

## RESEARCH ARTICLE

# Research and in situ Conservation of Owl Monkeys Enhances Environmental Law Enforcement at the Colombian-Peruvian Border

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This study reports on impacts of illegal trade in owl monkeys (*Aotus nancymaae*, *A. vociferans*) for the biomedical research market in the Colombian-Peruvian Amazonian border. Through freedom of information requests and interviews with hunters we found that 912 owl monkeys, including *A. nancymaae* captured in Peru, were trapped over a 3-month period in 2012 to supply a malaria research facility based in Leticia, Colombia, which had trapping permits for the use of only 800 *A. vociferans* annually yet experimentation took place using *A. nancymaae*. High levels of extraction in Peru have had population-level impacts with significantly lower densities of *Aotus* spp. (3–24 individuals/km<sup>2</sup>) compared to Colombian sites with low hunting pressure (26–44 individuals/km<sup>2</sup>). Post-experimental release of this species in Colombian territory has created a new distribution whose status and impacts on resident populations of *A. vociferans* remain unknown. The trapping method has also had environmental impact, with loss of over 65,000 trees (including sleeping sites), annually. As *Aotus* species are registered under the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II, international trade requires official permission and evidence that extraction does not impact wild populations. However, no official records exist and CITES legislation has failed, due principally to a lack of appropriate monitoring by national authorities responsible for compliance. Of further concern is that we had previously documented and reported the illegal trade to the appropriate governmental authorities yet still no action was taken—as demonstrated by the continuing trade in 2013. Enforcement eventually occurred when a non-governmental organization initiated legal action against organizations responsible. A successful second instance ruling by the Colombian State's Council in 2013 revoked trapping permits. Using the trade in owl monkeys as a case study we consider implementation, compliance, and enforcement of CITES in the border area to identify mechanisms to improve enforcement of environmental legislation. *Am. J. Primatol.* 76:658–669, 2014. © 2014 Wiley Periodicals, Inc.

**Key words:** CITES; *Aotus*; Colombian-Peruvian Amazon; law enforcement; malaria research

## INTRODUCTION

Under appropriate governance and management the exploitation of natural resources can improve human standards of living, local livelihoods, and even provide incentives for ecosystems conservation.

However, when extraction levels are not based on species and ecosystem carrying capacity, over-exploited species can be brought close to extinction [Terborgh, 2002]. To control impacts of international trade on wild species 175 signatory countries agree with the Convention of International Trade in

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Endangered Species of Wild Fauna and Flora (CITES). Signatory countries agree to ensure that trade in species listed under CITES appendices (see below) is not detrimental to their survival in the wild by implementing, ensuring compliance and enforcing CITES legislation. Individual signatories implement CITES measures at governmental level to fulfill their obligations under the convention. Under CITES, species of concern are listed under appendices, where Appendix I species are the most endangered with international trade banned except for non-commercial purposes such as scientific research. Appendix II species are not necessarily threatened at present but may become so if trade is uncontrolled. Appendix III lists species that are protected in at least one country that has asked other CITES signatories for assistance in controlling the trade [CITES, 1973].

It is clear that accurate information on international export/import and monitoring of wild populations are essential to the effective functioning of CITES. Recent reviews, assessing the impacts of international trade on CITES-listed species, suggested links between CITES national authorities, CITES technical committees, and local communities could be strengthened by engaging with research scientists working in the field and generating data for publication in *peer reviewed journals*. It also highlighted the need for scientifically rigorous case studies to identify strengths and assess current implementation strategies of CITES [Smith et al., 2011]. Several conservation organizations have been approaching governments with hard evidence regarding illicit wildlife trafficking but have been unable to elicit an effective response because governments do not give the issue high enough priority. This has had direct costs for the environment as well as national and international security [WWF/Dalberg, 2012].

The Amazon basin has been a major source of wild harvested primates for export to the overseas biomedical markets [Mittermeier et al., 1994; Neville, 1975, 1977; Smith, 1977, 1978]. In the 1970's both Colombia and Peru, together with India, provided some 65% of the total international market of primates for biomedical research [Held & Wolfe, 1994]. Historically, extraction of wild caught primates took place with minimal consideration of impacts to wild populations and the alarming official export figures caused international debate leading to Colombia and Peru implementing national bans on export of primates in 1974 and 1973, respectively [Held & Wolfe, 1994]. The recorded impacts to levels of wild populations of primates from trade [Southwick & Siddiqi, 2001] contributed to the establishment of CITES in 1973. Of the Amazonian countries, Brazil and Peru signed in 1975 with Colombia becoming a Party in 1981.

