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Do Community-Managed Forests Work? A Biodiversity Perspective

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Abstract: Community-managed reserves (CMRs) comprise the fastest-growing category of protected areas throughout the tropics. CMRs represent a compromise between advocates of nature conservation and advocates of human development. We ask whether CMRs succeed in achieving the goals of either. A fixed reserve area can produce only a finite resource supply, whereas human populations exploiting them tend to expand rapidly while adopting high-impact technologies to satisfy rising aspirations. Intentions behind the establishment of CMRs may be admirable, but represent an ideal rarely achieved. People tied to the natural forest subsist on income levels that are among the lowest in the Amazon. Limits of sustainable harvesting are often low and rarely known prior to reserve creation or respected thereafter, and resource exhaustion predictably follows. Unintended consequences typically emerge, such as overhunting of the seed dispersers, pollinators, and other animals that provide services essential to perpetuating the forest. CMRs are a low priority for governments, so mostly operate without enforcement, a laxity that encourages illegal forest conversion. Finally, the pull of markets can alter the "business plan" of a reserve overnight, as inhabitants switch to new activities. The reality is that we live in a hyperdynamic world of accelerating change in which past assumptions must continually be re-evaluated.

Keywords: extractive reserves; communal forests; human-occupied protected areas; Amazonia; indigenous reserves; tropical forest; sustainable-use reserves; hunting; deforestation

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Community-managed forests comprise the fastest growing category of protected areas throughout the tropics and now far exceed strictly protected reserves in both numbers and total area (Schmitt, et al., 2009 [1]; Peres 2011 [2]). Yet their role in protecting full complements of tropical biodiversity remains contentious and poorly understood. We provide a conservation biologist perspective on this issue. Both of us have conducted ecological research in Amazonia for several decades, JT in Perú and CAP in Brazil. Our comments are based on long personal experience with native Amazonians, global trends and an understanding of the ecological requirements of biodiversity conservation. Although we shall offer examples from other ecosystems, our emphasis will be on the Amazon where huge tracts of land have been allocated to community management in the form of indigenous reserves and several categories of legally occupied community-managed reserves. For example, a total of 22.0% of the Brazilian Amazon has been allocated to "extractive" and "sustainable development" reserves (de Marques, et al. 2016 [3]), and a further 22.3% is represented by officially designated indigenous territories (RAISG 2015 [4]).

Community-managed reserves in Amazonia were created to sustain the traditional lifestyles and economies of established Amazonians, including both *caboclos* and *ribereños* (people of mostly mixed ethnic background who speak Portuguese or Spanish) and native Americans. Most such people subsist

on small slash-and-burn plots supplemented with hunting and fishing. Cash income, if any, is derived from selling forest products, including fish, game (bushmeat) and non-timber products, such as natural rubber, Brazil nuts and several oil seeds. Various restrictions and regulations apply but a constant among them is that there should be no large-scale deforestation.

Amazonian lands designated for community management were intended to be models of sustainable development. When reserves were established, most of the residents lacked capital and modern technology and survived on meager subsistence economies in remote corners of a region the size of the continental US. However, the justifying assumptions of sustainability and perpetuation of traditional lifestyles are being rapidly eroded by the penetration of modernity into the farthest reaches of the basin. In this context, the notion of sustainability has become an oxymoron. A truly sustainable lifestyle, as we view it, would resemble that practiced by native Amerindians prior to Western contact. Human population densities were mostly <1 individual per km^2, technological innovation was glacially slow, and the demographic processes of birth and death were more or less in balance. These fundamental conditions for sustainability have been massively disrupted by government policies designed to lift marginal populations out of poverty and by the rapid expansion of heavily capitalized logging, mining and agriculture into the heart of Amazonia. In other words, all bets are off with respect to the nominal motivation for creating community reserves, that of preserving traditional economies and lifestyles. Conserving biodiversity was always regarded as a secondary benefit of reserve creation and few or no provisions for biodiversity conservation were written into the enabling legislation. In effect, community-managed reserves are free-wheeling entities that operate under few restraints that might help ensure the perpetuation of biodiversity.

At the most basic level, community management and biodiversity conservation are inherently in conflict because the community subsists on the resources of the reserve. It entails exploitation and exploitation implies disturbance and selective removal of preferred resources while others are ignored, a process that progressively enhances the abundance of ignored resources at the expense of preferred ones. The process often leads inexorably to one or both of two alternatives. Either the community expands the area over which it extracts preferred resources and/or it initiates a process of intensification. Intensification can take many forms, such as agroforestry, expansion of forest clearings for agriculture, sowing pasture grasses for livestock, replacing natural forest with tree plantations (e.g., oil palm, rubber, *Eucalyptus*), and aquaculture. None of these forms of intensification enhances native biodiversity and most are detrimental to it.

