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Expanding protected areas and incorporating human resource use: a study of 15 forest parks in Ecuador and Peru

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Data from legal records, management plans, and interviews with 63 local experts reveal the substantial expansion of 15 protected areas (PAs) of forest in Ecuador and Peru during the last two decades. Combining results for these PAs, the area under protection increased by over half, from 5,760,814 to 8,972,896 ha, with the Amazonian PAs adding the greatest expanse. Most of this expanded land was legally designated for strict protection; however, in practice, human resource use and settlement are widespread. Hunting is the most common resource use, followed by logging and livestock grazing. Mining and petroleum extraction also occur in four of the 15 PAs. Together these activities on average affect approximately 30% of the area within eight Peruvian PAs and approximately 45% of the area of seven Ecuadorian PAs, far exceeding previous deforestation estimates. By expanding these PAs, Ecuadorian and Peruvian conservationists have significantly improved the coverage of key ecosystems and endangered habitats. However, they now face the daunting task of managing larger, more complex protected areas that *de facto* include thousands of local people. Conservation agencies in both countries are turning toward land-use zoning within PAs to integrate resource use with biodiversity conservation.

KEYWORDS: protected areas, resource availability, parks, forestry, environmental management, human settlements, logging, habitat improvement, ecosystem management, zoning, land use

Introduction

Over the past 25 years, the area of land under legal protection worldwide has increased exponentially, particularly in developing countries where biodiversity is greatest (IUCN, 2004). Concurrently, the mission of parks and reserves has also expanded significantly. By global mandates, protected areas (PAs) are now supposed to do far more than conserve biological diversity; they are charged with improving human well being, guarding local security, and providing economic benefits across multiple scales (Naughton-Treves et al. 2005). Some analysts fear that despite the recent emphasis on human welfare and poverty reduction the expansion of PAs imposes high social costs by limiting local access to land and resources (Ghimire & Pimbert, 1997; Geisler & De Sousa, 2000). Other experts are concerned that the increasingly broad goals for PAs jeopardize their ability to protect biodiversity and overstate progress toward that objective (Locke & Dearden, 2005).

Remote sensing of deforestation provides one important measure of PA effectiveness (DeFries et al. 2005), but avoiding deforestation is not the ultimate litmus test for parks. Biodiversity can be significantly compromised by "invisible" threats such as hunting (Redford, 1992). Some critics have also interpreted reduced deforestation within a given PA relative to the surrounding area as indicating that the PA is simply displacing forest extraction elsewhere and failing to promote sustainable development (Ghimire, 1994). Given the broadened objectives for PAs, monitoring effectiveness now entails accounting for an expanded list of physical and social conditions (Chape et al. 2005) and thus requires interdisciplinary research, including remote and field-based assessments.

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Table 1 Protected areas of Ecuador and Peru included in the study.

Protected Area	Year of establishment	Size at time of establishment (ha)	Size in 2003 (ha)*	Percentage change in size from year of establishment to 2003	Number of boundary changes since establishment to 2003	Range in elevation (masl)	IUCN Category (see Table 2 for definition)
Ecuadorian Protected Areas							
Reserva Ecológica Cotocachi Cayapas	1968	204,420	234,420	15	2	300-4,939	VI
Reserva Ecológica Cayambe Coca	1970	403,000	397,667	-1	1	600-5,790	VI
Reserva Forestal Cuyabeno	1979	254,760	603,380	137	5	180-300	VI
Parque Nacional Sangay	1979	271,925	517,765	90	3	600-5,230	II
Parque Nacional Yasuní	1979	679,730	982,000	45	3	500-600	II
Parque Nacional Machalilla	1979	55,059	55,059	0	3[1]	0-838	II
Parque Nacional Podocarpus	1982	146,280	146,280	0	0	900-3,600	II
Peruvian Protected Areas							
Reserva Nacional Pacaya Samiria	1940	1,500,000	2,080,000	39	3	125-800	VI
Reserva de Biosfera Manu	1968	1,532,806	1,881,200	23	5	365- 4,000	II
Parque Nacional Bahuaja-Sonene	1977	5,500	1,091,406	247	5	220-2,700	II
Bosque de Protección Alto Mayo	1979	160,000	182,000	14	2	950-4,000	VI
Parque Nacional Río Abiseo	1983	274,520	274,520	0	1[2]	320-4,500	II
Bosque de Protección Pui Pui	1985	60,000	60,000	0	1[2]	1,750-4,500	VI
Parque Nacional Yanachaga-Chemillén	1986	122,000	122,000	0	0	800-3,800	II
Bosque de Protección San Matías-San Carlos	1987	145,818	145,818	0	0	300-2,250	VI

* Size includes land legally classified as belonging *within* the specific protected area (as well as marine area in the case of Machalilla National Park). Area in adjacent corridors, buffer zones, or reserves is not included in estimate.
[1] Areas were added to the park equivalent in size to the area excised.
[2] Boundary changes were made to correct minor cartographic error.

To move beyond the highly charged but data-poor debate, we analyze management trends and patterns of resource use in 15 forest parks and reserves in Ecuador and Peru (Table 1). We first document changes in the size of these PAs and/or in management category. We then present estimates of the extent of other extractive resource uses, including hunting, fishing, mining, and livestock grazing. Our study reveals that in Ecuador and Peru considerable land has been added to protected areas, and much of this land is legally designated for strict protection (Type II in the International Union for the Conservation of Nature (IUCN) nomenclature of management categories) (Table 2). However, in practice, the actual area free from human use is considerably smaller than formal classifications indicate. The results of interviews and participatory mapping exercises also suggest that remotely sensed deforestation offers a conservative estimate of the actual area under human use. In sum, by expanding protected areas, Ecuadorian and Peruvian conservationists have significantly improved coverage of key ecosystems and endangered habitats. They now face the daunting task of managing larger, more complex PAs that, in aggregate, include thousands of people as residents and even more as forest users.