### Population Status and Biogeography of Owl Monkeys (*Aotus* spp.)

Our work focuses on the impacts of trade on night or owl monkeys (*Aotus*), a genus used in biomedical research on malaria at a laboratory in Leticia, Colombia [Maldonado, 2011; Maldonado et al., 2009]. Both study species, *Aotus nancymae* and *A. vociferans* are considered as least concern by the International Union for Conservation of Nature (IUCN), partly due to their wide distribution. Although the IUCN does not suggest major threats to these species actual field data are lacking as there are few studies, particularly in areas where human pressures are increasing, such as in the Colombian-Peruvian border. Recently the IUCN recommended monitoring of extraction, legal and illegal, for both *A. vociferans* and *A. nancymae* with the aim of understanding effects on wild population levels [Cornejo & Palacios, 2008].

In this border region the Amazon River acts as a major biogeographical barrier to species of owl monkey. To the north of the Amazon-Solimões River, Spix's night monkey (*A. vociferans*) can be found in Colombia, Ecuador, Peru, and Brazil. Its distribution is determined by geographical barriers: to the north by the Guaviare river in Colombia, to the west by the Andean Ridge, and to the east probably by Rio Negro river in Brazil [Aquino & Encarnacion, 1988, 1994; Defler, 2010; Groves, 2005; Hernandez-Camacho & Cooper, 1976]. To the south of the Amazonas-Solimões, Nancy Ma's night monkey (*A. nancymae*) extends from the Loreto department in Peru to the Jandiatuba River in Brazil, reaching up to the Jutái river head. In Peru, its northern limit is the Marañon River, reaching the enclave between the Tigre and Pastaza rivers [Aquino & Encarnacion, 1994; Groves, 2005].

Although only the presence of *A. vociferans* has been registered in Colombia to the north of the Amazonas-Solimões River in the early 1980's both *A. nancymae* and *A. nigriceps* were observed in a laboratory at the Fundación Instituto de Inmunología de Colombia (FIDIC) in Leticia, Colombia [Defler, 2004, 2010]. Since 1987, the Colombian environmental authorities have granted permits to this medical research laboratory in the Amazon to collect wild owl monkeys, specifically *A. vociferans* for malaria research. After being subjected to research procedures for up to 6 months, owl monkeys are released back into the wild. In previous papers we reported that from 2007 to 2008 >2,500 animals were sold to the facility by Peruvian trappers although they have a legal limit of 800 annually and there are no CITES permits for the export of *Aotus* from Peru to Colombia [Maldonado et al., 2009]. The international trade of *A. nancymae* reported by the UNEP-WCMC database provides figures for the period 1994–2011. It shows that Peru exported 3,258 animals. Of these, the US

imported 86% with 61% of the total export transactions classified as “S” (Scientific). However, biomedical research (M) is not reported, neither was Colombia listed as an importer country [UNEP/WCMC, 2013].

Information regarding the effect of the illegal trade on wild populations of *Aotus* was reported by Maldonado [2011], while Ruiz-Garcia [2009] presented genetic evidence of the presence of *A. nancymaae* at the FIDIC facility in Leticia. This information was submitted to the relevant governmental organisations responsible for monitoring and controlling illegal trade in wildlife in Colombia and Peru, however no action was taken.

In this paper, we present a case study based on fieldwork to investigate the history of legal and illegal trade in night or owl monkeys (focusing on *A. nancymaae*), to assess the effectiveness of organizations charged with upholding obligations under CITES as a mechanism for controlling wildlife trade in the Amazonian border region between Colombia and Peru. We also report on positive results from a public benefit law suit (acción popular) initiated against; the regional environmental authority “Corpoamazonia” (Corporación para el Desarrollo Sostenible del Sur de la Amazonía) responsible for issuing and compliance of legal permits for scientific trapping and trade, the Colombian Ministry of Environment (the CITES Administrative authority), the Colombian environmental Fiscal Control body (Procuraduría para Asuntos Ambientales y Agrarios), and FIDIC—the medical research laboratory involved in the use of owl monkeys for research. We discuss the implications of this in context of implementation, compliance and enforcement of CITES and we provide clear guidelines on how to monitor and tackle the trade in owl monkeys in the region. Finally we suggest revision to the IUCN and CITES categories of *A. nancymaae*; a species that has been the subject of continuous exploitation for biomedical research in the region. This case study highlights current weaknesses and illustrates the important role that scientific research and non-governmental organizations currently play in providing data on illegal trade to national CITES bodies and, in the absence of action, initiating legislation and enforcement.

