

Recognizing Local People's Priorities for Tropical Forest Biodiversity

Tropical forest people often suffer from the same processes that threaten biodiversity. An improved knowledge of what is important to local people could improve decision making. This article examines the usefulness of explicitly asking what is important to local people. Our examples draw on biodiversity surveys in East Kalimantan (Indonesian Borneo). With local communities we characterized locally valued habitats, species, and sites, and their significance. This process clarified various priorities and threats, suggested refinements and limits to management options, and indicated issues requiring specific actions, further investigation, or both. It also shows how biological evaluations are more efficient with local guidance, and reveals potential for collaborations between local communities and those concerned with conservation. Such evaluations are a first step in facilitating the incorporation of local concerns into higher-level decision making. Conservationists who engage with local views can benefit from an expanded constituency, and from new opportunities for pursuing effective conservation.

A CHALLENGE

There is much soul searching on how to achieve conservation in the tropics (1–3). Decision-makers in many tropical countries view conservation as something imposed by rich countries and foreigners. Conservation is rarely viewed as a significant local priority, and often remains dependent on donor support and pressure. Meanwhile, various spokespersons for global conservation continue to see local people as a problem (3–9). A perceived failure of integrated conservation and development projects and community-based conservation efforts (10, 11) has led to calls for a return to a protectionist conservation paradigm (e.g. 3, 12, 13).

Conservationists rarely seek genuine allegiances with local people, yet declining biodiversity and the poverty and marginalization of remote communities are connected. In particular, forest-dependent people often suffer from the same development decisions that damage forests.

Decision-makers are faced with diverse stakeholder demands. The interests of some, such as commercial enterprises, are clear and easily communicated. On the other hand, the aspirations of indigenous communities may remain hidden unless specific efforts to solicit them are made (14). Inaccessibility, language barriers, economic marginality, and prejudices against them make such consultation harder.

While indigenous knowledge and development issues are increasingly recognized, local preferences remain neglected (15). This is critical, for if local views remain unknown, any conservation intervention will likely overlook both opportunities for collaboration and the pitfalls of predictable conflicts. What is needed is an understanding of local views and a means to make these more influential. Tapping into this realm of values and attitudes does not guarantee effective conservation, but it may help tip the balance (16).

The purpose of this essay is to provide an overview of our research with seven communities in East Kalimantan, where we explicitly set out to identify and clarify local views and priorities with regard to forest landscapes and biodiversity. We do not attempt a detailed overview of the methods themselves (see 17), rather we set out to illustrate why asking local views is valuable even to those whose primary interests concern conservation.

AN OPPORTUNITY

We observe a widespread process of decentralization and democratization across the tropics. Whether we consider wider public consultation in planning, or full-blown representative democracy, the political process is already underway. We believe that dialogue and consultation between communities and conservation interests can create new opportunities for conservation and we hope to catalyze this process.

We ask what is important to local people, and whether we can find simple means to assess this. Our starting point is to develop an improved understanding of local needs, priorities, perceptions, knowledge, and value systems, and to encourage other stakeholders to share these insights. Such a diagnosis is a specific first step in a process of identifying, developing, and reviewing interventions.

Our illustrations draw on our research in Malinau District, East Kalimantan (Borneo). We devised methods to ask what really matters to communities living in tropical forest landscapes by linking conventional biophysical assessment of the landscape with techniques to identify, gauge, and clarify local needs and perceptions (17). The work takes four main themes: *i*) asking what occurs where (as in classical biodiversity assessments), *ii*) asking why it matters to local communities, *iii*) evaluating implications and possible courses of action or diagnoses, and *iv*) sharing insights and implications with stakeholders and decision-makers. We shall touch all of these, but will emphasize the second, because this aspect is missing in so many research and survey activities where it could easily be included.

Our approach is diagnostic in nature; it doesn't necessarily solve problems. It does help to identify them, as well as to clarify opportunities to address them. By building a basis for mutual understanding, oversights and misunderstandings are better avoided. Ideally, the process should be iterative, gaining refinement through more detailed consultation. Improved communication supports the search for workable solutions. We shall not address participation and local power relationships; other than to note that despite various viewpoints, no one contests the notion that improved recognition of, and response to, local views can improve communication (18, 19). Mutual understanding facilitates dialogue among researchers, policy-makers, forest communities, conservationists, and others on the significance of forested landscapes and the roles they perform.

In terms of policy responses, we believe that conservation values should not be sought exclusively in large protected areas, and should not be the sole preserve of professional conservationists. We believe that it is possible to maintain considerable biodiversity in areas used for other purposes by gaining the cooperation and guidance of local people, timber managers, and

others (20–22). We do not refute Western biocentric arguments for protected areas; rather, we see local involvement as a pragmatic and ethical means to foster a new constituency and to achieve conservation across a wider landscape. Neither do we wish to neglect so-called ‘less-useful’ species. We find that the concerns of local people are not exclusively utilitarian; their landscapes too, are much more than a larder of raw materials and services, and they resonate with culture, heritage, and even recreation (23). In essence, we propose that conservation can be built around what local people find important.

THE MALINAU FOREST AND ITS INHABITANTS

Borneo’s forests are renowned for their diversity, and more than one-third of the exceptional flora is endemic (restricted) to the island (24). The loss of these forests is a global concern. At the same time, though, often neglected by media and policymakers, those living in these landscapes are also confronted by these changes.

Much of Malinau District is rugged and sparsely populated. It is an area of considerable conservation significance and still contains a large continuous extent of tropical forest (25). Indigenous populations include Merap, Punan, and Kenyah ethnic groups (26). The entire area is divided by traditional claims, but most of the region has been allocated to timber concessions. Indigenous communities were not consulted when previous governments granted these concessions (27).