Research Design and Methods

Peru and Ecuador are both countries of great conservation importance given their extraordinary species richness and endemism and the high threat to biodiversity posed by human activities (Myers et al. 2000). Within this region, we selected PAs that met the following criteria:

- The majority of the protected area lies at less than 3,000 meters above sea level and the dominant vegetation is closed canopy forest.
- The protected area is administered by the government and one of its major official purposes is biodiversity conservation.
- The protected area was legally established before 1991.
- The protected area covers more than 10,000 ha.

Fifteen PAs met these criteria, eight from Peru and seven from Ecuador (Table 2, Figure 1). During 2003–2004, members of our team traveled to each of these PAs and interviewed, on average, four experts per park. At each site we aimed to include 1) a local representative of the government agency managing the PA, 2) a representative of an NGO actively involved in the PA, and 3) a representative of a community organization, such as an indigenous federation, agriculturalists' union, or landholders association. In all three categories of expertise, when possible, we selected individuals with more than five years of field experience in the region. During each interview, we first explained that we were not judging the performance of individuals or organizations at a given PA, but were rather gathering data for several PAs to reveal regional trends and conditions. One of the authors of this report was always present for these interviews to ensure continuity of methods across the various sites and at some PAs experts were interviewed in groups of two or three. We then presented the expert with a poster-sized map of the PA illustrating basic physical features, PA boundaries, and administrative units. Each expert was asked to describe the history of the PA, prompted by our questions regarding initial state and change in: 1) the process of PA establishment, 2) the presence of human settlements within the PA, 3) the conflicts between local communities and PA managers, and 4) the changes in the location of PA boundaries, and/or in the conservation status of internal zones. We then asked each expert to draw the present location of resource use within the PA, including both illicit and sanctioned activities. Interviews typically lasted over two hours and we offered informants the option of remaining anonymous. We subsequently plotted each expert's drawing of resource use into a GIS file.

Table 2 The six categories of protected areas recognized by the IUCN.

Category	Description
I (a and b)	Strict nature reserve, wilderness protection area, or wilderness area managed mainly for science or wilderness protection
II	National park, managed mainly for ecosystem protection and recreation
III	National monument, managed mainly for conservation of specific natural features
IV	Habitat/species management area, managed mainly for conservation through management intervention
V	Protected landscape/seascape, managed mainly for landscape/seascape conservation or recreation
VI	Managed resource protected area, managed mainly for sustainable use of natural resources

(WDPA Consortium, 2005)

Figure 1 Map of 15 protected areas included in study, Ecuador and Peru (WDPA Consortium, 2005).

A total of 63 interviews were conducted.[1] During the process, we were aware that the information we gained was potentially subjective and imprecise (Pearce et al. 2001; Doolittle, 2003; Yamada et al. 2003). The experts were obliged to sketch their maps of resource use in a rapid manner on large-scale maps. Also, PAs varied markedly in

[1] Only two field interviews were conducted for Cuyabeno Forest Reserve in Ecuador. We were able to record park history and boundary changes, but did not calculate area or intensity of use at the Reserve.

size and prior research coverage. Our effort to compile information for 15 PAs, given a limited budget and time, prohibited us from conducting field research to corroborate the informants' estimates. However, as indicated in other published accounts, participatory mapping by experts (especially long-term local residents) offers a cost-effective, rough method to complement other means of assessing human activities (Pearce et al. 2001; Yamada et al. 2003; Bojorquez-Tapia et al. 2004; Treves et al. 2006). To test the accuracy of the participatory mapping exercise in this case, we examined interobserver variability within the PAs and tested for possible biases among experts across the PAs according to the type of organization they represented and the number of years they had been working in the area. For example, it is possible that park managers might systematically over- or underestimate the extent of human activity according to their desire to emphasize their budgetary shortfalls or successes in limiting threats. Similarly, we predicted that experts with longer histories at a site would be able to identify more uses in a larger number of areas (Yamada et al. 2003). Rather than discard any individual expert's map, we present interobserver variation and statistically assess differences associated with the expert's organization and years of experience.

We supplemented these field interviews with reviews of park-management plans, reports, press releases, legal documents, and other published and gray-literature items. While we aimed to collect the same type of data for every PA, we encountered some country-level variation in the type of information available. For example, data regarding human settlement in Ecuadorian PAs was usually available as an estimate of area settled, while in Peru numbers of residents per PA were more commonly reported. In both countries, the size and location of concessions for industrial mining and oil and natural gas extraction (or exploration) were obtained from official maps.

Results

Boundary Changes, Evictions, and Zoning

Most of the 15 PAs had dynamic histories. Twelve had changed in size or level of legal protection since their creation. On average, each PA had 2.5 boundary changes since its establishment, but three had five changes (Table 1). The total area included within these 15 PAs increased by 56%, from 5,760,814 to 8,972,896 ha (the eight Peruvian PAs grew slightly more than the seven Ecuadorian PAs—Peru: 60% from the original size, 3,800,644 to 6,091,329 ha; Ecuador: 47%, from 1,960,170 to 2,881,567 ha) (Figure 2). The Amazonian PAs had the greatest absolute growth (Peru: Manu, Bahuaja-Sonene and Pacaya-Saimiria each grew by more than 500,000 ha — Ecuador: Yasuni and Cuyabeno each grew by approximately 300,000 ha). Two Ecuadorian PAs experienced the greatest expansion relative to their original size (Sangay: 90%; Cuyabeno: 137%). Whereas several PAs had portions of their area excised or degazetted, only one of the 15 PAs had a net decrease in size (Cayambe Coca Ecological Reserve decreased by 5,000 ha) (Table 1). In Ecuador, from 1982 to 2002 more of the land added for inclusion was designated for multiple use rather than for strict protection (land designated for multiple use within the seven study PAs grew by 157,300 ha (or 86%) and strictly protected land by 129,000 ha (or 54%)) (Table 1). During the same period, the reverse was true for the eight Peruvian PAs (the area under multiple use actually shrank by 64,300 ha (-31%) and strictly protected by 306,500 ha (-67%)) (Table 1).

