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Current Conservation

Volume 3 Issue 2

Monitoring Tigers in the Sundarbans

Best Practice Stakeholder Participation

Fuzzy Logic and Shifting Base Lines

Reduced-impact Logging

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Cover Photo: A typical set of tiger tracks coming out of the water / Adam Barlow

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Usman Ghani

Himalayan Brown Bear in Deosai National Park, Pakistan

Monitoring Tigers in the Sundarbans

Adam C. D. Barlow

Tracking changes in wild tiger numbers is essential for evaluating the impact of conservation strategies and for identifying emerging threats. Unfortunately, tigers are notoriously elusive, particularly so in the Sundarbans of Bangladesh and India; a globally important tiger landscape and the largest mangrove forest in the world. The Sundarbans is made up of a maze of thickly vegetated islands interspersed with tidal waterways that presents a unique set of challenges for counting tigers. Camera trapping has been used in other areas to estimate tiger abundance, but such efforts in the Sundarbans have been hampered by the lack of recognizable tiger travel routes, without which capture rate is too low to make sound conclusions. However, tigers crossing creeks in the Sundarbans leave distinct tracks on the muddy banks which can be used to infer relative abundance with a suitable sampling strategy and reasonable set of assumptions. Furthermore, the fact that the track sets are made in a uniform medium and are degraded by the same tidal process, effectively limits the potential effects of variation in detectability across the study area.

To get an index of tiger abundance, we designed a survey that recorded the number of tiger track sets/km of creek surveyed for each of 65 sample units covering the 6,000 km^2 of the Bangladesh Sundarbans. Over two months of field work, three teams surveyed 1,201 km of *khals*, recording 1,338 tiger track sets. Tiger tracks sets were noticeably sparser in the north-east, where the forest borders village areas, compared to the south and west. The next step is to investigate if this apparent disparity in relative tiger abundance across the landscape is related to ecological factors or human activity. If low tiger abundance is a response to human activity, such as prey poaching for example, there may be considerable scope to increase the tiger population in the future through improved management of the problem areas. Work is underway to estimate prey numbers and human use across the area to provide further insight into the potential causes of variation in tiger abundance.

We calculated that we could detect approximately 20% or more future change in the tiger population if we repeated the same survey every two years. This fits with the current management protocol that will consider management intervention (such as additional forest patrolling) if the tiger population drops by 30% or more over two years. The survey does not differentiate between changes from natural processes and anthropogenic pressures, but reacting to substantial declines is a sound precautionary approach to ensure continued population persistence.

The first survey was carried out in early 2007 and at the time of writing the 2009 survey was underway. Since the last survey, the Bangladesh Sundarbans was hit by cyclone Sidr, which damaged vegetation cover in the east and killed thousands of local villagers living next to the forest. The cyclone could likewise have negatively impacted prey and tiger numbers in that area. Cyclones are a regular occurrence along the Bay of Bengal coastline and, although not frequently as devastating as Sidr, must be considered as a contributing factor to tiger and prey levels.

Adam Barlow

Tiger track in the Sundarbans mud

The track survey will be a key component of a monitoring programme being developed to measure success in tiger conservation in the Bangladesh Sundarbans. This is part of an overall conservation programme for Bangladesh, being developed in line with a recently finalised Bangladesh Tiger Action Plan developed by the Forest Department (FD). The next challenge is to integrate the survey into the FD forest management protocol and plan activities to mitigate potential future declines. We are also in talks with the Wildlife Institute of India to discuss opportunities for developing a transboundary monitoring and conservation approach for both sides of the Sundarbans.

Adam Barlow

Taking a closer look at some tiger tracks in the Sundarbans mud

Monitoring changes in tiger populations across tiger conservation landscapes is essential for understanding threats and focusing management response. However, with the dire predicament of tiger conservation worldwide (<4000 individuals left in the wild), there are few tiger areas that track change in tiger populations on a landscape level, whether it be in terms of relative abundance or absolute numbers. The Russian Far East (whose monitoring approach influenced our study in Bangladesh) and some sites in India, are the only other areas where tiger population change is measured on a landscape scale. If changes in other tiger populations are not monitored closely, then wildlife managers will not be able to detect or react to declines in time to save the population in question.

However, although important, monitoring should not overshadow the need for improved protection for tiger forests. Working out how to measure tiger populations takes time, and if we do not act now to combat the multitude of threats they face, then we run the risk of loosing tigers faster than we can count them.

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Fisherman's boat in the early morning mist

Christina Greenwood

Carnivore Protection: Including Biological Traits in Conservation Planning

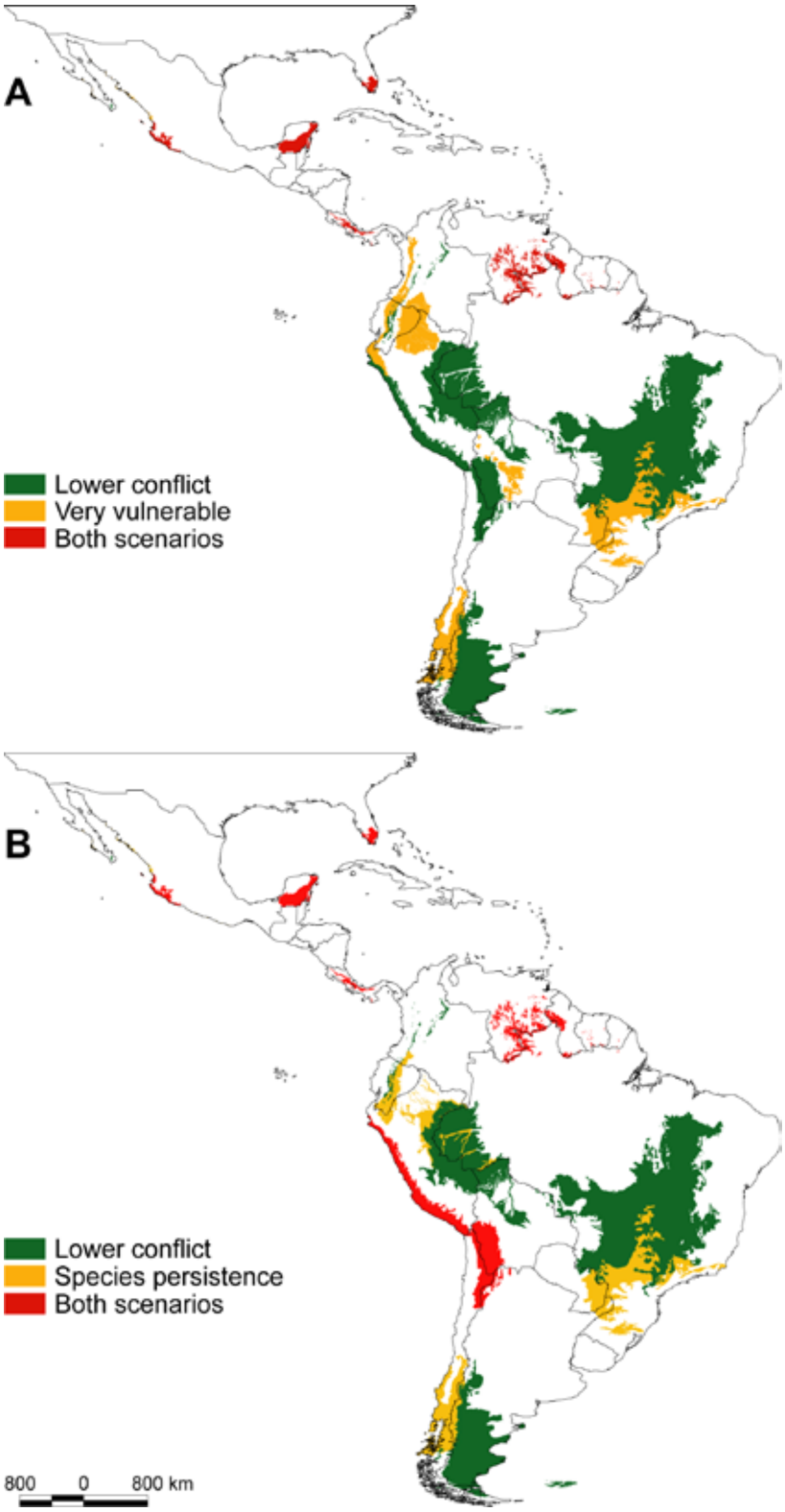
Rafael D. Loyola and José Alexandre F. Diniz-Filho