In the literature on community management, a topic that is almost never mentioned is human demography. Demography is the proverbial elephant in the room. Conservation planning is typically based on current circumstances, not those of even one generation forward when the community is likely to contain twice as many families. It is also based on current lifestyle and access to technology, ignoring the fact that lifestyles inexorably evolve and technology is subject to a process of continuous upgrading and refinement. This brings us to the well-known IPAT equation: human Impact = Population $\times$ Technology $\times$ Consumption, which helps frame how we think about humanity's footprint on the natural environment at different scales (Ehrlich 2014 [5]).

Demographic trajectories of rural and indigenous communities in tropical developing countries often diverge from those in cities. In urban areas, everything has to be bought with hard-earned money. Children are demanding and expensive, and require significant parental investments in education extending over many years, so there are strong incentives to limit family size. But in a rural context, children are mostly regarded as assets because they often contribute labor to family activities instead of going to school. In this context, a local annual population growth rate of ~3.52%, representing a village doubling time of 20 years, could be defined as normal (Joppa, et al. 2009 [6]). How often is a community management project planned on the assumption of a 20-year population doubling time? Not often. And while management plans of communal reserves, if any, may limit or preclude immigration from other areas, they rarely if ever address internal population growth.

In our hyperkinetic world, few people live in such remote locations that they lack access to the latest technology. Highly desired items such as guns, chainsaws, boat motors and smartphones thus find their way into the heart of any African rainforest and the most distant tributaries of the Amazon. People who a generation ago wore grass skirts, paddled dugout canoes and hunted with bows and arrows today wear Western dress, drive outboard motors and hunt with shotguns. Governments are eager to provide public amenities, including roads, primary schools, health clinics, electricity, and more recently cell phone service and the internet. Under the relentless pressure of modernization, nothing stays the same, and material aspirations understandably escalate.

Historically, indigenous communities were autonomous and largely self-sufficient, but exposure to the market awakens desires, which have irreversible consequences for human behavior. A person who walks barefoot, for example, will envy the person who has a pair of shoes. But a pair of shoes can't be made from forest products, it has to be bought, so the individual is confronted with a need for cash. In a remote community, there is unlikely to be readily available employment, so money can only be earned by commercializing products obtained from the communal holdings.

And thus begins a spiraling economy of exploitation that is often inherently unsustainable and that has no logical or practical end point other than the exhaustion of desirable resources. Rules and regulations are rarely enforced because governments are reluctant to curtail the earning capacity of people who are poor, and technical assistance from government agencies or conservation NGOs to ensure the co-management and sustainable harvest of resources is rarely available.

Back to the equation. None of the components of the I = PAT equation are constant or even plausibly constant under any reasonable scenario. Family planning services are often unavailable to rural people, so birth rates remain high. Exposure to television and social media arouses desires and aspirations that motivate the rapid adoption of new technologies and patterns of consumption, making a mockery of any claim of sustainable development.

In areas under community-based management of forest lands, bushmeat, other nontimber forest products and timber are the near-universal sources of cash revenue. In Indonesia, for example, there are specialty products like rattan, durian and gaharu, but rattan and gaharu have become scarce and durians are increasingly grown in plantations (Soehartono, et al. [7]). Few people can any longer make a living extracting them from the natural environment. There is an inevitable progression here, driven by human striving.

Products derived from communal reserves are of two basic types. Either they can be propagated *en masse* in gardens, plantations, or animal enclosures, or they possess properties inimical to mass propagation. Although there have been scores of attempts to domesticate wild animals that are favored in the bushmeat trade, few of these have been successful. More generally, there is a widespread notion that bushmeat can be sustainably harvested, but this is a simplistic view that overlooks the wide spectrum of life-history traits in tropical forest vertebrates, and the extreme vulnerability of species possessing low reproductive potential. For example, one of the most highly favored species of bushmeat across the Amazon is the spider monkey (*Ateles* spp.). The natural interbirth interval in this species is 30 months, longer than in humans (Symington 1987 [8]). Spider monkeys thus cannot withstand even light hunting pressure, and should at best be described as a "bad" game species. Only after exhaustion of the bushmeat resource can protein-starved villagers be persuaded to engage in animal husbandry. However, small-scale animal husbandry is a poor competitor against commercial livestock production, which tends to supply the protein requirements of market-integrated communities much more efficiently.