Explanations for boundary changes vary (Table 3), but the most frequently reported reason was to

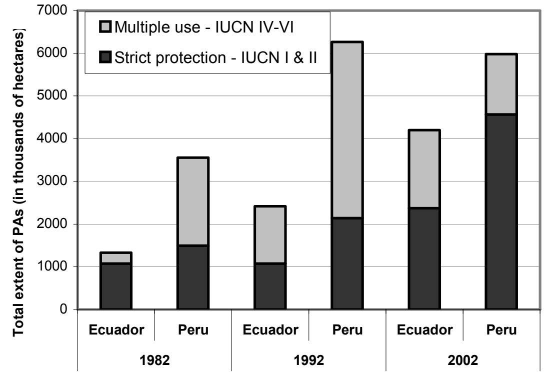

Figure 2 Area under strict protection (IUCN Categories I and II) vs. multiple use (IUCN Categories IV-VI), for 15 protected areas in Ecuador and Peru, 1982–2002.

Table 3 Historical tally and list of explanations for land additions and excisions to 15 protected areas in Ecuador and Peru, 1968–2003.

Number of changes	Explanation
14	Add land to include critical ecosystems.
9	Correcting surveying and mapping error.
9	Cede cultivated or titled land to local communities.*
2	Cede land to oil-exploration concession.
1	Add land to protect archeological treasures or monuments.

* Three of these cases involved claims by indigenous groups specifically.

expand PAs to include critical habitats or watersheds (on average, 290,000 ha were added per change: range 1,250 to 800,030 ha, standard deviation 270,060 ha). On nine occasions land was ceded to local communities (on average, 26,880 ha was ceded per change: range, 20 to 133,000 ha, standard deviation 41,550 ha). Equally frequent were boundary changes to correct cartographic or survey errors associated with original PA creation (these errors were usually only on the order of 1,000–2,000 ha per PA). On two occasions, PA boundaries were affected by oil exploration and extraction. In 1990, 133,000 ha were excised from Yasuni National Park in Ecuador to allow oil exploration and extraction (greater areas were subsequently added to the park). Similarly, 363,964 ha were removed from the original proposed area for Bahuaja-Sonene National Park in Peru, but this same area was later incorporated into the park when oil reserves proved commercially insufficient for extraction.

The following generalizations emerged from expert interviews. Typically, local communities were not consulted when the PAs were first created and this often led to subsequent conflict. However, for seven out of the 15 PAs, their official creation did not generate immediate conflict with local residents because these PAs existed for years only on paper (six were established in the 1960s and one during the 1940s). It was not until conservation rules were enforced that conflict erupted with the people dependent on natural resources in these seven areas. Beginning in the 1970s and 1980s, managers at some PAs attempted to prevent resource use by force (although in some cases use by indigenous people was allowed) (Fiallo & Naughton-Treves, 1998). Thus, small-scale farmers were evicted from Pacaya-Samiria, Rio Abiseo, and Machalilla, and Brazil nut harvesters from Pampas del Heath (Chicchón, 2000).[2] Respondents described the public outcry and occasional violent protests associated with some of these interventions. In other cases, rather than attempt to evict local people or to impose resource-use restrictions, PA boundaries were legally changed to cede land back to local citizens. For example, in the Peruvian Amazon, a portion of the transitory Tambopata Candamo Reserve Zone was excised in the year 2000 in response to residents' demands to be "liberated" from the Reserve. An interesting counterexample (also from the Peruvian Amazon) is the Manu Biosphere Reserve where communities of indigenous people and other long-term residents petitioned to have their land *included* in the PA, hoping that such action would hasten investments in sustainable development and guard the area against colonists' incursions.

All of the cases involving the ceding of PA land to communities occurred before 1993 (except for the above-described change to the Tambopata transitory reserve in Peru during 2000). Since then, a new strategy has taken hold. Now, rather than evicting people from PAs or legally excising land to communities, conservation agencies are rezoning land *within* PA boundaries to accommodate human use and thus integrate local people into the management of the PA. Park managers explained that this approach was the only realistic option given the widespread presence of human settlements and resource use in PAs. On average, approximately 12% of the area within the Ecuadorian PAs was settled (range 1–29%). Estimating the population within Peruvian PAs is confounded by the presence of two vast biosphere reserves, Manu and Pacaya-Samiria, with approximately 83,500 and 45,000 inhabitants respectively living in their buffer zones. Including these two areas, the eight Peruvian PAs we sampled were each inhabited by approximately 19,600 people (range 0–83,500). Without the two biosphere reserves, the average drops to 1,760 (range 0–5,000).

At the time of our study, 11 of the 15 PAs had official internal zoning plans, including five Peruvian PAs and six Ecuadorian PAs (a seventh Ecuadorian park had a proposed internal zoning plan, but it was not yet officially accepted). Ideally, these zoning efforts would improve relations between local residents and park authorities and allow for more management flexibility. However, according to the PA officials, only one of the eleven PAs (Bahuaja-Sonene) had at the time of this writing implemented the internal zoning plans in actual management (Landeo, 2006).

Peruvian and Ecuadorian conservation agencies are also working to promote environmentally sound development beyond the PA boundaries. With the exception of only two PAs (PuiPui in Peru and Machalilla in Ecuador), all of the sites in this study had new conservation areas added to neighboring holdings, including ethnic reserves, conservation concessions, communal reserves, protected forests, and, in the case of Peru, municipal and regional conservation areas and buffer zones. These adjacent conservation lands are sizeable,[3] covering 1,849,995 ha around six of the Ecuador PAs in our study, and 2,319,581 ha around six of the Peruvian PAs. Most of these new areas belong to IUCN categories IV–VI that allow for human uses of various intensities. In the case of Peru, officials of Instituto Nacional De

[2] Area established prior to Bahuaja-Sonene National Park.