Mammals are key components in ecosystems acting as grazers, predators, and seed dispersers, and providing important benefits to humans, such as food, and recreation. Despite that, mammals are also an extremely endangered group with around a quarter of extant species being considered as threatened. Mammals from the order Carnivora are likely to come into conflict with humans, especially when they prey upon livestock. This leads to human illegal activities (hunting, poaching, poisoning) that adversely affect their population viability. In fact, the ultimate driving force of almost all recent and ongoing declines in mammal populations and their immediate causes (habitat loss, hunting, and species invasion) is the growth of human populations; hence species inhabiting more heavily impacted regions are at higher extinction risks.

However, species respond differently to human threats and several factors can influence such responses. It is known that extinction risk in mammals can be driven both by environmental factors (habitat loss, climate change) and intrinsic biological traits of the species (gestation length, body size, population density). Moreover, small and large species have different probabilities of extinction given that smaller species are primarily affected by environmental factors (including human impacts), whereas larger species are also constrained by their intrinsic traits. Some species of carnivores, for instance, are likely to move more rapidly towards extinction than others, as a result of synergistic effects of their own biology and threats posed by the increase of human population density in certain parts of the globe. Therefore, as biodiversity and threats are not homogeneously distributed around the Earth's surface, setting conservation priorities is unavoidable and necessary.

Until recently, conservation planning experiments tended to attribute high importance to areas with the highest species richness and endemism, where many species are thought to be at imminent risk of extinction, or where extensive habitat loss has already taken place. However, as species respond differently to human-driven threats, there is need for including biological traits into such prioritisation schemes, because this would entail more ecologically-based options and flexibility for conservation planners, stakeholders and policy makers. We have recently included species evolutionary and ecological traits in different prioritization scenarios for mammals of the order Carnivora inhabiting all Latin America (the so-called Neotropical region) and were able to indicate regions that are less impacted today due to human activities while harboring most very vulnerable species. These regions should, therefore, provide the best return for conservation efforts.

To do this, we first acquired data on four species biological traits, namely body size, rarity, extinction risk, and phylogenetic diversity. These traits are crucial given that they are obviously linked to the persistence of carnivore populations. In particular, the rationale for including phylogenetic diversity (a measure of a species unique evolutionary history) is that species with higher amounts of independent evolution be assigned a higher priority ranking because they retain more genetic/evolutionary information, maximising the accumulation of conspicuous diversity. Secondly, we mapped these biological traits, and used prioritisation algorithms to find optimal sets of regions capable of representing all Neotropical carnivore species in as little an area as possible. Algorithms were constrained by biological traits so that different planning scenarios could be derived. Hence, when optimal sets were forced to include regions tending to aggregate rare large-bodied species, with high phylogenetic diversity, and under high extinction risks, a very vulnerable scenario emerged (Fig. A). On the other hand, when optimal sets included regions with large-bodied species, but that are not rare nor under high extinction risks, a species persistence scenario emerged (Fig. B). These scenarios were then compared with another representing all carnivore species, but favoring the inclusion of regions with higher degree of protection, lower levels of original habitat loss, larger numbers



Optimal set of regions required for representation of all carnivores at least once under a very vulnerable scenario (orange) combined with those included in a scenario of lower conservation conflict (green). Priority regions included in both sets are shown in red (A), and the combination of a species persistence scenario and the lower conservation conflict scenario (B).

of large blocks of original habitat, and lower rates of conversion of remaining habitat, that is, a lower conservation conflict scenario (Fig. A, B).

These results showed that conservation efforts for carnivores in Latin America should be concentrated in priority sets of 12–14 regions if all species are intended to be represented. The most important regions are those that occur in the optimal sets that minimize conservation conflicts, as well as those that are very vulnerable and call for urgent intervention. Conservation action in these areas is likely to yield the best return for the investment at the regional scale.

The incorporation of species evolutionary and ecological traits can generate more ecologically supported priority sets and this has important implications for reserve network design. Conservation planning would benefit from the inclusion of species biological traits in optimisation algorithms once the results would better support policy negotiations that, ultimately, are intended to maintain wild animal populations over large periods of time. This kind of approach contributes now to a joint framework for the development of national and continental strategies for carnivore biodiversity conservation. It also adds to growing efforts to establish action plans to apply finite funds and efforts where they will be most effective.

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Loyola, R.D., G. Oliveira, J.A.F. Diniz-Filho and T.M. Lewinsohn. 2008. Conservation of Neotropical carnivores under different prioritization scenarios: Mapping species traits to minimize conservation conflicts. *Diversity and Distributions* 14: 949-960.