The economic crisis of 1997–1998, and an increase in the export value of palm oil, encouraged prospecting by private investors. The recent devolution of power from the central government in Jakarta to the district level is also having major effects, with local authorities controlling logging and land

clearing permits. Conflict over land and resources is increasing (28, 29). New roads are opening up previously inaccessible areas. For local people, this is a time of change and uncertainty.

APPROACH AND METHODS

Our multidisciplinary approach was developed during a study with seven communities in the forest-rich upper Malinau watershed, an area of more than 2000 km² and a total population of about 1100 (Fig. 1). We chose to work with the Merap and Punan, because these represent distinct local cultures. The Merap are a politically influential group in the local context, with affinities to the regionally powerful Kenyah. The Punan have been less politically visible. The primary difference between the two groups, at least until very recently, is the emphasis that the Merap place on swidden (dryland) rice farming, whereas the Punan have specialized in extractive forest-based activities. Each community was studied for 3 to 4 wk, although follow-up visits occurred beyond this period.

We sought to identify and understand what local people find important. Thus, despite our biodiversity-survey emphasis, importance was not limited to natural resources and economic values in any conventional sense. Things can matter for reasons other than utility or trade (23, 30). Various community-focused methods provided a framework for identifying, discussing, and scoring the significance of local land types, sites, species, and resources (Table 1).

A closely linked field survey assessed different vegetation types and features across the wider landscape. Using efficient and innovative methods (31), 200 field plots were established and described, and we catalogued information on location, soil, vegetation, site use, local plant names, and potential for cultivation. This provided substantial information; more than 15 000 plants were recorded, representing more than 2000 distinct species, some new to science. Local informants attached 1457 unique species-use combinations to these.

Ownership of local knowledge was addressed, because the potential exploitation of medicinal knowledge and locations of valuable resources pose concerns. All community members were informed about our intentions and goals regarding data collection. We emphasized that they need not tell us anything they did not want to. We never requested or recorded details of how medicinal plants were prepared and administered.

Developing a Shared Understanding

Given constraints of limited time and funding for field research, and a desire to cover a large area, we emphasized rapid methods. Community meetings and joint mapping exercises elicited local landscape classification and terminology, and clarified the geography of resource use. The maps provided a basis for our field survey; many plots were sited in unusual locations that would not have been easily found by outsiders. Maps were revised and clarified together over the study period.

We also relied on local informants to help define the various types or categories of value—for example, food, medicine, recreation—they attach to their land and resources, and to assess the importance of locations, plants, and animals for each of these. For this purpose, focus groups and joint scoring exercises allowed a consensus to develop among informants. Sometimes follow-up discussions were needed to clarify understanding of these choices. For example, we initially wondered why respondents in the village of Langap preferred to value many medicinal plants as “products to sell,” rather than as “medicine.” We learned that this village possesses highly regarded herbal expertise—it is a point of local pride that they provide remedies to other

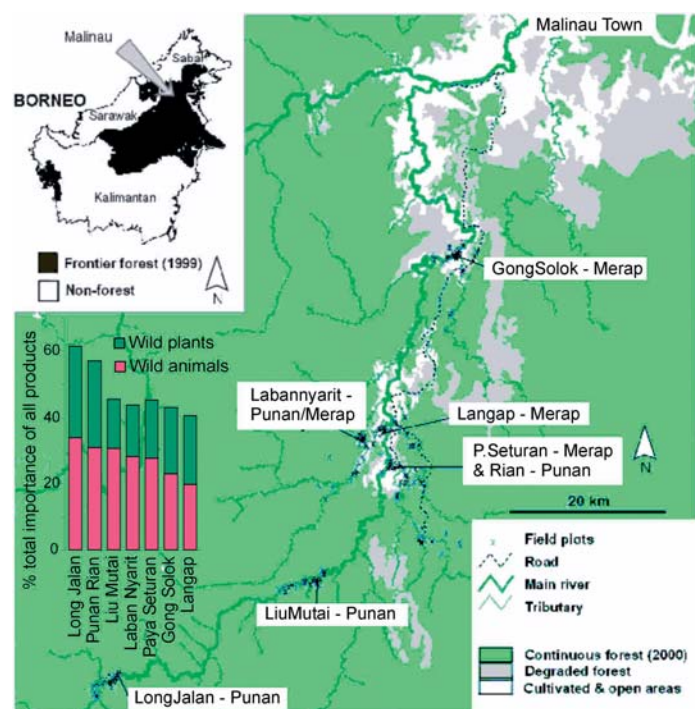


Figure 1. Map of the Malinau River Valley showing the location of the surveyed villages. Top left inset, derived from WRI Frontier Forest Initiative. Main map based on manual classification of Landsat TM image (May 2000). Villages cover a range of accessibilities; the nearest to Malinau Town is Gong Solok, which takes about 1 hr by road. The journey to Long Jalan takes a full 3 d by boat. The bar chart inset at lower left shows communities’ self-scored assessment of the importance of wild (as opposed to farmed or purchased) products (as a percentage of all products) to their well-being: distant Long Jalan is the most reliant (61.5 percent), and rich rice-farming Langap the least (41 percent). Villagers also associated many other values with the forests.

Table 1. Data collection techniques used in CIFOR's Multidisciplinary Landscape Assessment study.

Emphasis of data collection	Method
Village description/perspective of land use	Interview with village head only
Cultural background of land use	Interview with traditional leader only
Demography	Household survey (census) and documentation from village head
Price of traded goods	Interview with shopkeepers
Household survey (includes questionnaire of problems and aspirations, with comments on needs and solutions)	Interview with head of household of at least 30 households
Traditional knowledge of land use	Interview with 3–5 key informants
Forest product collection and sale	Interview with 3–5 key informants
Settlement history and land use	Interview with village head and traditional leader
Disasters and important events	Interview with village head and traditional leader
Identification of land and forest types	Community meeting (with mapping exercise)
Identification of forest products	Community meeting
Scoring the importance of landscape units	Focus group discussion. Women/men, old/young separate
Scoring changes in importance of landscape units and natural resources over time	Focus group discussion. Women/men, old/young separate
Scoring how distance of landscape units influences importance	Focus group discussion. Women/men, old/young separate
Scoring the importance of different sources of products	Focus group discussion. Women/men, old/young separate
Scoring the most important species per use category	Focus group discussion. Women/men, old/young separate

communities. Cross-checking of information with informants was performed through both formal and informal means.