[3] We define "adjacent conservation land" an area which legally includes environmental protection among its objectives and that shares a boundary with one of the 15 PAs examined in this project. In many instances (e.g., Yasuni National Park) adjacent conservation land includes indigenous areas.

Recursos Naturales (IRENA), the agency responsible for PA management, have also legally established large buffer zones around the eight PAs to influence land-use activities in the surrounding area in favor of environmental conservation. In practice, Peruvian PA managers have uncertain authority in these buffer zones, but the zones provide legal footing for INRENA to demand environmental impact assessments for mining and oil extraction, including analysis of potential impacts on adjacent PAs (Suárez de Freitas, 2002). In both Ecuador and Peru, there is significant overlap between indigenous territories and national parks and reserves; thus a precise comparison of area devoted to each is problematic. Some respondents were reluctant to offer data on indigenous reserves due to the highly political nature of these territorial disputes. However, the majority of our respondents stressed that indigenous territories (within and adjoining the PAs) have tremendous biodiversity conservation importance.

In sum, over the past four decades most of the PAs have expanded significantly. The concurrent expansion in the mission of the PAs has blurred the boundary between land-use activities within and outside PAs. In the 1970s and 1980s, managers at several sites attempted to implement the strict protection model of parks by evicting people and/or by excising occupied land from PAs. Managers are now more likely to accept extractive resource use in some portions of the PAs (even Type II PAs), while they also attempt to influence land use beyond PA boundaries. As a veteran Ecuadorian park guard commented:

> In the past our job was clear. We walked the park boundary and said "NO" to any use inside the park, and "OK" to anything outside the park. Now we are supposed to promote sustainable development on both sides of the boundary.

Estimating the Spatial Extent of Human Activities

We observed differences in experts' maps of extractive resource use in each protected area (Figure 3). To aid in the interpretation of the maps, we first measured the variation between experts' estimates of the percentage of area in each PA affected by the three most prominent land uses: hunting, logging, and livestock grazing. The variability was highest for estimates of logging (sd 1–31%), followed by hunting (sd 1–18%) and then livestock grazing (sd 3–9%). We then analyzed the degree of overlap between the areas of use drawn by different experts who were reporting on the same PA. We found that the experts' estimates regarding the location of resource use for each PA differed by 30% for logging (i.e., there was a 70% overlap between experts' delineation of logging areas), 23% for hunting, and 11% for livestock grazing (n=45 interobserver differences for logging and hunting, n=42 for livestock grazing). The size of the differences between estimates increased with the size of the PA, except in the case of Ecuador's relatively small Machalilla National Park, where four

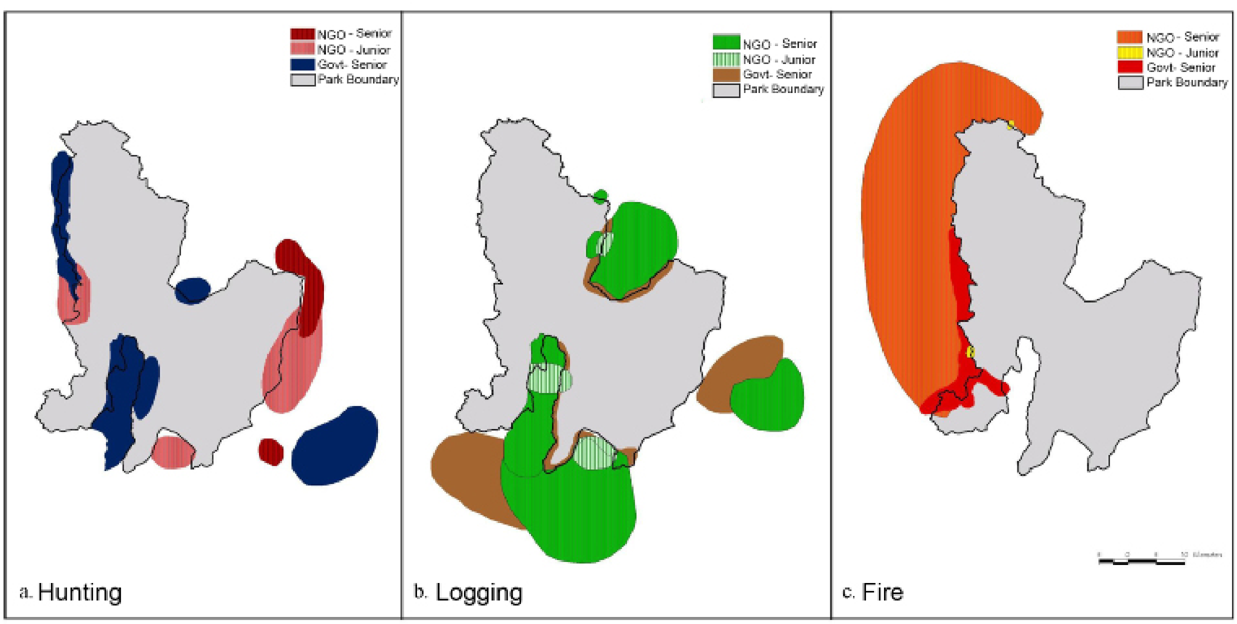

Figure 3 Sketch maps by three experts for hunting, logging, and fire in Podocarpus National Park, Ecuador.

Note: Experts often sketched resource use outside the PA boundaries, but we only recorded and analyzed estimates within the PA. Senior = >10 years experience on site, Junior = 5–10 years on site.