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Best Practice Stakeholder Participation for Conservation

Mark Reed

Mark Reed

Upland stakeholders and researchers discuss future policy and management options in the Peak District National Park, UK

Conservation problems are typically complex, uncertain, multi-scale and affect multiple actors and agencies. This demands transparent decision-making that is flexible to changing circumstances, and embraces a diversity of knowledges and values. To achieve this, stakeholder participation[1] is increasingly being sought and embedded into environmental decision-making processes, from local to international scales. However, involving people in decisions is inevitably time-consuming and costly – and it may not work. History is littered with examples of failed attempts to work with stakeholders. Old conflicts have been re-ignited, and dominant groups and individuals have been given the power to de-rail or bias outcomes. So why are so many conservationists still interested in participatory approaches?

First of all, whether it works or not, there is a strong argument that we should give those who are affected by, or who can affect, proposals to develop the uplands a chance to have their say. Increasingly this is a right that is being enshrined in law. The Aarhus Convention stipulates that all environmental decisions must involve stakeholders. Local communities are now being involved in environmental decision-making across Europe as River Basin Management Plans are developed in collaboration with stakeholders to reach water quality targets under the Water Framework Directive.

[1]Participation is defined as a process where individuals, groups and organisations choose to take an active role in a higher level decision-making process that affects them (after Reed, 2008)

But proponents of participatory approaches argue that there are also many pragmatic benefits to be gained from working with stakeholders. They argue that the reason why stakeholder engagement has sometimes failed in the past is that people haven't done it right. Poor engagement may be more damaging than none at all. But to what extent are these claims supported by evidence? There is now empirical evidence showing that environmental decisions that were taken in collaboration with stakeholder were higher quality and more durable. Decision quality can be higher because decision makers can access a wider range of often higher quality information upon which to base decisions, rather than relying solely on text-book answers from researchers. By getting a more complete picture in this way, unintended consequences may be anticipated and avoided. The long-term durability of decisions can be enhanced through participation because the design of interventions, projects and technologies can be more effectively adapted to local circumstances, needs and priorities.

Although empirical evidence has yet to be collected, many other benefits have been claimed. For example, by establishing common ground and trust between participants and learning to appreciate the legitimacy of each others' viewpoints, participatory processes may have the capacity to transform adversarial relationships and find new ways for participants to work together. This may lead to a sense of ownership over the process and outcomes. If this is shared by a broad coalition of stakeholders, long-term support and active implementation of decisions may be enhanced. Depending on the nature of the initiative, this may significantly reduce implementation costs. Surely even if a few of these additional benefits can be realised, it is worth trying to engage stakeholders in conservation?

Multi-criteria evaluation of land degradation indicators with pastoralists in the Kalahari, Botswana

There are numerous ways of conceptualising stakeholder participation in conservation. Early work used the metaphor of a 'ladder of participation' to describe different levels of participation from no engagement (one-way communication), through more consultative levels to community empowerment at the top of the ladder. More recently, this has been re-cast as a 'wheel of participation', emphasising that different levels of participation are relevant in different contexts. In some contexts (e.g. informing stakeholders about a change in the law), communication may be the most appropriate course of action (indeed anything more would raise unrealistic expectations and waste everyone's time).

But participation is more than either of these metaphors can describe. It is an approach that values and attempts to reconcile multiple (often differing) perspectives, to facilitate learning and progress. There is a philosophy (some have called it a world view) underpinning stakeholder participation that emphasises empowerment, equity, trust and learning. There is a need to replace a 'tool-kit' approach to participation, which emphasizes selecting the relevant tools for the job, with an approach that views participation as a process. This view emphasises the people who use the tool-kit in the context of a long-term relationship where the parties develop mutual trust and respect as they learn from each other to negotiate potential solutions.

In this context, it is possible to consider best practice principles that can guide the design of effective participatory processes. Box 1 suggests 6 principles based on a Grounded Theory Analysis[2] of available literature on stakeholder participation from around the world.

Although few of the claims that are made for stakeholder participation have been tested, there is evidence that it can enhance the quality of environmental decisions, possibly due

[2]Grounded Theory is a qualitative method used to systematically analyse large bodies of text, to construct theoretical models that are "grounded" in the text (Corbin and Strauss, 1990). It is performed by reading texts with specific questions in mind, coding passages using keywords as answers emerge, and using the keywords to sort quotes into themes from which theory can be derived.

Box 1: Best practice principles of stakeholder participation in environmental management

1. Start talking to people as soon as you can
Stakeholder participation should be considered right from the outset, from concept development and planning, through implementation, to monitoring and evaluation of outcomes. Engagement with stakeholders as early as possible in decision-making has been frequently cited as essential if participatory processes are to lead to high quality and durable decisions. Typically, stakeholders only get involved in decision-making at the implementation phase of the project cycle, and not in earlier project identification and preparation phases. Increasingly they may also be involved in monitoring and evaluating the outcomes of the decision-making process. However, unless flexibility can be built into the project design, this can mean that stakeholders are invited to get involved in a project that is at odds with their own needs and priorities. This may make it a challenge to motivate stakeholders to engage with the decision-making process, and those who are engaged may be placed in a reactive position, where they are asked to respond to proposals that they perceive to have already have been finalised. The Sustainable Uplands Project presents one of the few documented examples of stakeholder engagement right from the development of the initial concept. This was made possible by seed-corn funding from the Rural Economy and Land Use programme where stakeholders developed a project proposal with researchers in a Scoping Study. A review of the Programme's seed-corn funding showed that it played a crucial role in catalysing interdisciplinary collaborations to tackle complex problems, and recommended wider use of such funding mechanisms. Other researchers have shown how stakeholders could be actively engaged in sampling design, data collection and analysis, in addition to more traditional roles.

2 Make sure you're talking to the right people
Stakeholder analysis is increasingly being used to systematically represent those relevant to environmental decision-making processes. Stakeholder analysis is a process that: (i) defines aspects of a social and natural system affected by a decision or action, (ii) identifies individuals and groups who are affected by or can affect those parts of the system (this may include non-human and non-living entities and future generations), and; (iii) prioritises these individuals and groups for involvement in the decision-making process. A wide variety of tools and approaches have been used for stakeholder analysis to: (i) identify stakeholders; (ii) differentiate between and categorise stakeholders; and (iii) investigate relationships between stakeholders.

3 Make sure you know what people want to talk about
In order to design an appropriate process using relevant tools, it is essential to clearly articulate the goals towards which the group will be working. This is closely linked to stakeholder analysis and may take place as part of such an analysis, where system boundaries and issues are identified alongside those who hold a stake in what happens to the system under investigation (Reed et al., submitted for publication). This may require negotiation, and different stakeholders may have irreconcilable objectives. If the goals are developed through dialogue (making trade-offs where necessary) between participants, they are more likely to take ownership of the process, partnership building will be more likely, and the outcomes are more likely to be more relevant to stakeholder needs and priorities, motivating their ongoing active engagement.