RESULTS

The results are rich and multifaceted. Here we present some summary illustrations. Using consistent classes of importance allows us to summarize the data collected across the different exercises in the seven communities. Summaries can be made about various key value classes, including food, medicine, light and heavy construction, ritual and decorative tools, boats, crafts, recreation, etc. We will illustrate this for hunting, which concerns three of our primary value classes: species used for hunting tools, those valued as providing good locations for hunting, and what people wish to eat.

Initial Diagnosis—Hunting

Hunting still plays a significant role in the area. Out of all sources of animals, including purchased and farmed items, wild species contribute more than half (58%) of what people rated as important. In remote communities such as the Punan village of Long Jalan, the importance of wild species reaches 81%. In downstream farming communities, domestic animals and trade are judged more significant, although wild animals remain important (45%).

The *hunting function* class refers to items needed to hunt effectively. This includes plants and plant parts used for constructing hunting tools. Mature forests contribute more than half the total importance associated with all species identified in this class. The most useful plants were all trees or palms, with the most important species being the tree *Antiaris toxicaria* (Moraceae), with its poisonous latex used for blowpipe darts. We thought this was surprising, given the visible trend to hunt with dogs, spears, and shotguns (widespread if technically illegal). While some Punan still regularly hunt with darts, the majority of blowpipes are today used primarily in festival day competitions. The high score seems to reflect a desire to preserve species with historical and symbolic value, and a backup hunting technique.

Of 115 relevant plant uses recorded in this class during the field survey, 12 were said to be unique to a given species. Only one animal was recorded in this role; the feared king cobra, *Ophiophagus hannah*. Although one Punan group noted its value for dart poison, it is not viewed as important (it was associated with warfare in the past, E. Dounias pers. comm. 2004).

The *hunting place* value class refers to the locations preferred for hunting. Although hunting occurs in all habitats when the opportunity arises, forests, especially unlogged, and remote mountain areas are rated the most important. The most important species (primarily dipterocarp trees, oaks, figs, and palms) yield fruit that attract animals. Some Punan informants implied that one of the values of cultivation was that rice and cassava draw animals into open areas where they can be hunted. However, these animals still depend on the forest; the fields serve as bait. Five hundred and eighteen plant species recorded in the field survey were said to provide value by supporting and attracting wildlife.

In terms of locations, “salt springs” (sources of salts or detoxifying clays, or both [32]) visited by deer, pigs, monkeys, and birds also provided a key role, as did some former or abandoned village areas where the concentration of planted fruit trees was an attraction. Logging, and especially understory cutting (see later) was said to degrade habitat suitability for hunting, as most valued species decline in these areas. In addition, after logging, debris and tangles make access physically difficult, and the right to hunt in active concession areas is unclear.

The most valued food resource and the primary focus for hunting, is the bearded pig (*Sus barbatus*). Pigs provide the bulk of vital animal fats and proteins in people's diet. According to local people, numbers of these migratory animals usually decline in logged areas. This is credible—not only does the cutting, road building, and associated noise drive away animals, but the slashing also removes herbaceous food. Timber cutting specifically removes many of the larger fruiting species (e.g. Dipterocarps and tropical oaks) that are known to attract pigs in the fruit season (see also 33). When there are fewer pigs the communities are forced to find other ways to supplement their diets. Eating of less-preferred and often protected species, such as monkeys, appears more common in active concession areas (34).

Insights Regarding Local Needs

Understanding local views suggests improvements to current forestry practices. All sections of the communities considered unlogged forest as the most important land type, both in general and for almost all classes of value and use that we assessed; logged forest is given a much lower preference (Table 2). Timber harvesting regulations (TPTI—the Indonesian Selective Logging and Planting system) require concession holders to slash all undergrowth and climbers each year for 5 years after felling. This is intended to reduce aggressive weeds that might impede

Table 2. Importance of uses per land type (mean of seven communities by principle value categories).*

	All	Food	Medicine	Light construction	Heavy construction	Boat construction	Tools
Village	13	10	16	1	2	0	2
Old village site	6	7	5	5	2	1	2
Garden	11	14	8	5	1	0	0
River	13	15	11	11	7	8	9
Marsh/swamp	7	7	6	9	9	12	11
Cultivation	14	14	5	2	2	1	0
Young fallow	7	6	6	2	1	1	2
Old fallow	8	6	8	27	5	5	12
Forest	21	21	36	38	71	73	61
Total	100	100	100	100	100	100	100
Unlogged forest	31	39	36	36	51	50	45
Logged forest	10	9	8	9	6	5	5
Secondary forest	16	11	15	23	4	2	5
Swamp forest	19	11	13	12	10	15	15
Mountain forest	24	30	28	21	29	28	31
Total	100	100	100	100	100	100	100

*This table summarizes the importance people place on different land and forest types both in total and according to a range of value categories (all numbers are averages rounded to the nearest whole number). For most value categories people rated forest as the most important. Rivers are preferred for recreation (this is mostly described as fishing) and secondary forests for firewood, but the unlogged primary forest (*hutan rimba*, a term specifically referring to primary natural forest) is without question the most important overall. Results are not necessarily intuitive; for example, Langap people, with their apparently more sophisticated modes of cultivation, still rated the forest more important than cultivation—they explained this as due to the value of the forest as the most important source of medicine and timber. Each column is based on two separate exercises (each adding to 100%); the first is general land-cover types, the second is types of forest. Each value in the table is the mean value from 7 communities with 4 exercises in each (28 exercises).

regeneration. In practice, however, many useful species are cut, including rattan canes and timber seedlings, as well as plants that serve as medicinals, foods, craft materials, and food for valued wildlife. Even if applied properly, the silvicultural benefits are limited, whereas the impacts on biodiversity and communities are considerable. This slashing is implemented concession-wide, even on rugged areas where logging is impractical and may be more damaging than the harvesting itself. We have suggested that this policy be reviewed (35, 36).