## METHODS

This research complies with Colombian and Peruvian legislation and with the protocols and guidelines for animal care contained in the following research permits: Colombian Park System No. DTAO059 and PIDB DTMA 011-11, Corpoamazonia No. 06-91-001-X-009-062-08 and Peruvian Ministry of Agriculture No. 428-2009-AG-DGFFS-DGFFS. This study also adhered to the American Society of Primatologists principles for the ethical treatment of primates.

## Estimating Densities of *Aotus* spp. Under Differing Hunting Intensities

We estimated *Aotus* spp. population densities and hunting intensity at eight sites in Peru and Colombia (Fig. 1, Table I). In Peru the sites included three indigenous territories. In Colombia the sites were: one indigenous territory overlapping the Amacayacu National Park, three private reserves and the Calderón basin, a State Forest Reserve (SFN).

## Distance Sampling

We undertook a population census using standardized visual line transect surveys [Buckland et al., 2001, 2010; Peres, 1999]. We recorded perpendicular distance and height to the first observed animal, or to the center of the group. We also noted; weather conditions, date, time, lunar phase, moon visibility, species, and group size. Additional information such as group composition, activity (movement, feeding, resting, and social behavior), diet, and association with other species was recorded when possible. We carried out the census at a speed of 1km/h with observers stopping every 100 m to listen and observe [Buckland et al., 2001; Marshall et al., 2008; Peres, 1999]. Nocturnal censuses were performed between 18:00–21:00 and 3:00–6:00 following the methodology of Aquino & Encarnacion [1994]. For detailed description of the methods please refer to Maldonado [2011].

## Estimation of the Hunting Levels of *Aotus* spp.

Using freedom of information requests we obtained official records of incoming owl monkeys at FIDIC under the supervision of Corpoamazonia during the first quarter of 2012. Other relevant data included date received at the research facility, name of collector and community, number of animals sold by each collector and sex of animals [Corpoamazonia, 2012b]. In order to validate this information we interviewed key collectors [for detailed methods see Maldonado, 2011, 2012; Maldonado et al., 2009] and used information recorded by the British Union for the Abolition of Vivisection (BUAV-UK) in their trade investigation during 2012 [BUAV, 2012a,b].

## Assessing Environmental Impacts of Capture Methods

In August 2010 the Colombian research team composed of one wildlife veterinarian (with 2 years experience in handling owl monkeys), one primate conservationist and seven local co-investigators, accompanied by two Peruvian biologists, undertook collections in the communities of Vista Alegre and Chinería, Peru. Collections were carried out using methods identical to local collectors to document and quantify deforestation impacts. We estimated the number of adult trees felled per capture using the