Table 4 Estimated area within park or reserve under extractive use according to expert interviews during 2000–2002.

Protected Area	Area under hunting, ha (% total area, ±SEM)	Area under logging, ha (% total area, ±SEM)	Area under grazing, ha (% total area)	Area under fires, ha (% total area)	Area under mining or oil extraction[1], ha (% total area)
IUCN I & II (strict protection)					
PN Bahuaja-Sonene	72,436 (5%, ±2%)	12,006 (1%, ±2%)	n/a[2]	n/a	14,882 (1%)
PN Machalilla[3]	11,908 (30%, ±1%)	19,218 (48%, ±13%)	6,047 (15%, ±4%)	n/a	107 (<1%)
RB Manu	104,636 (6%, ±4%)	98,415 (6%, ±5%)	51,325 (3%, nd)	51,325 (3%, nd)	14,155 (1%)
PN Podocarpus	14,122 (10%, ±3%)	9,702 (7%, ±11%)	2,542 (2%, nd)	3,476 (2%, ±3%)	133 (<1%)
PN Río Abiseo	15,624 (6%, ±2%)	n/a	21,542 (8%, nd)	31,450 (12%, nd)	85,074 (31%)
PN Sangay	151,672 (31%, ±8%)	47,469 (10%, nd[4])	195,375 (40%, ±10%)	n/a	28 (<1%)
PN Yanachaga-Chemillen	16,239 (15%, ±1%)	37,102 (34%, ±4%)	n/a	n/a	135 (<1%)
PN Yasuní	317,807 (31%, ±8%)	25,778 (3%, ±7%)	n/a	n/a	482,995 (48%)
Average %	**14%**	**5%**	**5%**	**2%**	**12%**
IUCN IV-VI (multiple use)					
BP Alto Mayo	48,557 (24%, ±6%)	37,032 (18%, ±6%)	n/a	n/a	n/a
RE Cayambe Coca	176,900 (43%, ±11%)	27,698 (7%, ±5%)	22,833 (6%, ±4%)	83,800 (21%, ±8%)	22,744 (6%)
RE Cotocachi Cayapas	23,678 (12% , ±3%)	23,134 (11%, ±7%)	25,150 (12%, ±2%)	n/a	328 (<1%)
RN Pacaya Samiria	499,921 (23%, ±3%)	741,845 (34%, ±5%)	n/a	27,793 (1%, nd)	n/a
BP Puipui	7,983 (15%, nd)	n/a	3,201 (6%, nd)	n/a	n/a
BP San Matias San Carlos	82,524 (55%, ±4%)	2,985 (2%, nd)	n/a	n/a	n/a
Average %	**26%**	**26%**	**2%**	**3%**	**1%**

[1] Area under mining or oil extraction was recorded from official maps, not expert interviews.
[2] For all n/a: experts did not report this type of use in area, or they judged it to be negligible.
[3] Terrestrial area only.
[4] For all nd: data are from one expert only or from consensus of experts interviewed simultaneously, thus SEM is not calculated.

respondents disagreed considerably about the percent of the park subject to logging (3–47%). There was greater agreement between experts in the estimates of resource-use intensity within each site. On a scale of one to five, experts' estimates differed by an average of 0.6 for logging, 1.0 for hunting, and 1.4 for livestock grazing.

To test for systematic bias in the resource uses drawn by different categories of experts, we compared the area and intensity of logging and hunting estimated by government employees versus those from representatives of nongovernmental organizations (NGOs) for the same PA. For this test, we calculated the mean difference in absolute area (not %) between pairs of observers from the same PA and pooled hunting and logging because these two uses did not diverge on this measure on average. Government vs. NGO representatives did not differ in absolute area on average (n=45 pairs, t=-0.31, p=0.38) or in the variance of this measure (F ratio=0.097, df=1, p=0.76). Similarly, government vs. NGO estimates of intensity of hunting and logging did not differ on this measure (F ratio=0.23, df=1, p=0.63). Across the PAs, we found no consistent differences between government and NGO respondents in grouped analyses (difference in area: mean t=-0.06, p=0.94, variances are equal, F ratio=0.01, p=0.95; difference in intensity: mean t=1.68, p=0.10, variances F ratio=2.94, p=0.10). Likewise, differences between experts in their years of local experience were not significantly correlated with differences in their estimates of area under extractive use or intensity of use (Spearman rho=-0.004, p=0.98; rho=-0.22, p=0.17).[4] Conclusive endorsement of this expert mapping method is hindered by a relatively small sample size, but our findings bolster other multistakeholder spatial threats assessments that present it as a valuable complement to other techniques (Bojorquez-Tapia et al. 2004; Treves et al. 2006).

Extractive resource use was widespread in the PAs according to the experts. Hunting was the most prevalent resource use, followed by logging and livestock grazing (Table 4). However, the experts reported that certain PAs were more imminently threatened by mining or petroleum extraction (e.g., Rio Abiseo National Park in Peru, Yasuni National Park in Ecuador). To evaluate the extent of extractive resource use within the PAs, we combined all the uses delineated by experts on the map for each PA. According to their combined estimates, the area of each

[4] It merits noting that we only interviewed experts with five years or more experience at the PA under assessment and the maximum experience was 40+ years.

PA under extractive resource use varied from 5 to 57% for the eight Peruvian PAs (average of 28%) and 15 to 70% for the seven Ecuadorian PAs (average of 43%) (Figure 4). Multivariate analysis revealed no significant linear relationship between the area under extractive use for each PA vs. the IUCN category, size or country, but again the relatively small sample limits the analysis.