Timber species rate as the most important of all species considered by communities in our exercises. At the very top is ulin (*Eusideroxylon zwageri*—a durable construction timber, and possessing various other significant uses). Technically, companies are not allowed to log ulin, but enforcement is lacking. Other preferred timber species (kapur, *Dryobalanops lanceolata*; meranti, *Shorea* spp.) are equally valued by logging companies and a shortage of preferred construction materials is already occurring in many local communities. One, Paya Seturan, has responded with an internal agreement to keep an area of local forest cover as a community resource, thereby promoting a *de facto* protected area. Sites need to be located upriver as timber is floated downstream. Unfortunately, such local reserves have no official recognition and are threatened by both official concessions and increasing timber demands from less fortunate villages.

Many remote Punan groups cultivate little and are regularly dependent on wild food resources such as palm starch (sago). Other ethnic groups also rely on these palms during occasional crop failures due to droughts and floods: all villages reported several such events within living memory. In primary forest, the palms are common enough and are protected by community management practices (37). However, they are rare in logged forest. The primary local sago palm (*Eugeissona utilis*) tends to grow along ridge tops, and this is where heavy machinery is used to extract logs on the steeply undulating local terrain—normal practice endorsed in “reduced impact logging” due to erosion and safety benefits. Machine access destroys the palms. Concerns about this food resource might be addressed by modifying skid-trail design to reduce damage to the palms, or indeed, by programs to improve food security.

Such information appears so common sense, that once it is highlighted, it may appear trivial to elicit. Unfortunately, it is not so simple. Reliance on sago, for example, has been strongly stigmatized as being symbolic of backwardness, to the point at which communities are ashamed to discuss it. When talking to

outsiders, community representatives, who are often the wealthier members, will say that sago was “only eaten in the old days,” even though this is untrue. It is only through using a combination of approaches that these discrepancies are identified and then examined.

There are other instances of hidden values, and some pose even greater difficulties to uncover. For example, many (though not all) Punan groups traditionally buried their dead in large ceramic jars, which are very valuable now and are often stolen. Such sites are secret, to provide protection. Many outsiders still believe that the Punan merely leave their dead in the forest—a myth that the Punan themselves have been happy to perpetuate. However, the destruction of such gravesites during timber concession development has recently become a concern.

Logging has also destroyed Merap gravesites. Traditionally an area of about a hectare or more surrounds each gravesite, often surviving as remnant forest groves—even in more intensively cultivated areas. Graves (Merap and Punan) are taboo to all forest product collectors. The destruction of forest gravesites by concession holders remains a major cause of resentment between communities and companies. Protecting such sites would seem uncontroversial, and easy to implement. It would not only provide small forest refuge areas with conservation significance, but at the same time would help avoid the local conflict and discontent that currently threatens community-company relationships. Such a simple step would indicate a change in attitude, and offer a basis for further improvements.

Local priorities, although relatively uncontroversial once elicited, are rarely clear in advance to outsiders. The examples described above represent only a fraction of the information we have documented about how local communities relate to their environment. All were uncovered through a process of identifying what is important locally, through various interactive exercises. With this knowledge, we can seek land-use options that better reflect local needs and conservation goals.

Soils and Land-use

Although we focused on finding out what was important from a local perspective, we also considered some land development options of local relevance. Our soil data helped clarify the potential for various crops. The soils encountered were diverse, but chemical analyses showed that nutrient levels were

Table 2. Extended

	Firewood	Basketry/cordage	Ornamentation/ritual	Marketable items	Hunting function	Hunting place	Recreation	Future
Village	2	3	13	9	7	0	18	13
Old village site	2	4	5	7	5	6	2	5
Garden	9	3	10	17	5	7	12	16
River	19	11	16	15	8	15	27	9
Marsh/swamp	4	8	4	4	6	7	2	7
Cultivation	17	1	1	12	1	8	12	10
Young fallow	10	3	3	4	2	5	0	8
Old fallow	14	18	14	3	14	15	3	11
Forest	24	50	33	30	53	38	25	22
Total	100	100	100	100	100	100	100	100
Unlogged forest	29	39	30	36	44	36	34	31
Logged forest	16	6	10	8	5	7	8	13
Secondary forest	36	16	27	7	9	12	15	24
Swamp forest	10	15	12	12	14	16	18	14
Mountain forest	9	25	21	36	29	29	24	19
Total	100	100	100	100	100	100	100	100

consistently low, while aluminum toxicity, hard-pans, erosion-vulnerable soils, and steep terrain further limit cultivation opportunities. According to local perceptions, the best soils are found primarily on the limited alluvial plains. These views are consistent with our textbook-based evaluations; indeed, these assessments also suggest the reason why regional population densities are so low.

A formal evaluation (involving national guidelines and criteria) of our 200 sample sites indicated that these are all unsuitable for sustainable production of cash crops such as pepper, coffee, cocoa, candlenut, rubber, and oil palm—all of interest to local government. However, some alluvial areas have potential for sustained field rice and coconut cultivation. All the suitable sites identified are already under cultivation or fallow, and even these sites are not ideal, as nutrient status is low, and flood risk appears high. Even with heavy application of artificial fertilizers there is little room for economically viable, large-scale agricultural expansion on such rugged and inappropriate land conditions. Sharing this understanding will be vitally important in avoiding ill-conceived developments. It appears then, that the future well-being of the district largely depends on forests and how they are used.