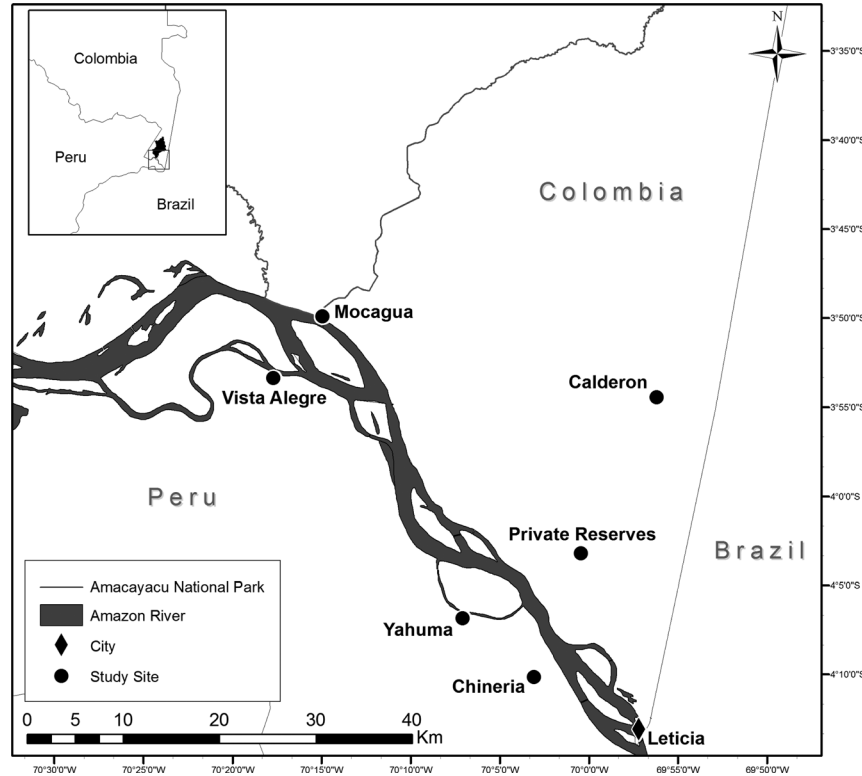


Fig. 1. Location of census sampling sites of *Aotus* spp. at the Colombian-Peruvian border.

mean group size from field surveys to estimate the number of sleeping site trees sampled in the collection of 4,000 individuals for the 2007–2008 period [Maldonado, 2011] and a conservative radius of 15 m from the sleeping site. To estimate loss of trees we used the density of 640 trees per hectare adult trees (diameter at breast height of 10 cm or more) calculated by Ter Steege et al. [2003] in Amazonia at the frontier between Colombia and Peru.

**Impact of Post-Experimental Release of Owl Monkeys in Colombia**

Through freedom of information requests, we also obtained official records of the releases of owl monkeys

between 2007 and 2012 by the FIDIC under the supervision of Corpoamazonia including GPS positions of release sites, names of people involved in the process, code of each released animal (corresponding to the tattoo given by the laboratory), and the minutes signed by staff members of FIDIC and Corpoamazonia [Corpoamazonia, 2012a]. This information provided evidence to investigate changes in species distributions associated with post-experimental release.

**DATA ANALYSIS**

**Estimation of Population Densities**

We analyzed field census data using DISTANCE 6.0 software [Buckland et al., 2001] using the

**TABLE I. Study Site Characteristics for Colombia and Peru**

Study site (coordinates)	Protection category	Forest type	MASL <sup>a</sup> (m)
Chinería—Peru S4° 10.121' W70° 02.607'	None-indigenous community	Flooded	73
Yahuma—Peru S4°05.993' W70°07.594'	None-indigenous community	Flooded	75
Vista Alegre—Peru S3° 52.816' W70° 17.420'	None-indigenous community	Flooded	78
Calderón—Colombia S3° 54.463' W69°56.193'	State Forest Reserve	<i>Terra firme</i>	106
Private Reserves-Colombia S4°02.713' W70°00.236' -S4°07.339' W69°56.832'	Private reserves	<i>Terra firme</i>	94–119
Mocagua—Colombia S3°49.402' W70°15.196'	Overlapping area <sup>b</sup>	Flooded	49

<sup>a</sup>MASL, meters above sea level.

<sup>b</sup>Overlapping area: indigenous protected area and Amacayacu Natural Park (ANP).

mid-normal and uniform models with cosine adjustment [Laake et al., 2009; Thomas et al., 2010]. We pooled the datasets for Peruvian sites where numbers of *Aotus* spp. observations were low. In a similar manner we grouped the datasets for the Private Reserves. Grouping was based on among-site similarities with respect to forest structure, soil, and hunting pressure. To increase the confidence of our estimates, perpendicular distances were truncated to avoid extreme points. Truncation was based on the values of the Akaike information criterion (AIC) and the best-fitted curve.

### Predicted Distribution of *Aotus nancymaae* in Colombia

To map the new predicted distribution of *A. nancymaae* in Colombia we used a Geographical Information System (ArcView GIS 10) to map the GPS waypoints registered by FIDIC and Corpoamazonia during the releases in Colombia for the period 2008–2012. In addition, we visited sites and collected GPS waypoints where FIDIC had released owl monkeys on private lands with the assistance of an ex-collector hired by the medical research institute in the late 1990s. We applied the minimum convex polygon (MCP) method to map the new home range of the introduced population.