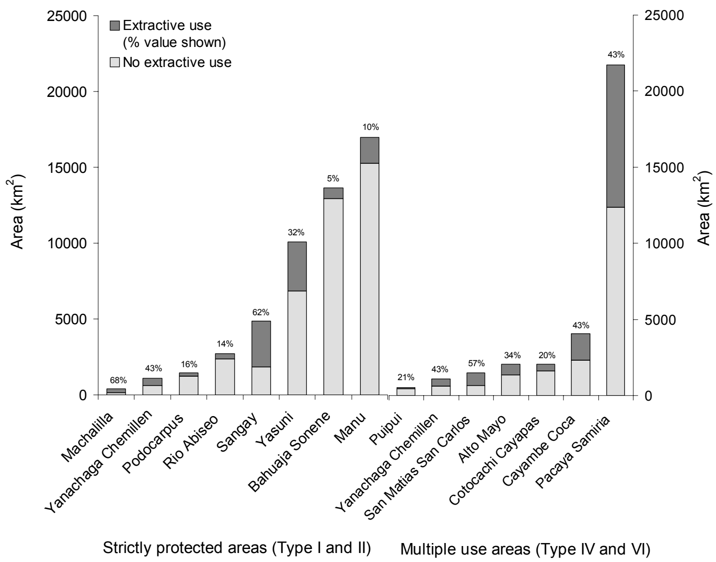

Figure 4 Area under extractive use within 14 parks and reserves in Ecuador and Peru

Discussion

Expansion and Reclassification of PAs

The 15 PAs in this study have in aggregate nearly doubled in size since their creation. This growth mirrors national and regional trends. According to the World Database on Protected Areas (WDPA), the system of IUCN Category I–VI protected areas for Ecuador grew by 26% between 1990–2005 and the Peruvian system grew by 20% during those same years (WDPA Consortium, 2005). More broadly, IUCN data indicate that, relative to other regions, South American PA systems experienced an extraordinary expansion during 1986–1997 (Zimmerer et al. 2005). Although these databases are subject to error (West & Brockington, 2006), the regional growth of PAs during the past 30 years is significant and reflects both the expansion of existing PAs (as in the case of the 15 PAs studied here) and the creation of new parks and reserves. We also discovered that more area was added for multiple use within the seven Ecuadorian parks versus more for strict protection in the eight Peruvian PAs (Table 2). This mixed result does not resolve debate regarding the relative dominance of strictly protected versus multiple-use land in newly expanded conservation territories in developing countries (Naughton-Treves et al. 2005; Zimmerer et al. 2005). Moreover, our results require careful interpretation for two reasons: 1) our Peruvian sample was swamped by events in the Department of Madre de Dios where large sections of a vast transitory multiple-use reserve (Tambopata-Candamo) was upgraded to a national park (Bahuaja-Sonene) (Alvarez & Naughton-Treves, 2003), and 2) our original selection criteria favored large PAs older than 10 years. Therefore, our data do not reflect the recent proliferation in both countries of many smaller, multiple-use PAs (i.e., at a national level, the Peruvian protected area system now designates more land for multiple use than for strict protection) (Instituto Nacionalde Recursos Naturales, 2006).

The Current Extent of Human Resource Use within PAs

Expert mapping suggests that extractive resource use is common within the 15 Andean PAs. Hunting, in particular, was widespread and covered an average of 14% of strictly protected and 26% of multiple-use areas (n=8 strictly protected areas, range: 5–33%; n=6 multiple use, range: 12–55%) (Table 4). This accords with Fa, Peres, & Meeuwig's (2002) observation that hunting is the most geographically widespread resource use in tropical forests and permeates even remote reserves (Peres & Terborgh, 1995; Rubio del Valle, 2002). In fact, in most of the PAs, experts reported that hunting was more prevalent *within* park boundaries than in outside areas where valuable game species had been reduced or extirpated (Naughton-Treves et al. 2003). Paradoxically, the presence of hunting in a PA can be interpreted as a sign of park effectiveness (game are still plentiful enough within the PA to attract hunters) and as a threat (given that this wildlife may soon be depleted). Similarly, hunting-free regions within PAs may signal well-protected wildlife, or conversely, wildlife that has been so depleted that hunters have moved on. Programs to monitor hunting and to improve its sustainability are urgent for this region, given the activity's ecological significance and its importance in providing protein for the rural poor (Bodmer & Lozano, 2001).

Respondents identified logging as a threat to all but two of the PAs (Table 4). The location and extent of logging was subject to the greatest interobserver variation of any activity, but on average logging affects approximately 5% of strictly PAs and approximately 26% of multiple-use areas. Fewer PAs were affected by mining and petroleum extraction, though these activities seriously endangered only two parks (Rio Abiseo in Peru and Yasuni in Ecuador). Other parks (Podocarpus in Ecuador and Bahuaja-Sonene in Peru) were threatened by "artesanal" mining, an activity seldom registered on official concession maps (Tello et al. 1998).

Despite widespread human activities within their boundaries, these 15 protected areas (PAs) are not simply "paper parks." Remote sensing data were available for nine of the PAs, all of which experienced average deforestation rates of < 0.11% per year during 1991–2001 (Steininger, 2006), a rate lower than regional averages (Alvarez & Naughton-Treves, 2003). Avoiding deforestation is not the ultimate litmus test for parks, but intact forest is an important signal that PAs are having substantive impacts on land-use changes (Bruner et al. 2001). Among the activities invisible to remote sensing, hunting in tropical forests is seldom sustainable (Robinson & Redford, 1994) and may represent a threat to basic ecosystem function due to the importance of wildlife as seed dispersers and predators (Redford, 1992; Peres & Lake, 2003). Others counter that hard evidence is too sparse to conclude that hunting is compromising forest integrity (Schwartzman et al. 2000); or they acknowledge possible overhunting but point to the success of local communities in defending forests from other threats, including fire and conversion to agriculture (Nepstad et al. 2006). Assessing the sustainability of hunting and other extractive activities is beyond this scope of this study, but our findings suggest that remotely sensed deforestation offers a highly conservative estimate of the actual area under human use. This underscores the value of using multiple methods for assessing the extent of human resource use in forested areas.