Insights Relevant to Ecological Research

Collaborative fieldwork with local communities can benefit even those concerned primarily with more classical conservation biology (38). During our work, we were faced with a rugged area of about 2000 km². Local people helped us develop maps showing and naming rivers, roads, villages, sources of sago and rattan, abandoned villages, hunting locations, caves, and other special sites and resources (Fig. 2). In studying the range of sites and habitats, local advice proved invaluable. But we wanted to go further.

We suspected that many special sites not only have significance for local people, but also contain restricted habitats and species, and so it turned out. For example, limestone outcrops provide a restricted habitat for valuable birds nests (made by cave swiftlets, *Aerodramus/Collocalia* spp. and prized for Chinese soups), but also for many other restricted species. We learned that Punan groups dispatched to guard these birds nest caves had also planted dense stands of rattan, both to impede access to the area and to have a valuable forest product to trade with their farmer patrons. With local assistance, we sought out and clarified the status and background of such special locations. Generally, such sites, especially those in undisturbed habitats, added more unique species (some new to science) to our overall survey than did the more typical sites.

Thus, locating such sites, which is dependent on local guidance, provides more effective biodiversity inventories.

Focused Studies

As we have shown, our approach not only allows us to ask what species and habitats occur where, but also whether they matter to local stakeholders, and if they do, how much and why they matter. This clarifies priorities, and allows us to ask how these values are threatened and what might be required to maintain them. Such approaches need not be limited to large-scale multidisciplinary surveys, but can enrich more focused studies as well.

In addition to the main surveys introduced above, we have also undertaken smaller studies, addressing specific topics. Fish, for example, are important as a source of animal protein, especially when pigs are scarce or the time available for hunting is reduced by farming activities (39). Local people from three villages distinguished all but one of the 45 species recorded in the field survey (at least two are new to science) and ranked the most important ones. Among the fish most preferred for local consumption are two species of river carp (*Tor* spp., Fig. 3), which also have cultural significance. *Tor* are primarily plant eaters; they eat algae that grow on rock surfaces in sediment-free rivers, and the fallen fruits and flowers of trees (e.g. *Dipterocarpus* and *Ficus*) growing along the riverbank (40). The adults occur in deep, clear pools in the forest, whereas the juveniles live in shallower tributaries. Our survey did not find these fish in rivers affected by siltation from forest cutting or road building, or in more open areas generally. These fish appear vulnerable: they require clear water, are dependent on forest vegetation, have a relatively low reproductive rate, are keenly sought and easily caught. Recognizing that such species are vulnerable to forest change can help inform forest management and land use choices.

DISCUSSION

Scaling Up

Decision-makers prefer to focus on the general rather than the particular. A concern we have heard is how our approach can be applied beyond the boundaries of our field sites and community maps? First, one should separate approach and results. While our general philosophy has wide relevance and applicability, many results may indeed be only locally relevant. What we seek to generalize and promote is an approach that can build on the needs and priorities of local communities.

Second, although approaches such as ours can jumpstart consultation, there needs to be a genuine willingness to engage with local views and concerns.

Third, decision-makers may indeed favor simple, one-size-fits-all solutions (14), but this may contribute to the very problems we are trying to address (i.e. neglecting specific local priorities and contexts in which they arise) (30, 41). The need to address problems in specific locations may be a challenge, but this does not argue that we should remain unaware of such issues.

Finally, we may better ask, "How can policy be better framed, or particularized, so as to address the priorities of real people in real places?" The development of local democracy allows some room for optimism. The biggest obstacles may appear to be the mindsets of policymakers (42, 43), but many conservationists, too, could usefully adopt a new attitude.

A New Attitude

We suggest everyone, including farmers, schoolchildren, and others, must be seen as potential allies for conservation and

improved land use. In return, they are entitled to anticipate that decisions address issues that they consider important. It could make a difference.

In Malinau, deforestation currently looks set to continue with considerable environmental costs. Plantation projects will be implemented, but many will fail to be economically viable. Waterways will be choked with sediments. Conservation will become increasingly concentrated in a few guarded protected areas besieged by rising local demands. People will be increasingly alienated from the remaining forests. In the quest for food security and viable livelihood options, many members of distant communities will be forced into an alien urban poverty or the government will be forced to subsidize local livelihoods.

But perhaps this is not inevitable. The region is rich in natural resources. By recognizing and balancing local needs and priorities with other demands, we can envisage a future landscape that not only fuels a strong local economy, but also continues to provide some basic needs to people. This requires an agreed zonation of the landscape where different types of activities, controls, and management activities reflect wider needs and acceptable compromises. This landscape might