### Law Enforcement

From 2008 to 2011 we gathered solid evidence on the illegal trade in owl monkeys. This included population status of *Aotus*, quantification of trapped animals for the malaria research market and the

negligence of environmental authorities in controlling the trade [Maldonado, 2011; Maldonado et al., 2009]. This evidence was presented to the administrative CITES authorities from Colombia, Peru, and Brazil during the 61st meeting of the CITES Standing Committee held in Geneva, Switzerland. In April 2011 we filed a public benefit law suit (Accion Popular) against institutions responsible (Corpoamazonia, Ministry of Environment, and FIDIC). One of our requests included in the law suit, was that the sued environmental governmental institutions, and the CITES Administrative and scientific authorities must carry out a demographic and genetic study to determine the conservation status of the genus *Aotus* at trapping/releasing sites. The first phase of this study was carried out at five sites; four sites correspond to trapping/releasing sites (Naranjales, San Juan de Atacuari, Doce de Octubre, and Santa Teresita), with one location included as the control site—where animals have been trapped but not released (San Pedro de Tipisca) [UNAL & SINCHI, 2013].

The organizational linkages of the institutions relevant to this study, under the Colombian Environmental System, are shown in Figure 2.

## RESULTS

### Density of *Aotus* spp. in the Study Area

The reported densities for Peru correspond to *A. nancymaae* and reported densities for Colombia correspond to *A. vociferans*, as the sampled sites are not part of the post-experimental releasing sites used by FIDIC and Corpoamazonia (Table II). The lowest density and biomass estimates for *A.*

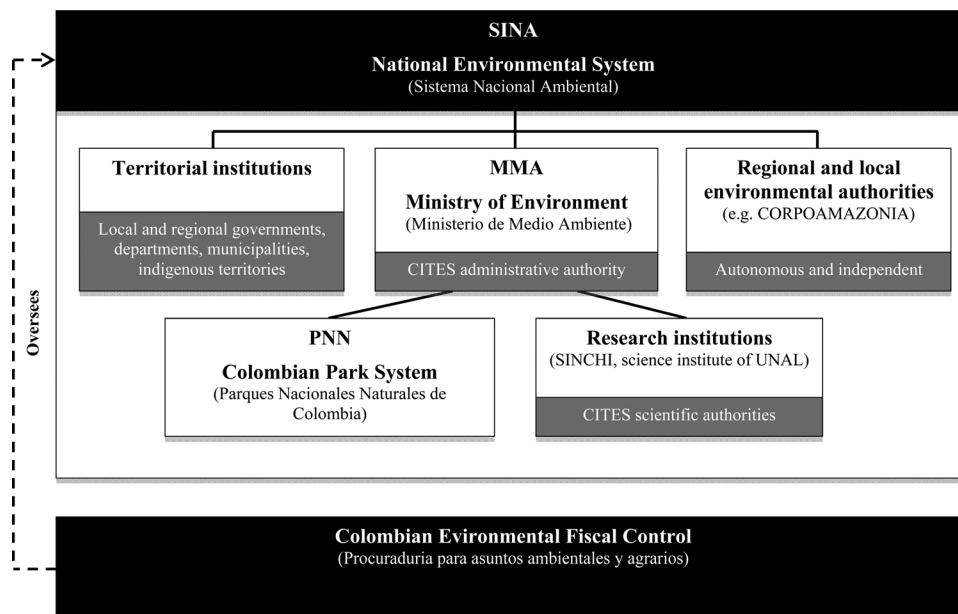


Fig. 2. Organization chart summarizing the relationship of the institutions under the Colombian Environmental System (SINA) and CITES (only institutions relevant to this research).

**TABLE II. Data Collected Between 2008 and 2012 on Population Densities and Biomass of *Aotus* spp. at Eight Study Sites in the Amazonian Frontier Between Colombia and Peru**

Sampling site	Group size ( $\pm$ SE)	N	Groups/km <sup>2</sup> ( $\pm$ SE)	Ind/km <sup>2</sup> ( $\pm$ SE)	Biomass (kg/km <sup>2</sup> )	ESW (m)	Trunc. (% m)	CV	95% CI for groups	df	AIC
Chineria & Yahuma-Peru	2.0 $\pm$ 0.22	43	12.02 $\pm$ 3.79	24.04 $\pm$ 9.62	28.85	8.82	18 m	31.55	5.96–24.23	8.66	228.69
Vista Alegre-Peru	1.88 $\pm$ 0.16	17	1.62 $\pm$ 0.65	3.24 $\pm$ 1.36	3.89	23.30	—	40.59	0.67–3.88	9.71	116.94
Calderon-Colombia	2.05 $\pm$ 0.13	40	10.95 $\pm$ 3.09	23.95 $\pm$ 6.66	28.74	13.53	—	28.23	5.46–21.94	5.44	248.48
Private Reserves-Colombia	3.5 $\pm$ 0.11	46	7.94 $\pm$ 1.12	25.92 $\pm$ 3.84	31.10	14.10	—	14.17	5.93–10.63	23.14	288.49
Mocagua—PNNA	3.3 $\pm$ 1.4	46	13.3 $\pm$ 14.3	44.0 $\pm$ 29.5	52.80	9.50	15 m	24.60	29.8–78.5	61.80	249.10