Prime, slow-growing timber species—such as mahogany and rosewood—are everywhere extracted to exhaustion, even if the harvest in community-managed forests is subject to fairly strict controls under government-enforced reduced-impact logging guidelines (Richardson and Peres 2016 [9]). High-value hardwoods can be difficult to propagate and do not attain commercial size for a century or more, so are beyond the pale for an impoverished villager who has to feed his family today. Low-fecundity game species and slow-growing prime timber are the first to go, and

can be effectively defined as non-renewable resources. They should not be considered anything else. To do so is to promote an illusion, a feel-good fiction that does a disservice to the whole concept of sustainable development.

Perhaps the most spectacular example of a sustainable resource extracted from nature was that of natural rubber. It generated vast wealth (and gruesome human exploitation) for a brief period of a few decades until it ended in a crash. The crash followed when plantations in Malaysia—based on rubber tree (*Hevea* spp.) seeds smuggled from Brazil—came on line. Plantations proved to be so much more productive and efficient than collecting rubber from the Amazonian forest that they caused the price to collapse and government subsidies to be discontinued, and with it the whole economy of gathering rubber from the natural forest.

After the murder of the renowned environmental activist Chico Mendes, there were well-intentioned efforts to revive the extraction of natural rubber from the Amazon, including the establishment of several large forested extractive reserves in the Brazilian states of Acre, Amazonas and Amapá. These efforts enjoyed modest success because the price of natural rubber gathered from the forest was heavily subsidized by the Brazilian government. As a member of GATT, the global trade organization, Brazil was eventually required to abandon the subsidy and rubber tapping in the Amazon came to an end. Many of the *seringueiros*, as they are called, were left without a means of support and had to migrate to the towns where most of the Amazon population now lives (Parry et al. 2010 [10]), and the rural exodus still continues today.

At present, the only major non-timber product of global commerce to be extracted from natural tropical forests is Brazil nuts. Brazil-nut trees (*Bertholletia excelsa*) grow to prodigious size, take many decades to mature and have special pollination requirements, so have not been widely propagated in plantations. But grafting and other modern silvicultural techniques are being applied to the challenge of growing smaller, fast-growing Brazil-nut trees in plantations, so it is very likely that the harvest of Brazil nuts from the wild will, as in the case of so many other natural products, eventually become a thing of the past. Just think of blueberries, raspberries, strawberries and pecans. All these crops started out as products gathered from the wild, as did all commercial mushrooms. With technology, most problems of large-scale production and commercialization can be overcome, so fewer and fewer products will eventually be harvested from wild nature in a post-modern world. For better or for worse, this is an inevitable certainty.

Two caveats. If we consider Brazil nuts as the flagship natural forest product on the global market, an age structure analysis has shown that the longest-harvested groves, those exploited for 100 years or more, are in decline due to the failure of young trees to recruit (Peres, et al., 2003 [11]). This is the logical, if not inevitable, consequence of removing all the seeds from the population for decade after decade, but on a time scale too protracted for most people to notice. Brazil nut harvesting is thus a self-limiting process that should be appropriately managed if it can ever be defined as a sustainable extractive industry.

Our second observation, based on travels through rainforests of the Americas, Africa and Asia, is that forest extractivists are among the poorest of the poor. Their livelihoods are often based on a seasonal resource that provides an irregular return, as both the volume of the offtake and market prices fluctuate wildly from year to year. The price of Brazil nuts in some years, for example, is so low that it simply doesn't pay to gather the nuts. No one dependent on such an unpredictable return can enjoy a decent life. Instead of thinking about ways to exploit harvest-sensitive natural forests "sustainably", poor rural people should be given the option of access to education that can make them employable in the regular economy.

To illustrate this point, we describe the shifting economic portfolio of the Chico Mendes Extractive Reserve (CMER) in Acre, southwestern Brazilian Amazonia, which ironically was created to slow down forest conversion into pastures following land disputes between environmental leaders like Chico Mendes and encroaching cattle ranchers. Since the mid-1990s this ~970,000-ha reserve, which is currently occupied by some 1900 households, has seen increasing diversification of income