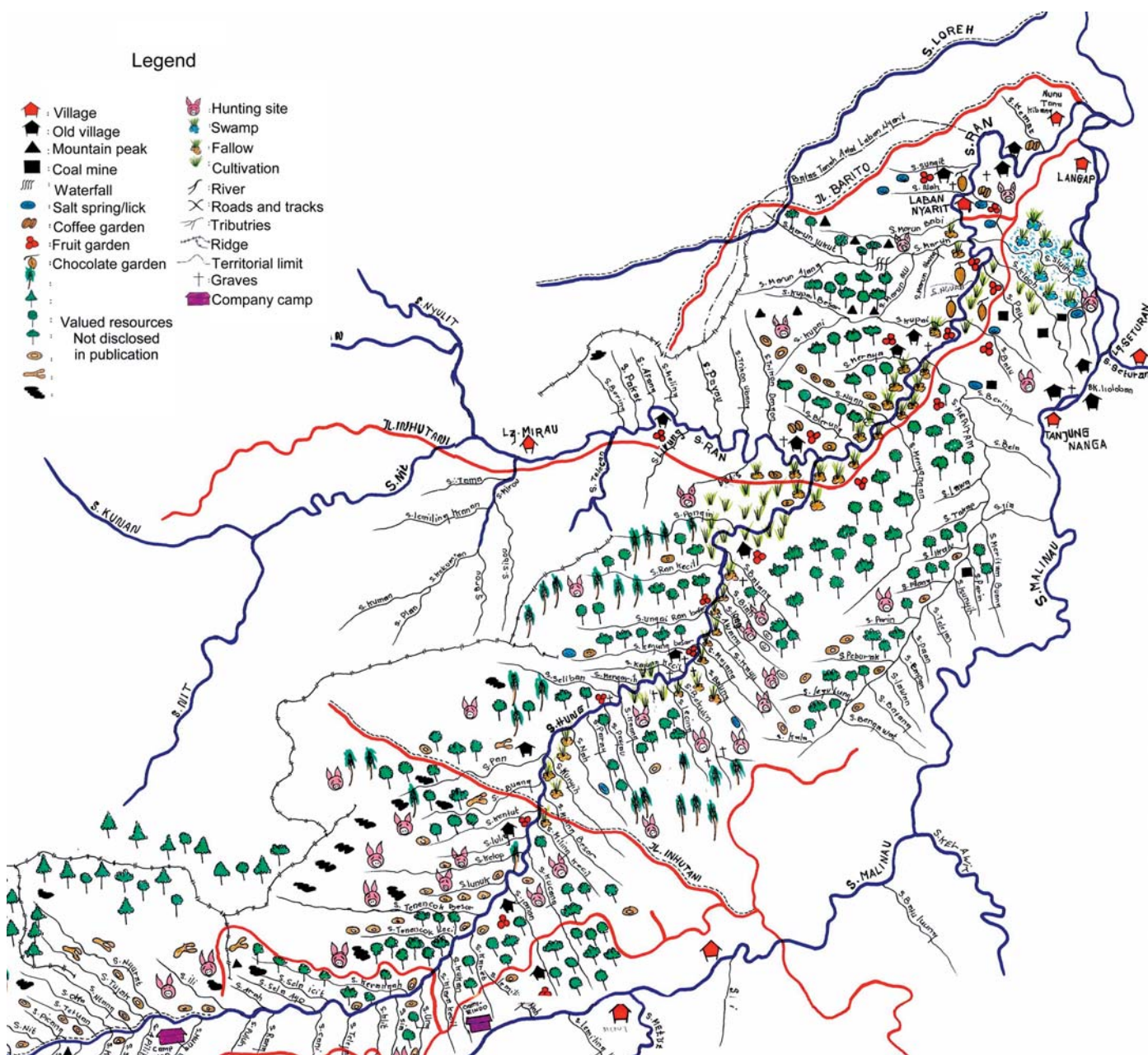


Figure 2. Example of detail revealed in part of a community map, made with the Punan community of Laban Nyarit.

maintain considerable forest cover, and many species of both local and more general conservation significance. Conservation can be viewed and implemented as a locally motivated process rather than merely a result of foreign and external pressures.

Attitudes must change. Conservation priority-setting must reflect a larger cross-section of society, to reduce conflict, and generate constructive new alliances and supportive constituencies, especially in the tropics. To help facilitate initial understanding we believe methods such as ours have considerable value. We foresee their use in two ways: *i*) as part of larger conservation assessments—the addition of local insight adds little cost, and can make surveys considerably more efficient, while also making the information relevant to many more stakeholders; and *ii*) as simple approaches for consultation and negotiation support.

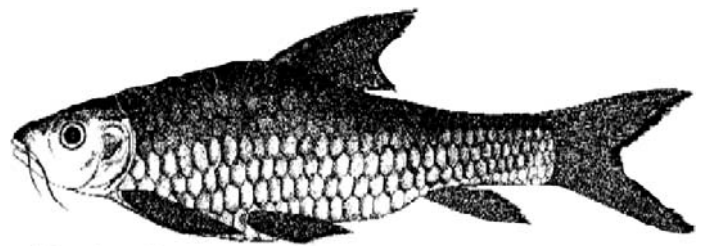
What needs further attention is the transfer of information to decision-makers in a manner that will increase the decision-makers' attention and application. The costs and efficiency of such surveys, the skills required, information to be collected, and communication of the results also need further evaluation.

Follow-up

The full conservation significance of local information may not be grasped in a one-off generic information-gathering process. Follow-up activities can help build on local information and clarify the wider implications of maintaining the status of a given resource or location in a changing landscape. Such activities hinge on the nature of the local concerns, and their context. In brief, the research and consultation process identifies key concerns and likely problems, and helps identify acceptable solutions based on local circumstances, local knowledge, and scientific understanding. This should be iterative.

Our work underlines that local communities have complex relationships with their environment that *need to be respected, understood, and taken into account in all relevant decision-making and policymaking and implementation* (44, 45). For Indonesia, this message requires a paradigm shift for all the institutions and processes related to forest management and conservation. There are opportunities for influence as decentralization has opened many issues for more localized scrutiny than was previously possible (46, 47).

We have been disseminating our main study results to local stakeholders in various ways. One major output has been a series of large, colorful posters describing and summarizing selected survey results and conclusions (people read little and there is no local radio, but posters are found on the walls of even the remotest villages). Poster content was developed with cycles of community review to agree on content and ensure clarity. The posters have been mass produced (1000 sets of 4 have been printed) and widely distributed, and a recent survey confirms that these have been well received and have favorably influenced the views of local communities, townsfolk, and even local civil servants (48). We have also printed and distributed several thousand packs of playing cards that present information on the 40 most important species defined on local views; and describe the threats to their maintenance and possible conservation ideas. Both cards and posters include some factual information on local conservation significance as perceived by outsiders like ourselves (e.g. on Borneo's endemics, deforestation rates, etc.): information that has also been well received. We are still working with other groups to incorporate survey information into a locally relevant environmental education curriculum. Most recently, we have developed a documentary film to explain and discuss the relevance of our surveys in the local context.