4. Be flexible: base level of participation and methods on your context and objectives
Participatory methods can only be chosen once the objectives of the process have been clearly articulated, a level of engagement has been identified that is appropriate to those objectives, and relevant stakeholders have been selected for inclusion in the process. For example, there are many methods that can be used to communicate (e.g. information dissemination via leaflets or the mass media, hotlines and public meetings), consult (e.g. consultation documents, opinion polls and referendums, focus groups and surveys) or participate (e.g. citizen's juries, consensus conferences, task-forces and public meetings with voting) with stakeholders. Methods must also be adapted to the decision-making context, including socio-cultural and environmental factors. For example, methods that require participants to read or write should be avoided in groups that might include illiterate participants. The amount of time that participants are likely to give up varies between cultures, and limited time may constrain the choice of methods. Equally, the resources available may also limit this choice. Depending on the power dynamics of the group, methods may need to be employed that equalise power between participants to avoid marginalising the voices of the less powerful. There is evidence that less powerful actors who are marginalised during decision-making can delay or prevent implementation through litigation.

5. Get a facilitator
Don't underestimate the power of a good facilitator to bring people together and deliver high quality outcomes. The outcome of any participatory process is far more sensitive to the manner in which it is conducted than the tools that are used. Highly skilled facilitation is particularly important in the uplands, given the high likelihood of dealing with conflict, for example between conservationists and resource users. Different facilitators can use the same tools with radically different outcomes, depending on their skill level. Such skills include technical expertise in the use of different tools. However, it is sometimes the most seemingly simple of methods, such as informal group discussion, which require the greatest expertise. A successful facilitator needs to be perceived as impartial, open to multiple perspectives and approachable. They need to be capable of maintaining positive group dynamics, handling dominating or offensive individuals, encourage participants to question assumptions and re-evaluate entrenched positions, and get the most out of reticent individuals. Such skills are difficult to learn and tend to be developed through years of experience, intuition and empathy.

6. Put local and scientific knowledge on an equal footing
The need for scientific information and analysis to inform stakeholder deliberation has been identified by many authors as an essential ingredient in any participatory process. It is argued that local stakeholders may be able to learn from scientific sources of knowledge and so make more informed decisions in highly technical decision-making contexts, for example using Citizens' Juries. Equally, by taking local knowledge into account, researchers may have their assumptions and validity of results questioned, leading to further investigation and a more rigorous understanding of the issues they are investigating. Following from this, cross-fertilisation of ideas between these different sources of knowledge may provide more comprehensive information upon which to base decisions, which may increase their robustness and durability. Having said this, opponents argue that local knowledge may be exaggerated or distorted, and irrelevant to 'scientific' nature of much modern environmental management. On this basis, concerns have been expressed that integrating scientific and local knowledge bases will inevitably involve a trade-off between meaningful participation and scientific rigour. However, the same critique can be made of scientific knowledge, which should also not be uncritically accepted without evaluating the uncertainty and associated value judgments in the claims being made. If we consider local and scientific knowledge to be equally valid, it is necessary to subject each to an appropriate level of scrutiny, before considering what exactly may be integrated.

to more comprehensive information inputs. However, the quality of decisions made through stakeholder participation is strongly dependant on the nature of the process leading to them. Deficiencies in this process are most commonly blamed for the failures that have led to disillusionment in stakeholder participation. Often this has arisen from a focus on the tools of participation, rather than the process within which those tools are used. However, by focusing on participation as a process, Box 1 identifies a number of best practice principles from the literature. But for these sorts of approaches to become embedded in conservation practice, stakeholder participation must be institutionalised, creating organisational cultures that can facilitate processes where goals are negotiated and outcomes are necessarily uncertain. In this light, participatory processes may seem very risky, but there is growing evidence that if well designed, these perceived risks may be well worth taking.

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Reed M.S. 2008. Stakeholder participation for environmental management: A literature review. *Biological Conservation* 141: 2417–2431.

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Firewood collection by donkey cart, Mopipi Dam, Botswana

Mark Reed

Recovery of Brown Bears in Northern Pakistan

Muhammad Ali Nawaz, Jon E. Swenson and Vaqar Zakaria

Biodiversity conservation in developing parts of the world, like South Asia, is challenging due to large-scale poverty, an enormous population, and greater dependence on resources taken from nature. Protected Areas (PAs) serve as important tools for conservation and sustainable development, and the number of PAs has grown impressively in South Asia during the last five decades. However, the traditional approach of excluding people from parks has often hampered the creation of PAs in a struggle between conservation and development. The modern perspective of PA management views resident communities as important stakeholders, and emphasises accommodating the economic and social needs of society. This approach is very relevant in south Asian countries, where the livelihood of rural communities and PAs are essentially linked. However these principles largely remain to be incorporated into national policy in south Asian countries, like Pakistan. Pakistan's conservation policies and legislation does not allow public participation in PA management nor recognises public rights. Recently, there have been a few initiatives to change the national management paradigm, and bring the concerns of peoples' livelihood into the conservation equation. The creation and management of Deosai National Park (DNP) in Northern Pakistan was one such initiative, which aimed to improve the livelihood of local communities without compromising conservation, particularly the protection of endangered brown bears (*Ursus arctos*). A recent study by Nawaz et al. (2008) evaluated the effectiveness of the park management strategy adopted in the DNP in terms of the trend of the brown bear population. The brown bear, the key species of the park, is an endangered species with rapidly shrinking range in Asia.

DNP (75° 27' N, 35° 00' E) is an 1800 km^2 alpine plateau, with elevations of 3,500 to 5,200 m. It is a relatively flat area between narrow valleys and steep mountains, and its vast grazing grounds make a significant contribution to the livelihood of local and nomad communities. The Himalayan Wildlife Foundation (HWF) initiated a project in 1993 to conserve brown bears in DNP. The HWF operated a summer field camp in DNP from 1993-2006, and its staff observed individual bears regularly and documented the information required to estimate population size and reproductive parameters. The following factors helped in individual recognition: 1) distinct color variation among individuals, 2) characteristic white patches, which differed in size and shape, 3) sexual dimorphism: brown bears are sexually size dimorphic, which helped differentiate between sexes, 4) radio-collaring: seven adults were radio-collared, which increased the reliability of the observational study, and 5) genetic analysis verified population size and maternal relationships among individuals that were assumed from field observations.