N, number of observed groups; TM, truncation measure: in meters or percentage; VC, coefficient of variation; CI, confidence interval; df, degrees of freedom; AIC, Akaike information criterion.

*nancymae* were obtained for Vista Alegre (3.2 individuals/km<sup>2</sup>), one of the Peruvian study sites, where extraction rates of owl monkeys were the highest recorded among 11 trading communities in the Brazil-Colombia-Peru tri-border area [Maldonado et al., 2009]. On the other hand, the highest population estimates of *A. vociferans* (44 individuals/km<sup>2</sup>) were found in Mocagua indigenous territory that overlaps the Amacayacu National Park in Colombia. The Colombian Private Reserves have the biggest group sizes among sites in this study (3.5 individuals).

### Estimation of Hunting Levels

Corpoamazonia registered a total of 912 owl monkeys received by FIDIC for the period March–May 2012, while legal permits granted by the same institution allowed the trapping of 800 animals per year [Corpoamazonia, 2010] (Fig. 3). A total of 14 Colombian indigenous communities were involved in the trade (Fig. 4). The interviews conducted by the BUAV in Peru, confirmed that during 2012, trappers from Yahuma community were selling owl monkeys to their relatives located in Los Lagos, Colombia, who were included in the lists of collectors given by FIDIC to Corpoamazonia. Thus the trade was not detected by Colombian authorities. However, in March 2013

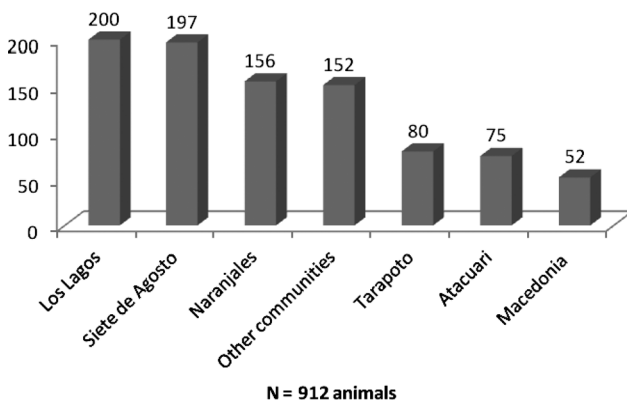


Fig. 3. Numbers of owl monkeys sold for the malaria research market for the period March–May 2012 [Corpoamazonia, 2012a,b].

the Colombian Police confiscated owl monkeys to be sold at FIDIC from a trader from San Francisco Yahuma, Peru. It was not possible for the Environmental Police to take penal action against the trader as Corpoamazonia did not take action in time and the statute of limitations ran out. The confiscated monkeys (*A. nancymae*) were subsequently transferred to a Colombian tourist center by Corpoamazonia.

### Environmental Impact of Trapping Methods

Owl monkeys are captured by teams of 5–7 people. The capture of 1–3 owl monkeys from their sleeping tree (nest) requires clearance of a 15–30 m radius around the tree. The collectors leave a “tree-bridge” forcing the primates to the ground where a 50 m double nylon fishing-net (3 cm mesh size) prevents animals from escaping once they have