Disparities between the Legal Status of Protected Areas and Actual Management

According to our interviews with local experts, the expansion of PAs in Peru and Ecuador was motivated by a desire to protect critical habitats and watersheds left out of original delimitations (Peres, 2005). But PA managers also noted that such enlargements were often conducted in the context of scarce or highly uneven data regarding local land use and human settlements (Peres, 2002). This uncertainty partly explains the disparity between the legal status of some PAs and their actual management. Some managers also explained that there was no choice but to incorporate areas under human use or settlement given that "empty" wilderness areas simply did not exist. As a result, large portions of PAs legally designated for strict protection (IUCN category I or II) are subject to extractive resource use. For example, according to local experts, approximately 30% of Machalilla National Park in Ecuador and approximately 50% of Yanachaga National Park in Peru (both Type II PAs) are free from hunting, logging, and livestock grazing (see Fiallo & Naughton-Treves, 1998; Yallico & Rose, 1998 for a history of these two areas). Forty-eight percent of Yasuni National Park in Ecuador is threatened by petroleum extraction or exploration (Table 4). By IUCN convention, Type I and II areas should protect at least 75% of their total area from extractive use (Phillips, 2003).

Widespread extractive resource use within national parks not only contradicts international conventions, but is legally prohibited in both Ecuador and Peru, as is human settlement in national parks (Government of Ecuador, 1981; Consejo Nacional del Medioambiente, 2000). Ecuador's 1981 Forestry Law goes on to bar extraction in ecological reserves, but obliges the government to purchase any titled land within parks or ecological reserves; a stipulation that has rarely been met (Government of Ecuador, 1981).

In recent years, Ecuadorian conservationists have discussed revising national law to acknowledge individually and collectively owned land inside PAs, hoping that legalizing human presence would improve the likelihood of sustainable and regulated use. However, this proposal has raised such heated debate over indigenous and ancestral land rights, the legitimacy of informal versus formal property claims, and other controversial issues that after a preliminary discussion the Ecuadorian Congress abandoned it.

As another means to resolve contradictions between legal status and actual practice, some international conservationists contend that parks with incongruent classifications, such as Machalilla and Yanachaga, should be reclassified as multiple-use reserves (Terborgh & Davenport, 2004). But local conservation NGOs are concerned that "downgrading" an area may result in lower levels of international funding or tourism and create a bad precedent for other PAs (Fiallo & Naughton-Treves, 1998).

We also discovered another, less controversial discrepancy in legal status versus actual PA management. Some Type VI areas in this study had large areas free from extractive use. Experts estimated nearly 80% of Ecuador's Cotocahi Cayapas Ecological Reserve and 67% of Peru's Alto Mayo Reserve (both Type VI PAs) were free from extractive use. However, both reserves face increasing resource pressure, particularly for logging (Rudel, 2000).

The discrepancy between legal status and actual management is common to many Latin American PAs and can lead to significant conflict, particularly if PA boundaries are ambiguous or disputed (Brandon & Wells, 1992; Bojorquez-Tapia et al.

2004). For example, some PA field staff complained that the disparity between PA legal code and accepted practice undermined their authority and hindered enforcement. Other local experts revealed that although some managers attempted to "correct" such discrepancies by evicting people from PAs and/or excising occupied land from parks during the 1970s and 1980s, these strategies have been replaced by a more integrated approach with respect to local populations. In fact, several PA managers indicated they were not particularly concerned with official IUCN categories and that some "pragmatic ambiguity" about resource use was necessary to avoid conflict and to build local alliances.

The Importance of Indigenous Reserves

A particularly important and controversial aspect of resource use within PAs concerns the territorial claims and rights of indigenous people. Both Ecuador and Peru legally allow subsistence use by indigenous or "ancestral" people within some PAs. A thorough treatment of indigenous territories is beyond the scope of this paper, but it is essential to stress the contributions of indigenous areas to biodiversity conservation (Peres & Zimmerman, 2001; Holt, 2005; Nepstad et al. 2006). The growth of indigenous territories and reserves in Ecuador and Peru during the past two decades has outpaced the growth documented for the 15 PAs in this study. For example, the area of land titled to indigenous groups in the Peruvian Amazon increased from nearly 74,000 km² in 1977 to 105,000 km² in 1999 (for lands titled as "comunidades nativas" under Peruvian law). An additional 28,120 km² have been declared as indigenous territorial reserves for those communities living in isolation (GEF/PNUD/UNOPS, 1997; PETT, 1999). Across Ecuador, the land designated as "ethnic reserves" and "ethnic areas" surpasses 10 million ha (Fundacion Natura, 2005). An accurate comparison of the area dedicated to indigenous territories versus state-managed national parks and reserves is not possible due to overlapping claims and legal ambiguities in land classification. In some cases, indigenous groups have exclusive legal rights to areas within national parks (e.g., the Machiguenga in Manu National Park) (Terborgh & Davenport, 2004; Terborgh & Peres, 2004). In other instances, the presence of indigenous people has been formally accepted within PAs (in practice and in official management plans), but their territories are not legally delineated (e.g., the Agua Blanca people in Machalilla National Park) (Fiallo & Naughton-Treves, 1998; INEFAN, 1998). In both Ecuador and Peru, indigenous territories are too often undermined by illicit resource use by outsiders or by mining or petroleum concessions issued by the government (IBC, 2005). While the explicit interest of indigenous communities may not be biodiversity conservation per se (Fiallo & Naughton-Treves, 1998; INEFAN, 1998; Holt, 2005), the coincidence of interests between indigenous peoples and conservationists, especially given large-scale external threats, is frequently high. The fact that indigenous groups usually manage land and resources collectively (as opposed to private parcels) improves chances for sustainable use, particularly for fugitive resources like wildlife (Naughton-Treves et al. 2003; Schwartzman & Zimmerman, 2005). Although alliances between indigenous peoples and conservationists are not always straightforward, these collaborations can have tremendous importance for both biodiversity and human welfare (Schwartzman & Zimmerman, 2005).