Counts of brown bears increased from 19 in 1993 to 43 in 2006. Averaged over the study period, there were 41% adults, 8% subadults and 18% young (up to 4 years of age) in the population. Population growth rate was estimated at 5% annually (95%CI: 1.03-1.07), by regressing population size (ln N) on year. This statistically significant population growth suggests that the program has been successful and that the park has met its primary goal. The DNP had a three-fold challenge for management since its inception: a biological challenge to conserve the small brown bear population, a resource management challenge to balance the needs of people without compromising ecological integrity, and a sociopolitical challenge to build the confidence of the local communities and engage them in conservation. The key factors behind the success of the park appear to be the reduction of human-caused bear mortalities and community participation. Community participation was achieved by recognising community rights and sharing park benefits, which was a major departure from the conventional PA management in Pakistan.

The recovery of the bear population is significant, because the population has the lowest reproductive rate yet documented for a brown bear population, due to a late age of first reproduction (8.25 years), a long reproductive interval (5.7 years), and a small litter size (1.33). Poor habitat quality, low quality food, high seasonality, and extreme weather conditions in the Himalaya probably explain the poor reproductive performance. Considering this low reproduction and known exchange of individuals with neighboring populations, we believe that the observed growth was a sum of reproduction and immigration.

The study documents movement of brown bears between Deosai and adjoining valleys in Pakistan, and also shows connectivity with the Indian populations. We recommend that protection be extended to the adjacent valleys, while allowing communities to sustain their livelihoods. Cross-border cooperation in this area, such as a joint peace park or protected areas along the Line of Control, should be a priority action to conserve bears in the region. Such an initiative would benefit many other threatened large mammals as well.

Brown bears are declining throughout South Asia and often have low productive rates. Therefore, conservation efforts for brown bears in this region must target reducing human-caused bear mortalities, particularly of adult females. Changes to the legislative and regulatory framework of the PA that would recognise the rights of communities and provide the framework for community participation and benefit sharing should promote the involvement of the local people. Involvement of the local people can increase the efficiency of conservation, in addition to reducing costs and conflicts.

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Nawaz, M.A., J.E. Swenson and V. Zakaria. 2008. Pragmatic management increases a flagship species, the Himalayan brown bears, in Pakistan's Deosai National Park. *Biological Conservation* 141(9): 2230-2241.

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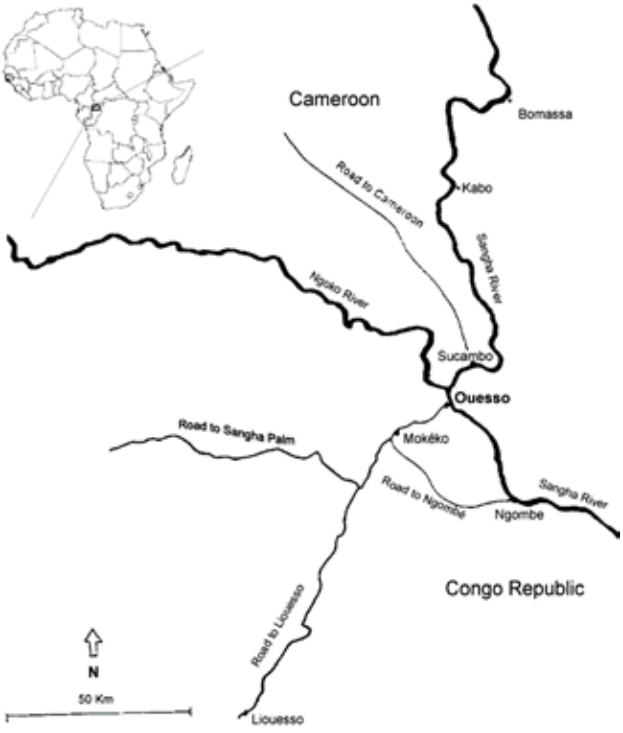
Himalayan Brown Bear in Deosai National Park, Pakistan

Usman Ghani

Bushmeat Trade in Ouesso, Republic of Congo

A. Bennett Hennessey and Jessica Rogers



Routes by which meat is brought into Ouesso

In biologically rich, but economically impoverished areas of the world, people frequently turn to bushmeat as a food source. Bushmeat is any meat caught in the wild for human consumption. The hunting and capturing of bushmeat often fails to discriminate between common and abundant, and rare and threatened species. As a result, the collection of bushmeat can be a force driving some bird and mammal species closer to extinction.

In the tropical rainforests of Central Africa's Congo Basin, fish and bushmeat are the primary sources of protein for the human population. Meat from domesticated animals is both rare and expensive. In the tropical forest habitat of the Republic of Congo, hunters target medium to large mammals, including chimpanzees, gorillas, other primates, elephants, bongo, and several species of antelope. Several of these species are globally endangered, although locally abundant. As the human population grows, the forests around villages and towns have been cleared for agriculture. In addition, hunting has decreased the supply of local wild animals. As a result, villagers increasingly depend on meat from outside the area immediately surrounding the villages.

The largest town in northern Republic of Congo, Ouesso, has a meat trade that consumed 5700 kg (12,566 lbs) of bushmeat a week in 1994. Duikers (small forest antelopes) were the most abundant animal hunted, with a remarkable 400 individuals sold per week, likely due to the ease of hunting and transporting them. Unfortunately, the meat of endangered species, such as chimpanzees, gorillas and even elephants, was also sold in the market.

By following hunters and interviewing them, we learned about the three main hunting systems used in the area: snares, night hunting with flashlights and guns, and day hunting, the only legal form of hunting. Snares were the most common form of hunting due to the inexpensive nature of the materials necessary. Snare hunting is indiscriminate, often capturing endangered species such as gorillas. We found that two-thirds of the meat for the market came from a road to a village called Liouesso, southwest of Ouesso. As the roads between these areas improve or degrade it is likely the routes of meat entering the market will change.

Finally, we concluded that law enforcement and wildlife management were ineffective in the study area, either because local people were unaware of the laws or because the area concerned was too large for local law enforcement to effectively patrol. The addition of roads to this area might aid law enforcement's ability to patrol, but would also result in easier transport of bushmeat and increased access to hunting grounds. We recommend that Ouesso should continue to be monitored to determine the sustainability of its bushmeat trade. The simplicity of this study means that it can easily be repeated to understand how sustainable this market has become, and what impacts the bushmeat trade may incur on local biodiversity.

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Cattle Populations from Protected Areas

Bidhan Kanti Das

In India, as elsewhere, protected areas (PAs) have permanent resident populations who are historically dependent on forest resources for their livelihood. The Buxa Tiger Reserve (BTR), in the northern part of West Bengal, is one such reserve forest where villagers have been residing for more than 100 years. With the creation of a national park, employment opportunities for the forest villagers, who were once treated as an important labour force during the commercial forestry regime, have drastically declined. To reduce pressure on forest resources at the BTR, the World Bank financed India Ecodevelopment Project (IEDP) was initiated with the aim to involve local people by supporting sustainable alternative income generating activities. In consonance with the dominant view that livestock grazing in bio-diverse regions is destructive to nature, reduction in cattle populations and stall feeding of cattle have been included as reciprocal commitments under this project.