Tor tambra

Figure 3. *Tor* spp. are among the most preferred fish in the diet of most people interviewed in the Malinau Valley. The ecology of these much sought-after species makes them vulnerable to forestry interventions and over-fishing.

To assist land use planning we are examining the use of geographic information systems as mapping tools to help visualize local values across larger landscapes (49). We are also compiling detailed ecological information to help improve timber-harvesting methods (36).

The methods themselves are published in Indonesian, English, Spanish, and French (17), and further trials have been conducted in Bolivia, Cameroon, and West Papua. There is ongoing work in the Philippines, Gabon, and Vietnam. We have developed a multilingual Web site to share our experiences (50), and various publications have been planned to address different audiences.

CONCLUSIONS

Conservation planning without adequate local consultation alienates local stakeholders, and many conservation interventions are seen as just one more attempt by outsiders to gain control over land and natural resources. At best, this fails to develop a local constituency for conservation; at worst, it sparks conflict. Our studies in Indonesia illustrate the value of creating a shared understanding of what is important as a foundation for dialogue between scientists, policy-makers, and forest communities. Surveys that integrate biodiversity inventories with information on how people view and value their natural environment can help improve forest conservation planning, address the needs of local people, and advance the management of tropical forestlands. Conservation can be undertaken by recognizing and building on what local people find important.

References and Notes

1. Kramer, R.C., Van Schaik, C. and Johnson, J. (eds.). 1997. *Last Stand: Protected areas and the defense of tropical biodiversity*. Oxford University Press, Oxford, UK.
2. Brandon, K., Redford, K.H. and Anderson, S.E. (eds.). 1998. *Parks in peril: People, politics and protected areas*. Island Press, Washington, D.C.
3. Terborgh, J., Van Schaik, C., Davenport, L. and Rao, M. *Making parks work: strategies for preserving tropical nature*. Island Press, Washington, D.C.
4. Alvard, M. 1995. Intraspecific prey choice by Amazonian hunters. *Curr. Anthropol.* 36, (5), 789–818.
5. Redford, K. and Stearman, A. 1993. Forest-dwelling native Amazonians and the conservation of biodiversity: interests in common or in collision? *Conserv. Biol.* 7, 248–255.
6. Redford, K. 1991. The ecologically noble savage. *Orion* 9, 24–29.
7. Clad, J. 1985. Conservation and indigenous peoples: a study of convergent interests. In: *The human dimension in environmental planning*. McNeely, J. and Pitt, D. (eds.). IUCN Publication Services, Gland, Switzerland, pp. 45–62.
8. Ghimire, K.B. and Pimbert, M.P. (eds.). 1997. *Social change and conservation: Environmental politics and impacts of national parks and protected areas*. Earthscan, London.
9. Mittermeier, R.A., Mittermeier, C.G., Brooks, T.M., Pilgrim, J.D., Konstant, W.R., da Fonseca, G.A.B. and Kormos, C. 2003. Wilderness and biodiversity conservation. *Proc. Natl. Acad. Sci. USA* 100, (18), 10309–10313.
10. Wilhusen, P.R., Brechin, S.R., Fortwangler, C.L. and West, P.C. 2002. Reinventing a square wheel: critique of a resurgent 'Protection Paradigm' in International Biodiversity Conservation. *Soc. Nat. Resour.* 15, 17–40.
11. Brechin, S.R., Wilhusen, P.R., Fortwangler, C.L. and West, P.C. 2002. Beyond the square wheel: toward a more comprehensive understanding of biodiversity conservation as social and political process. *Soc. Nat. Resour.* 15, 41–64.
12. Terborgh, J. 1999. *Requiem for Nature*. Island Press/Shearwater Books, Washington, D.C.
13. Oates, J. 1999. *Myth and reality in the rain forest: How conservation strategies are failing in West Africa*. University of California Press, Berkeley, CA, USA.
14. Scott, J.C. 1998. *Seeing like a state*. The Yale ISPS series. Yale University Press, New Haven, CT, USA.