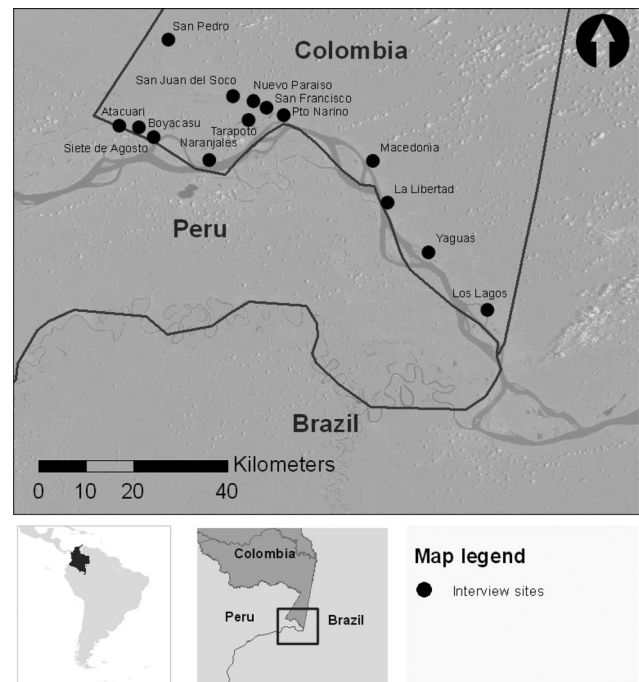


Fig. 4. Colombian indigenous communities involved in the trade in owl monkeys for the period March–May 2012.

descended across the bridge to the floor. One or two collectors climb the tree, making noise to scare the animals out. Once on the ground the primates are captured in sacks before being transferred to individual wooden cages. Extraction methods have also had environmental impacts on the composition of the forest with the loss of some estimated 65,000 trees annually.

### Impact of Post-Experimental Release in Colombian Territory

The release of owl monkeys does not comply with the IUCN guidelines for the re-introduction of non-human primates [Baker, 2002] as: (i) the release sites had not been assessed, and in most of the cases sites are not considered suitable habitats owing to their proximity to human settlements, (ii) the release-stock was subject to 4–6 months of malaria experimentation and received neither adequate veterinary screening (including genetic status identification) nor a rehabilitation process, (iii) animals had been released in numbers that range from 20 to 278 individuals, [Corpoamazonia, 2008, 2012a] while average group size is 3–5 individuals (Fig. 5), (iv) post-release requirements are not fulfilled as animals are released without monitoring or any follow-up. Local people reported the presence of carcasses of owl monkeys close to their crops. They described animals having a tattooed number on their legs, which

corresponds to the code given by the laboratory during the experimentation. During the BUAV investigation in Los Lagos, Colombia, they documented that one owl monkey marked with a tattoo was trapped and immediately released by the local collectors, as FIDIC do not pay collectors for animals marked with the tattoo. While collecting GPS waypoints in private lands in Colombia, where *A. nancymae* were released by Corpoamazonia, we found several animals of this phenotype, confirming the survival of this species in Colombia. Although released animals can survive, it is almost impossible to determine survival rates owing to the lack of follow-up.

Preliminary results from the UNAL & SINCHI [2013] study, reports that from 169 animals collected in five localities, 19 animals were released by the FIDIC, as they were marked with their tattoo number. They compared body weight of the FIDIC's animals when they arrived at the laboratory, before and after the release, and suggested that owing to the significant differences in weight (very low weight after releases) the release plan should be adjusted to improve the physical conditions and survival rate of the animals.

### *Aotus nancymae* in Colombia

Assuming that *A. nancymae* trapped in Peru and Brazil were liberated at any of the Colombian release sites over the last three decades the map resulting from the GPS waypoints obtained from the official releases [Corpoamazonia, 2012a] and from our field work suggests that *A. nancymae* is present in Colombia. It is distributed along the Amazon river with a broader distribution in the area between San Juan de Atacuari-San Juan del Soco, western limit with Peru (Fig. 6). The UNAL & SINCHI [2013] study confirms the presence of *A. nancymae* in four localities, but they only found *A. vociferans* at the control site (San Pedro de Tipisca), confirming our hypothesis that this species might be displaced by *A. nancymae*.

### Law Enforcement

On July 5, 2012 the Administrative Tribunal of Cundinamarca ruled against FIDIC and revoked their permit for trapping owl monkeys for biomedical experimentation. The Tribunal also requested internal investigations by The Ministry of Environment and Corpoamazonia. The verdict recognized the defending entities as culpable of not fulfilling their duty to ensure the protection of biodiversity and environmental integrity, and of not complying with Colombia's international commitments to the—CITES. On November 29, 2013 a State's Court (Consejo de Estado) provided the second instance ruling ratifying the first ruling, revoking trapping permits of owl monkeys. In addition, the ruling