This paper is an attempt to assess whether the strategy of cattle reduction is really possible. It also tries to explore how far a reduction of cattle is acceptable or feasible in the context of present findings, especially in India. Results show that there is little impact on cattle populations after the project intervention. However, the slow but consistently decreasing trend in cattle populations is evident due to natural processes like less resources, diseases, sale of cattle during the periods of crisis and natural calamities. Analyses also reveal that where alternative choices of income-generating activities were limited, people, especially those who had some land, adhered to traditional occupations like agriculture. In such a situation, cattle were regarded as an important resource due to multiplicity of use for sustaining daily livelihoods and also treated as a cash asset by rural as well as forest people for any activities requiring instant cash. The marginal cultivators, who do not possess their own resources for cultivation especially bullocks, have to hire either by giving something in return as kind or by paying high amounts as cash. So whenever opportunities arise, they try to procure items required for cultivation as observed in the IEDP.

Besides, forest villagers are reluctant to reduce cattle as they considered cattle of high economic value. They are not so much interested in rearing high bred cows due to poor understanding of rearing, less availability of veterinary care and unfortunate experiences in the past. Moreover, most forest villagers do not consider grazing in forests as harmful to forest and wildlife. But villagers from fringe areas are compelled to reduce cattle due to increased protection work, dwindling resources, reduced manpower for rearing with the disintegration of joint family system and less pasture lands due to increased agriculture.

Most conservationists typically generalise, without focusing on regional or local variations. As a result, the policy of imposing models developed for one area and with one set of values upon another area and culture is frequently ineffective. As cattle are an integral part of the rural economy and livelihood especially for marginalised, vulnerable groups in forests where alternative employment opportunities are limited, the reduction or removal of cattle may not be a viable strategy.

A management strategy, like rotational grazing of livestock, might be an alternative instead of sticking to the strategy of reduction of cattle and curtailing villager's rights over forests especially within the PAs. This will instill forest people's confidence in conservation of PAs in India.

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Forest Cover, Condition, and Ecology in Human-impacted Forests

Jane Carter Ingram and Terence P. Dawson

The littoral forests of south-eastern Madagascar possess high degrees of biodiversity and have been identified as a conservation priority, but face pressures from subsistence use of forest resources by local communities, increasing numbers of migrant populations using the forests for charcoal production and large-scale mineral extraction. Despite their conservation importance, little is known regarding how these forests have been impacted by and have responded to different anthropogenic pressures or natural stressors, such as climate, nor how these human and physical factors interact to influence forest integrity.

The forests are divided into three sites referred to as Ste. Luce, Mandena and Petriky, each of which have unique social, physical and ecological characteristics despite their collective classification as a unique littoral forest subtype and their close geographic proximity to one another. An assessment of deforestation patterns, forest condition and tree species composition of remaining forest stands at each site is important for understanding the nature, scale and distribution of human and natural pressures impacting littoral forests and, thus, may help inform forest conservation priority setting throughout the area.

The aims of this study were threefold: to document patterns of littoral forest loss at multiple spatial and temporal scales; to map forest structure across the littoral landscape; and to assess the abundance and diversity of littoral forest tree species valuable to humans and important for conservation. The methods applied included the use of satellite imagery of forest cover and forest loss combined with ground-based ecological surveys of tree diversity and structure.

Assessments of forest cover change using satellite imagery spanning an 18 year time period illustrated spatially and temporally dynamic patterns of forest loss across each site and, thus, contrast with commonly used linear portrayals of deforestation. The spatially and temporally disaggregated assessment of forest change conducted within this study permitted a site based understanding of the different factors threatening forest cover. This more nuanced depiction of deforestation was supplemented with a quantitative assessment of forest structure across the littoral landscape, which was derived by integrating satellite imagery and ground survey data. These results showed that a combination of physical factors, such as climate, acting at a coarse scale, and anthropogenic factors acting at a site-scale, influence forest basal area, which can be related to forest condition. An understanding of how different human and natural factors interact across the landscape and where anthropogenic pressures are the greatest can help guide which and where management interventions may be most effective.

In order to assess how forest condition may influence community composition, we conducted inventories of tree species diversity and abundance. These surveys revealed a strong relationship between basal area and diversity measures, suggesting pressures influencing forest condition may also affect species composition. Despite considerable human impact on the forests, species richness and diversity of tree species communities remained relatively high across the landscape. Human impact on species diversity varied across user groups: forest use practices by local people seem to be more sustainable with respect to maintaining diversity and abundance of utilitarian trees than practices such as charcoal making employed by migrant groups. The high overlap between endemic and utilitarian species suggests opportunities for conservationists and local people to work together to meet conservation goals and fulfill human needs across the landscape.

This study has demonstrated that, although humans have had a discernable impact on the littoral forest landscape in south-eastern Madagascar, this impact is variable throughout time and space and is a function of human and environmental factors that interact and differ in intensity across each site. Although, often described as severely degraded, these forests remain repositories of biodiversity and forest resources important for human well being. If these forests are to be conserved in the long-term, management plans must account for the nature, distribution and scale of the different pressures acting upon the littoral system at individual sites and must be designed to adapt to likely changes in these factors over time.

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Fuzzy Logic and Shifting Base Lines

Quantitative research shows that sometimes the 'good old days' were as good as they say

Nathan Brouwer

Fishermen are known for telling stories, the best known being the giant fish that unfortunately was 'the one that got away'. Cameron Ainsworth and Tony Pitcher, both of the University of British Colombia in Canada, and Christovel Rotinsulu of Conservation International Indonesia, think there's more to these stories than just tall tales. As fisheries around the world show signs of collapsing, its becoming apparent that stories of large fish and abundant catches from the past may not be so far-fetched. What if older fishermen aren't exaggerating about the good old days, but rather the younger generation don't appreciate what has been lost?

In some waters, the number of fish has been reduced by years of over-harvest. The fish themselves can also be smaller due to the genetic effects of harvesting large fish for many years. Older fishermen have witnessed these changes, but younger fishermen lack the experience to recognise emerging problems.

Conservationists call this phenomenon a shifting cognitive baseline (SCB). SCBs can cause two major problems. First, poor countries usually lack historical data on how productive their natural resources once were. Ecologists determining the sustainability of a fishery therefore have to consult fishermen about how many fish there were in the past. If there has been a process of shifting cognitive baselines, many fishermen will not have accurate knowledge of what fishing was like previously. Depending on whom they ask, researchers may be told that the harvest is declining, or that it's just fine. The health of the fishery could therefore be misdiagnosed. Second, if fishermen don't recognise that their fishery is in decline, they will accept its current health as the status quo. This makes them less inclined to believe that something needs to be done to help the fishery.