15. Sharpe, B. 1998. 'First the forest': Conservation, 'community' and 'participation' in southwest Cameroon. *Africa* 68, (1), 25–45.
16. Uphoff, N. and Langholz, J. 1998. Incentives for avoiding the tragedy of the commons. *Environ. Conserv.* 25, (3), 251–261.
17. Sheil, D., Puri, R.K., Basuki, I., van Heist, M., Wan, M., Liswanti, N., Rukmiyati, S., Sardjono, M.A., et al. 2003. *Exploring biological diversity, environment and local people's perspectives in forest landscapes*. CIFOR, Bogor, Indonesia. (http://www.cifor.cgiar.org/publications/pdf_files/Books/exploring_bio.pdf)
18. Mohan, G. and Stokke, K. 2000. Participatory development and empowerment: the dangers of localism. *Third World Q.* 21, (2), 247–268.
19. Cooke, B. and Kothari, U. (eds.). 2001. *Participation: the New Tyranny?* Zed Books, London and New York.
20. Hutton, J.M. and Leader-Williams, N. 2003. Sustainable use and incentive driven conservation: realigning human and conservation interests. *Oryx* 37, (2), 215–226.
21. Shanley, P. and Gaia, G.R. 2002. Equitable ecology: collaborative learning for local benefit in Amazonia. *Agric. Syst.* 73, 83–97.
22. Warren, M.D., Slikkerveer, L.J. and Brokensha, D. (eds.). 1995. *The cultural dimension of development*. Intermediate Technology Publications, London.
23. Posey, D.A. (ed.). 2000. Cultural and spiritual values of biodiversity: A complementary contribution to the global biodiversity assessment. Intermediate Technology Publications, London, UK: on behalf of United Nations Environment Program, Nairobi, Kenya.
24. MacKinnon, K., Hatta, G., Halim, H. and Mangalik, A. 1996. *The ecology of Kalimantan*. Periplus Editions, Singapore.
25. Sheil, D. 2002. Biodiversity research in Malinau. In: *Technical Report, Phase I (1997–2001). Forest, science and sustainability: The Bulungan Model Forest, Chapter 5*. Center for International for Forestry Research and International Tropical Timber Organization, and Ministry of Forestry, Bogor, Indonesia. (http://www.cifor.cgiar.org/mla/_ref/publication/chapter5.htm)
26. Sellato, B. 2001. *Forest, resources and people in Bulungan: elements for a history of settlement, trade, and social dynamics in Borneo, 1880–2000*. Center for International for Forestry Research, Bogor, Indonesia.
27. Lynch, O.J. and Harwell, E. 2002. *Whose natural resources? Whose common good?—Towards a paradigm of environmental justice and the national interest in Indonesia*. Center for International Environmental Law, Washington, D.C.
28. Iwan, R. 2003. Setulang village in Kalimantan: we protect our river. *IUCN CEEP Policy Matters* 12, 152–153.
29. Barr, C., Wollenberg, E., Limberg, G., Anau, N., Iwan, R., Sudana, I.M., Moeliono, M. and Djogo, T. 2001. *The impacts of decentralisation on forests and forest-dependent communities in Malinau district, East Kalimantan*. Center for International for Forestry Research, Bogor, Indonesia.
30. Sheil, D. and Wunder, S. 2002. The value of tropical forest to local communities: complications, caveats, and cautions. *Conserv. Ecol.* 6, (2), 9. (<http://www.consecol.org/vol6/iss2/art9>)
31. Sheil, D., Ducey, M.J., Sidiyasa, K. and Samsodin, I. 2003. A new type of sample unit for the efficient assessment of diverse tree communities in complex forest landscapes. *J. Trop. For. Sci.* 15, 117–135.
32. Krishnamani, R. and Mahaney, W.C. 2000. Geophagy among primates: adaptive significance and ecological consequences. *Anim. Behav.* 59, 899–915.
33. Curran, L.M. and Webb, C.O. 2000. Experimental tests of the spatiotemporal scale of seed predation in mast-fruiting Dipteroocarpaceae. *Ecol. Monogr.* 70, (1), 129–148.
34. Puri, R.K. 1992. *Mammals and hunting on the Lurah River: Recommendations for management of faunal resources in the Cagar Alam Kayan Mentarang*. Kayan Mentarang Project Report. World Wide Fund for Nature–Indonesia Programme, Jakarta.
35. Sheil, D., Liswanti, N., Basuki, I., Wan, M., van Heist, M., Samsodin, I., Kartawinata, K. and Rukmiyati and Agung, M. 2003. Prioritas lokal dan keanekaragaman hayati dalam lansekap hutan: apa yang penting menurut masyarakat? *Jurnal Hutan Indonesia (Indonesia Forest Journal) Edisi Agustus (August edition)*.
36. Sist, P., Fimbel, R., Sheil, D., Nasi, R. and Chevallier, M-H. 2003. Towards sustainable management of mixed dipterocarp forests of Southeast Asia: moving beyond minimum diameter cutting limits. *Environ. Conserv.* 30, 364–374.
37. Puri, R.K. 1997b. Penan Benalui knowledge and use of tree palms. In: *People and plants of Kayan Mentarang*. Sorensen, K.W. and Morris, B. (eds.). World Wide Fund for Nature–Indonesia Programme/UNESCO, London, pp. 194–226.
38. Sheil, D. and Lawrence, A. 2004. Tropical biologists, local people and conservation: new opportunities for collaboration. *Trends Ecol. Evol.* 19, 634–638.
39. Puri, R.K. 1997. *Hunting knowledge of the Penan Benalui of East Kalimantan, Indonesia*. PhD thesis, University of Hawaii, Honolulu, HI, USA.
40. Sulastri, Rachmatika, I. and Hartoto, D.I. 1985. Pola makan dan reproduksi ikan *Tor* spp. sebagai dasar budidayanya. *Berita Biol.* 3, 84–90.
41. Cohen, M.D., March, J.D. and Olsen, J.P. 1972. A garbage can model of organizational choice. *Admin. Sci. Q.* 17, 1–25.
42. Dove, M.R. 1983. Theories of swidden agriculture and the political economy of ignorance. *Agrofor. Syst.* 1, 85–99.
43. Dove, M.R. (ed.). 1988. *The real and imagined role of culture in development: Case studies from Indonesia*. University of Hawaii Press, Honolulu, HI, USA.
44. Chambers, R., Pacey, A. and Thrupp, L.A. (eds.). 1989. *Farmer first, farmer innovation and agricultural research*. Intermediate Technology Publications, London.
45. Hobart, M. 1993. *An anthropological critique of development*. Routledge, London.
46. Lutz, E. and Caldecott, J. (eds.). 1996. *Decentralization and biodiversity conservation*. A World Bank Symposium. The World Bank, Washington, D.C.
47. Colfer, C.J.P. and Resosudarmo, I.A.P. 2002. *Which way forward? People, forests and policymaking in Indonesia*. Resources for the Future, Washington, D.C.
48. Based on an analysis of more than 50 structured interviews, local perceptions were found to be in general agreement with poster content (even before poster distribution); nonetheless, understanding and agreement increased significantly after poster distribution as shown by i) the declining number of "don't know" answers, ii) the increased level of agreement with poster statements, and iii) the statistically significant number of individuals demonstrating increased agreement.
49. Lynam, T., Cunliffe, R., Mapaure, I. and Bwerinofa, I. 2003. Assessment of the value of woodland landscape function to local communities in Gorongosa and Muanza districts, Sofala province, Mozambique. Center for International for Forestry Research, Bogor, Indonesia, 111 pp.
50. More information can be found at CIFOR's Web site: <http://www.cifor.cgiar.org/mla>. Or contact ISusilanasari@cgiar.org.
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