Current Trends in Protected Area Management: Zoning and Collaboration

In the majority of our study sites, management agencies have initiated zoning projects of varying scope to regulate resource use within PAs, in some cases (e.g., Machalilla National Park) allocating land for resource use within Type II areas. Ideally, these zoning projects provide a way to balance conservation aims with economic development goals across large areas and among diverse stakeholders. Zoning potentially allows the needed flexibility to draw boundaries that acknowledge preexisting claims and/or highlight areas of special ecological importance. However, zoning can also be a purely political maneuver to postpone or prevent enforcing unpopular rules or confronting powerful commercial interests. In such cases, zoning may reduce the size of PAs and set a precedent for carving them up (Terborgh & Peres, 2004). To date, zoning exercises in most of the 15 case study PAs have suffered from serious implementation problems. Some of the community representatives that we interviewed complained that the zoning process was not truly "participatory." Park staff meanwhile admitted that actual enforcement activities seldom matched the complexity of the elaborate zoning plans resting on office shelves. Managers and community representatives agreed that the rules of resource use and location of zones within PAs were often unclear. In the worst cases, "paper zones" have been drawn in "paper parks," leaving forest ecosystems and legitimate forest residents both at risk. Future zoning efforts are more likely to be implemented effectively if they are scaled to managerial capacity and are viewed as legitimate by local citizens and key stakeholder groups.

The rezoning of areas to assign locations where various uses are permissible is equivalent to the biosphere-reserve concept that includes one or several protected areas (core areas), but also allows for the presence of people and internal zoning to regulate a variety of uses. Although the biosphere model is often viewed as more accommodating to local people, evidence suggests that some of these areas may impose significant social costs that over time can burden local populations (Brandon, 1997; Holt, 2005). These communities will likely remain poor if they rely entirely on non-timber forest resources (Byron & Arnold, 1999; Vedeld et al. 2004). The experiences to date with biosphere reserves suggest the necessity of formalized agreements with local residents that are periodically revisited. Residents themselves may often be the first to see that existing patterns are, in fact, not sustainable (Holt, 2005). Issues of transparency, social justice, and poverty reduction are therefore paramount within these greatly expanded biosphere reserve-type managed areas.

Agrawal's (2001) synthesis of 20 years of research on common pool resource management offers important lessons for managing land for human welfare concerns and biodiversity. From his review, Agrawal concludes that sustainable and successful resource management is shaped by many factors, but is most likely when: 1) boundaries are clearly defined, 2) rules are easily understood and enforced, 3) user groups live near the resource, 4) there is external support for sanctions, and 5) monitoring and enforcement systems are in place. Achieving these "conditions" for sustainability in inhabited areas of Ecuadorian and Peruvian PAs is a tremendous challenge. For example, with regard to enforcement, Stern (2007) documents that in the over 20 years since Podocarpus National Park was created in Ecuador, park offenders have been punished only in a few instances, with equipment and harvested timber seizures. No arrests have ever been made and no fines have been levied. Government agencies themselves too often undermine PAs, such as when they issue mining or petroleum concessions within parks (Chicchón, 2000). Successful PA management will require substantial increases in financial and legal support. Both Ecuador and Peru are attempting to reform their PA management by promoting co-management and/or decentralized administration for some areas. The outcome of these reforms is uncertain (Rubio del Valle, 2002). The more promising examples of PA co-management include an initiative led by the Cofan, an indigenous group of Ecuador (Lundmark, 2002), and one by a municipal water company, Empresa Municipal de Telecomunicaciones, Agua Potable, Alcantarillado y Saneamiento Ambiental (Echavarria et al. 2004; Nyce, 2004).

Conclusion

If our findings of disparities between legal status and actual management prove common beyond Ecuador and Peru, conservationists may be further from the Rio Convention's 10% set-aside target than international datasets currently suggest. IUCN categories constitute an important "common language" and ideally enable comparisons of PA coverage and management status at regional and global scale (Chape et al. 2005). However, our study reveals that PA categorization is a dynamic and sometimes ambiguous process, with incongruities as common as accurate classifications. Although international accords and policies suggest that conservation strategies and rules are being globalized and homogenized (West & Brockington, 2006), our results show that, for better or worse, PA management in practice remains variable and idiosyncratic, if only because political realities and budgetary constraints hinder conforming to international guidelines.

Our study documents the substantial expansion of 15 PAs in Ecuador and Peru despite widespread human presence and resource use within these areas. According to Terborgh & Peres (2004), the majority of parks in developing countries are similarly affected by human activity and this human presence is a "time bomb." Other experts are more optimistic and see resident peoples as real or potential forest defenders (Schwartzman et al. 2000). Ultimately, the long-term conservation impact of the 15 PAs in this study will turn on clarifying rules of resource access and distribution and building alliances among diverse stakeholders. None of the 63 experts that we interviewed proposed large-scale evictions or land-purchase programs to remove people from PAs. Nor did they propose the degazettement of a PA or excisement of occupied areas. Thus, the challenge ahead for Ecuadorian and Peruvian conservationists is to resolve thorny political issues regarding who has legitimate claims to resources within PAs and where, and to seek solutions that make conservation possible in complex contexts. One key need is to act quickly to protect the existing intact forest areas from commercial activities. Resolving these issues is urgent given the increased intensity of resource use and forest clearing in the region. As lands outside of PAs are increasingly developed, conserving biodiversity requires protecting core areas and negotiating equitable and ecologically sustainable management rules for areas designated for extractive use.

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