According to Ainsworth and his team, SCBs have been identified in only a few fisheries. They set out to see if one existed in the Raja Ampat Archipelago of eastern Indonesia. This was done as part of an evaluation of what changes had taken place over the last 40 years in this fishery.

Raja Ampat is part of the Southeast Asia Coral Triangle, an area of remarkable coral diversity. Both artisanal and commercial fishermen work these waters. Despite a low human population, many of the typical threats to reefs are occurring there: increased fishing pressure, run-off from logging, dynamite fishing, and harvest of corals.

Because there was little historical data on the fishery, the researchers relied on the knowledge of local fisherman participating in projects sponsored by the NGO Conservation International. Over 200 fishermen were interviewed and asked to describe the status of 44 different species of fish. Fishermen ranked the abundance of each species as high, medium, or low for each decade since the 1970s. They also indicated which fish became less common over time, as well as if their price changed. These descriptions of abundance were then standardized against harvest data collected by the government since the 1990s. By knowing the number and size of fish in the fishery over the last two decades, the authors were able to back-calculate the status of the fishery through

A coral trout for sale in a local market

Megan Bailey

Cameron Ainsworth

Despite their small scale and traditional gear, artisanal fish harvesters can significantly impact marine ecosystems

the 1980s and 1970s using trends established from the interview data.

Ainsworth and his collaborators had to overcome a major problem inherent in qualitative data - depending on age, experience, and expectations, one fisherman's 'high' could be another's 'low'. For example, an experienced fisherman who knows the best places to fish for a certain species may report that its abundance is high. A younger fisherman who lacks experience may be less successful, reporting its abundance as low.

The authors addressed this problem with fuzzy logic. In normal logic, 'high', 'medium', and 'low' would be represented using discrete categories, such as 3 for high, 2 for medium, and 1 for low, with only these three values allowed. In fuzzy logic, categories are represented on a continuous scale. For example, high is designated 1, low is 0, and medium 0.5, with any value between 0 and 1 allowed. Additionally, every answer is allowed to be a member of more than one group. If a fisherman said a species had medium abundance, his answer is given partial membership in both the high and the low categories. This fuzziness allows different groups to overlap, and makes it possible for one fisherman's 'high' to be treated the same as another's 'low.'

Ainsworth and his colleagues concluded that there was a SCB among fisherman in the archipelago. Older fishermen indicated that fish had been more abundant in the past, while younger ones did so less often. Moreover, the most experienced fishermen had the greatest understanding of the decline. Though there were high levels of variability, the fuzzy analysis indicated perceived declines among all species in the fishery, including those not harvested. The older fisherman did not exaggerate about the 'good old days', either: the authors' found evidence that some species may have declined by an order of magnitude since the 1970s.

Ainsworth and his collaborators conclude that the lack of precision in qualitative data is countered by the ease of collection and the breadth of knowledge fishermen possess. While government data indicated that some species were in decline, it did not indicate a community-wide decline. The Ainsworth team concludes that the use of indigenous knowledge is important in biodiversity assessment, and that shifting cognitive baselines must be accounted for in fisheries studies.

Summarised from:

Ainsworth, C.H., T.J. Pitcher and C. Rotinsulu. 2008. Evidence of fishery depletions and shifting cognitive baselines in Eastern Indonesia. *Biological Conservation* 141: 848-859.

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Collaborative Research and Management among the Kaxinawá in Amazonia

Kaxinawá and biologists collaborate to monitor and manage wildlife in Brazil

Nathan Brouwer

Research and conservation frequently go hand in hand. The data collected by academics helps inform management of natural resources, such as the establishment of reserves or bag limits on wild game. Most students complete their research in five years, and the grants that fund professors' research often have similar life spans. Many conservation problems, however, can not be characterised that quickly, and monitoring is required to assess management efforts. This creates a disconnection between the efforts of academics and the needs of conservation.

To address this, local people who rely on natural resource use are being integrated as collaborators in long-term biodiversity research. Pedro de Araujo Lima Constantino of the Brazilian non-profit Comissão Pró-Índio do Acre (CPI-AC), his colleagues at the University of Florida, and members of the Kaxinawá indigenous group report on their collaboration in Biological Conservation.

The Kaxinawá live in the Brazilian and Peruvian Amazon. In Brazil, the Kaxinawá live near the remote headwaters of the Jordão and Tarauacá rivers. In 1991 the Kaxinawá began receiving official title to their land. This allowed them to bar hunters from nearby Jordão City from their territory.

A conventional wildlife survey was conducted during the establishment of these territories. Wildlife populations were found to be severely impacted by unsustainable hunting, and several species were concluded to be locally extinct.

The Kaxinawá had also recognised that game was becoming less abundant. In 1996 they sought resource management guidance from CPI-AC. CPI-AC began training indigenous agroforestry agents (IAAs) to help the community develop sustainable resource management practices.

Among the IAAs' activities was monitoring hunting. In 2005 scientists collaborated with the Kaxinawá to systematise their monitoring system and develop hypotheses that could be tested through their efforts, as part of a bi-national conservation project between Brazil and Peru in the surroundings of Serra do Divisor, Acre. The Kaxinawá proposed that there was variation in the abundance of game between villages in their territory, and that the most favored species remained abundant only near the isolated headwaters of the rivers.

IAA leader Raimundinho Kaxinawá weighing a howler monkey

They also hypothesised that land use, hunting, and human density were the main factors causing this variation.

Constantino and his team then worked with the Kaxinawá to develop methods to test these hypotheses. An important goal of this process was to assure that the data would be meaningful to biologists as well as the Kaxinawá. Both parties could therefore interpret the results and collaborate to refine the Kaxinawá's wildlife management plan.

IAAs began surveying every household in their village. For every animal killed, the IAAs recorded data about the animal and the activity of

the hunting party. The study reports on the first year of this ongoing study, with individual villages contributing up to 11 months of continous data.

The study provided new insights into the status of game species in the area, and the effects of hunting. The IAAs recorded 33 different species being harvested. Five of these were purported by ecologists to be extinct in 1996. One of the 'extinct' species, the white-lipped peccary (*Tayassu pecari*), was being harvested regularly by villages along the entire river. Other species deemed rare by the 1996 survey were also commonly harvested. Some of these species were perhaps missed during the 1996 survey, while others had likely returned to the area from near-by nature preserves. These findings indicate the importance of using these collaborative methods in addition to conventional wildlife surveys.