sources and land use following the collapse of rubber prices (Salisbury and Schmink 2007 [12]). Much of that alternative household-scale income, which on average remains very low (US$281/month: Maciel, et al., 2014 [13]), has come from cattle ranching and timber extraction, mirroring the wider regional economy. For example, from 1990 to 2012 natural rubber production in Acre declined from 12,000 to 470 tons, while bovine cattle increased from 800,000 to 3,000,000 head, and native hardwood timber production from 300,000 to ~1,000,000 m^3/year. A growing cattle economy has obviously fueled much forest conversion into pastures, even inside forest reserves that had been nominally protected from deforestation. For example, Gomes (2001 [14]) recorded a 625% increase in pasture area within a single rubber estate within the CMER over a three year period (1995–1998). In fact, most previously forested rubber states at the Chico Mendes Reserve now contain cattle pastures ranging widely in size, clearly portraying a pocked landscape whereby the forest canopy of hundreds of rubber states has been perforated by exotic grasslands (Google Maps 2016 [15]).

Thus far, we have addressed intrinsic challenges to implementing sustainable development via communal management of tropical forests. There are also extrinsic obstacles that can further complicate the picture.

One is that practices can have unintended consequences. Bushmeat extraction is a prime example. All around the world, primates are targets of the bushmeat trade. Yet in most tropical forests, primates, particularly large-bodied species, constitute the most important class of seed dispersers, and their dispersal services are indispensable to the perpetuation of forest composition (Terborgh, et al., 2008 [16]). Depletion of large primate populations can then have the unintended consequence of reducing the carbon storage capacity of tropical forests via the gradual substitution of large-seeded, heavy-wooded primate-dispersed species by small-seeded, light-wooded species that are often small-bird or wind-dispersed (Peres, et al., 2016 [17]). This is, of course, a process with global implications.

Another extrinsic factor is that of enforcement, a function of the state. Communal reserves, while legally constituted, have little public visibility and, consequently, few advocates apart from the local residents, who are likely to be poor and lacking political connections. Thus, the political will required to enforce the original land use mandate is often weak or absent. Some extractive reserves established for the benefit of rubber tappers in the Brazilian Amazon, for example, have been extensively invaded by loggers and cattle ranchers who have mined high-value timber or deforested thousands of hectares without encountering official resistance (Pedlowski, et al., 2005 [18], Marques, et al., 2016 [3]). Miners, loggers and oil companies are also exerting strong political pressure to gain access to indigenous reserves, extractive reserves and even national parks in both the Brazilian and Peruvian Amazon (Finer, et al., 2014 [19], Marques and Peres 2015 [20], Pack, et al., 2016 [21]). In a world experiencing increasing resource scarcity, one wonders whether the political will to resist such pressures will be sustained.

Finally, the most important extrinsic factor influencing the management of communal reserves is that of markets. We have seen how the changing structure of markets has driven the rubber tapping economy out of the Amazon. Now, Brazil nut harvesting is under the shadow of commercial plantations of early-maturing grafted trees, and this argument could be extended to the emergence of commercial aquaculture of high-value fish species, which will compete with successful cases of community-based sustainable fishery management (Petersen et al. 2016 [22], Campos-Silva and Peres 2016 [23]). What surprises will follow next? No one can say. But what can be said with confidence is that transformative surprises are sure to occur with huge future consequences for land use across the tropics, obliterating the assumptions on which many communal reserves were established.

Conclusions

As originally conceived, communally managed reserves have the potential to benefit biodiversity by greatly increasing the area of protected forest cover in the Amazon. Some still do provide substantial biodiversity benefits. But the handwriting is on the wall. Globalization is transforming

the human condition at an unprecedented rate. Populations that lived more or less sustainably in isolation from world markets are now in thrall to them as their members aspire to become modern consumers. Lured by the pull of markets, rural communities across the breadth of Amazonia desire to participate in the money economy and enjoy the fruits of technology—outboard motors, cell phones, television, and much more. Logging, cattle ranching, mining and large-scale agriculture are irreversibly transforming the economy of the region, rendering extractive reserves as obsolete as a Model T. What will the landscapes of today's communal reserves look like 20 years or 50 years from now? Unless the world comes to its senses and completely halts deforestation to avoid releasing additional gigatons of greenhouse gases into the atmosphere, we can expect that areas like the Chico Mendes Extractive Reserve will eventually resemble the surrounding unprotected landscape. Communal reserves in Amazonia were established with little thought given to the future impacts of globalization, much less the rapidity with which globalization can transform the economy of an entire region. Now, in hindsight, it is apparent that these reserves cannot be counted on to provide havens for biodiversity in perpetuity. The only policy yet devised that can ensure the perpetuation of biodiversity in perpetuity is absolute protection. May we not repeat the mistake of imagining otherwise.

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