rice was a widespread crop, sago was an important staple in their diet. It was the main food. What is perhaps less recognized, particularly in the area I've been working in, is that people are still to some extent dependent on it. We're working in an area with steep valleys and steep slopes and sometimes the rice crops will fail because of floods — the best soils are by the riversides and every few years there will be a flood, which will destroy the rice crop. Sometimes there's a drought, or maybe an infestation of insects, which also diminishes the crop. People do talk about having periods of food shortage, and in these times they've always turned to the forest because it's there and they know how to extract food from it. They have that knowledge, they have that insight, and it's been their forest. They've been able to go in, and it's not that hard for them to get enough starch and other food to survive. It may not be their preferred starch, but it keeps them alive, so it's important.

The thing about this sago palm, *Eugeissonia utilis*, is it tends to grow on ridges. Another side to our research is we find that local people give a low value to areas that have been logged. In trying to understand why that is, we find that the areas that have been logged no longer have much in the way of sago palm because the heavy machinery goes in on the ridge tops, which tends to destroy and even selectively destroys this forest starch reserve.

That's an example of a value that was not protected but could be relatively easily. One of the reasons that it hadn't been protected was the view that people didn't need it anymore, that it wasn't important anymore. But this was an outsider's view. I've had people here tell me, Oh, it's not important anymore, nobody eats it now. But that's not what the local people say. They've all had to survive on it sometime in the last twenty years or so, so it's still important to them.

If you go in as an outsider and ask people about sago they don't necessarily want to talk to you about it, so it's easy to overlook its significance. I think it would be easy to change logging practices to recognize that value and protect it.

ER: What's the degree of protection of this area? Is part of it protected or all of it protected?

DS: The area we work in, none of it is technically protected. There is an area

farther to the west, which is a national park, the Kayan-Mentarang National Park. It's part of a large WWF project to try to protect that site. But we're at some distance from that.

What we're seeing is a massive land and resources grab at the moment. That is probably the best way to put it. In Indonesia there's considerable political turbulence. We're coming out of thirty years of highly centralized, highly undemocratic rule with an explosion of democracy and also an explosion of decentralization. It is chaotic at the moment because it's not clear whose rules apply and who's going to enforce rules in any case. It's quite a land grab right at the moment.

ER: Who is doing the grabbing?

DS: I think those who are powerful enough to exploit the situation, and many of those are businessmen who have money to invest. The problem is that there's nobody who knows whether they have the ability to enforce rules, and there's not much incentive for enforcing rules because it's a relatively Wild West situation at the moment.

The local governments themselves are well meaning, but they're quite new. They don't necessarily have much in the way of capacity, and they're being pulled in all directions at the same time. They want money, so investors come in and offer money. Then the local people themselves are suddenly seeing that after thirty years of having no rights, they have some rights. Some of the local communities are saying, Maybe it's now or never. Maybe it's now that we try and get the benefits ourselves for a change. And even though they might prefer longer-term solutions, they might be quite willing to get money for logging right now rather than wait a year and have their rights taken away again.

There's a dreadful lack of security, and I think that's probably the most destructive thing we're seeing right now. It's an opportunity for everybody to rush in and get what they can now. Nothing is long-term.



The bearded pig is a key resource for local people. Changes in land use threaten this resource and may force people to eat other animals with higher conservation value.

ER: Are there any good estimates of the rates of loss of primary forest? We've heard in the press here that it could all be gone in five to ten years.

DS: For about 90 percent of it, which isn't on steep land, my guess is that's accurate.

But there are positive sides to the recent changes also. I was talking about this terrible power vacuum, but there are some communities who have maintained enough integrity within their own traditional system and who now feel that they have enough political clout and ability to enforce their own traditional rules. That's one of the things we're seeing coming out of this chaos. Certain villages recognize that if nobody else is going to control what's going on they'll have to take control. We're seeing communities confronting logging companies in some areas, and stopping logging. We're seeing that quite a lot. In some cases people are taking heavy equipment and holding it for ransom. We're seeing a lot of direct action, and in some cases it appears that this has involved a wish to protect the forest in the long term. At least for the moment it's been successful in the case of some communities. I should also add that, to their credit, the Indonesian Ministry of Forestry has just this month launched what it calls its social forestry initiative. This refers to the types of community forest management systems we are seeing in other countries that aim to allow local people greater control over their resources. This is a welcome move by the government and I hope it succeeds, but I guess we will have to wait and see.

ER: Do you have any parting thoughts before we ring off?

DS: If I have a key message it would be that scientists, when they're dealing with local people and local communities, have to engage with local communities to see what their views are and whether what we're proposing is good for them. We should be a little bit more modest. If we're going to act on behalf of local views and opinions, we should be willing to ask local people's opinions. I think it's true for conservationists in general too. Economists and conservationists often talk about integrating conservation and development, but we're talking about conser-

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vation that we want. We're not talking about conservation that local people might want. If we think conservation and democracy are important we need to be consistent and be willing to be guided, at least to some degree, by local views.

Additional Reading:

1) Valuation of an Amazonian Rainforest. Peters, C.M., Gentry, A. H., Mendelsohn, R.O. 1989 *Nature* 339:655-656

2) The Economic Value of Sustainable Harvest of Plants and Animals from the Tropical Forest. Godoy, R.A., Bawa, K.S. 1993 *Economic Botany* 47:215-219

3) The Value of Tropical Forest to Local Communities: Complications, Caveats, and Cautions. Sheil, D. Wunder, S. 2002 *Conservation Ecology 6(2):9* also online at: www.consecol.org/vol6/iss2/art9

4) Local priorities and biodiversity in tropical forest landscapes: asking people what matters. Sheil, D., Liswanti, N., van Heist, M., Basuki, I., Syaefuddin, Samsoedin, I., Rukmiyati, Agung, M. 2003 *Tropical Forest Update. 13:1* www.itto.or.jp/newsletter/Newsletter.html

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