Analysis of the IAAs' data indicated that wildlife abundance was highest near the headwaters of the rivers and decreased downstream toward Jordão City. As proposed by the Kaxinawá, this trend correlated with increasing human population density, the density of villages in an area, the age of villages, and the number of trails for harvesting rubber.

The authors also examined whether the analyses done with the IAAs relatively simple data corresponded to more complex multivariate analysis. In general, results from the basic univariate variables collected by the IAAs were correlated with multivariate analyses. This indicates that more straight-forward forms of wildlife data and analysis can be as robust as more labor-intensive techniques.

Additional insights were gained regarding the effects of wildlife abundance on Kaxinawá hunting.


Daniella Marchesi

Kaxinawá hunter boys with cayman

Down-stream villagers were more likely to hunt non-game species or those considered suitable when food was short. This included the taboo giant-armadillo and capybara. Constantino and his colleagues propose that depleted wildlife populations have led to the harvest of less-preferred species and the expansion of some villagers' diets.

These research techniques and villager participation in data analysis are being promoted via CPI-AC to other indigenous groups. Constantino and his colleagues propose that results from this long-term and cross-cultural collaboration will continue to help the Kaxinawá and other indigenous peoples to understand and manage their wildlife resources.

Summarised from:

Constantino, P.A.L., L.B. Fortini, F.R.S. Kaxinawá, A.M. Kaxinawá, E.S. Kaxinawá, A.P. Kaxinawá, L.S. Kaxinawá, J.M. Kaxinawá and J.P. Kaxinawá. 2008. Indigenous collaborative research for wildlife management in Amazonia: The case of the Kaxinawá, Acre, Brazil. *Biological Conservation* 141: 2718-2729.

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IAA José de Lima Kaxinawá and colleague mapping their hunting territory


Renato A. Gavazzi

Reduced-impact Logging: The Right Direction, but There's Room for Improvement

Selective logging preserves forest structure but disrupts bird communities

Nathan Brouwer

"Save the rainforest!" is one of the most well-known cries of the environmental movement. Global demand for timber, and local demand for farmland, still cause 12 million hectares of tropical forest to be logged each year. One way of lessening the impact of logging is to selectively harvest only high-value trees and reduce the impacts of harvest on the soil and forest understory.

Reduced-Impact Logging (RIL) is a new approach that integrates several sustainable practices. The process begins by identifying a select number of trees of the appropriate species and size prior to harvest. In some cases, loggers are required to leave every fifth tree selected as a seed tree. During harvest, logging roads and the trails used to bring logs to them are laid out to minimize disturbance. Before felling, vines are removed from trees to prevent them from snagging their neighbors. Loggers also try to avoid having falling trees crash into other trees. Additionally, the vehicles that transport the timber to logging roads have rubber tires instead of treads, which minimises soil compaction. After harvest, stands are left for several decades to regenerate.

Timber harvesters, trade organisations and environmental groups such as the Nature Conservancy and the World Wide Fund for Nature have asserted that RIL preserves biodiversity. Adam Felton and his colleagues at The Australian National University and the Instituto Bolivana de Investigación Forestal have tested these claims in an RIL forest in Bolivia.

Half of Bolivia's lowland tropical and sub-tropical forests have been divided among logging concessions. Laws enacted in the mid-1990s have promoted sustainable logging, and 2.2 million hectares are now certified by the Forest Stewardship Council (FSC). Felton and his team conducted their study in the FSC-certified Guarrayos Forest Reserve. The firm Agroindustria Forestal La Chonta has the rights to log within the preserve using sustainable practices. The logging concession was certified in 1998 by SmartWood, an organisation that certifies the sustainability of a timber harvest.

The forest giant *Ficus boliviana* often dominates the canopy

Kristen Evans

A chestnut-eared Aracari resting within the majestic canopy of a *Ficus boliviana*

Previous studies have shown that RIL can minimise damage to uncut trees in a forest. However, there can still be significant changes to the amount of forest canopy, the plants that compose the ground cover, and the humid microclimates that characterise tropical and sub-tropical forests. Felton and his colleagues examined whether RIL impacts are extensive enough to affect the composition of the bird communities found of the forest.

To test this, the researchers conducted bird surveys at various points in logged and un-logged stands within the Guarrayos Forest Reserve, recording the number and species of birds they observed. Tree surveys were used to asses the structure of the forest and determine how much of the canopy was open and allowed light in. The understory vegetation was also surveyed to gauge the impact of roads and trails.

Their findings may take some wind out of the sails of RIL's proponents. Despite the care taken during RIL, many birds appear to find logged areas to be uninhabitable. Of the 158 species observed, 20% were either absent from the logged section, or significantly less abundant. These species seem to prefer the un-logged areas, which typically had more large trees, higher tree diversity, or more diverse understories.

Additionally, they found that 40% of the birds that preferred un-logged forests are of conservation concern; this included woodpeckers, falcons, and toucans, and many insect-eaters. On the other hand, many of the birds which were found in significantly higher abundance in the logged sections were those known to be tolerant of human disturbance.

The harvest and the hauling of trees appear to cause these changes. Trails, roads, and landings were found by other researchers to disturb 25% of the ground cover of the forest. This damage especially impacts insect-eating birds, which typically forage around small trees and shrubs near the forest floor. Though only four trees were harvested per hectare, openings in the canopy still increased by 25%. Gaps in the canopy allow light to reach the plants in the forest understory, presumably increasing temperature and decreasing humidity. The authors propose that the cool and moist microclimates favored by insect-eating birds and their prey are reduced by the intrusion of light.

Felton and his colleagues point out that the impact of RIL could be reduced in this forest by not logging a single species: *Ficus bolivina*. This fig tree can reach 200 cm in diameter, with a crown that is 30 meters across. Removing a single *F. bolivina* can therefore open a large gap in the canopy.

The authors also recommend that trail building within the logged areas be more tightly controlled to reduce disturbance to the understory. Previous work has found that 25% of trails in a selectively logged forest were short-cuts or otherwise unnecessary.

Felton and colleagues recommend that sustainable forestry practices be evaluated critically, and warn against complacently accepting new techniques. Forests and biodiversity are dynamic, and sustainability is not achieved simply because most of the trees remain standing after a harvest. The authors assert that sustainability can only be evaluated in light of long-term data on biodiversity, regeneration of the understory, and the effects of the harvest cycle.

Summarised from:

Felton, A., J. Wood, A.M. Felton, B. Hennessey and D.B. Lindenmayera (2008). Bird community responses to reduced-impact logging in a certified forestry concession in lowland Bolivia. *Biological Conservation* 141: 545-555.

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