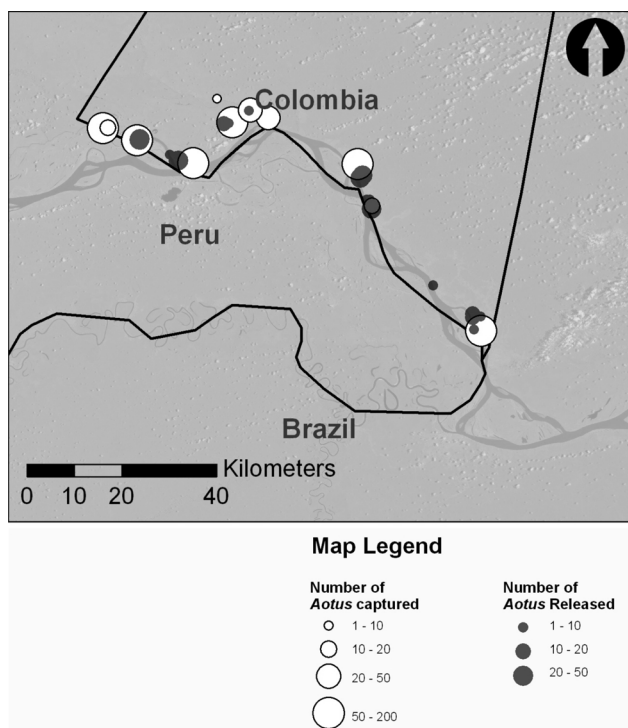


Fig. 5. Capture and post-experimental release sites for *Aotus* spp. in Colombia for the period March–May 2012 showing locations and numbers caught/released.

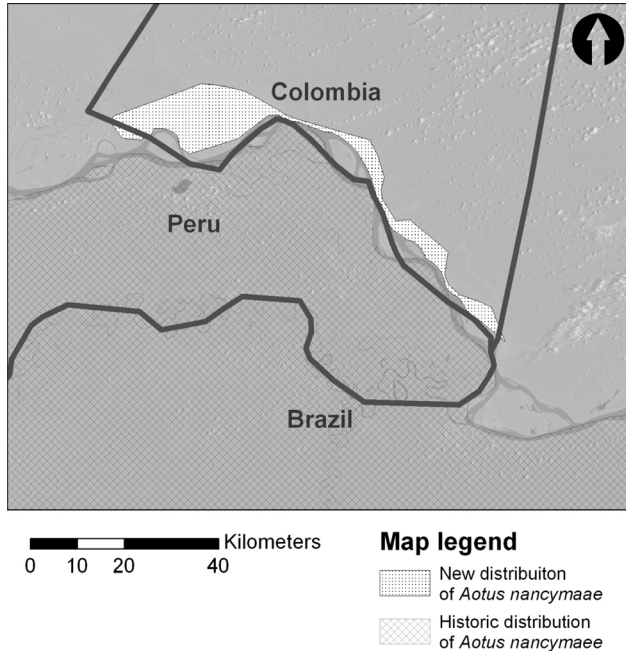


Fig. 6. Historical distribution and new distribution of *Aotus nancymae* following capture in Peru and post-experimental release in Colombia.

protects the collective rights regarding administrative morality and also includes a complete legal, philosophical, and ethical analyses on the use of wildlife—specifically the use of owl monkeys for biomedical research. The ruling emphasized that the use of animals to better human well-being has to adhere to international ethical protocols and to the species' reproductive limitations. If the FIDIC want to continue research using owl monkeys they must establish a captive breeding colony following the protocols provided by Entropika. In addition, the ruling ordered the establishment of a verification committee, to include members of Entropika, in order to guarantee compliance of the judgment.

## DISCUSSION

The average population density of *A. nancymae* at three sampling sites in Peru, reported in this study

(13.6 individuals/km<sup>2</sup>) is considerably lower compared to population averages reported by Aquino & Encarnacion [1988] for five sampling sites in flooded forests in Peru (46.3 individuals/km<sup>2</sup>; Table III). This might be the result of long-term extraction for the biomedical research market. In addition, this could be a response to the deforestation associated with the destructive trapping methods. Although the impact is likely to mimic natural gap formation, of concern is that trees with appropriate nesting holes are targeted and lost in the process. The loss of nesting habitat may have longer-term impacts on owl monkey population recovery if it is a limiting resource.

The Colombian sampling sites located on *Terra firme* showed higher population estimates for *A. vociferans* (24.9 individuals/km<sup>2</sup>) in comparison with the densities reported in Peru (7.9 individuals/km<sup>2</sup>). Aquino & Encarnacion [1988] suggested that the difference in population densities of *Aotus* in flooded and *Terra firme* forests might be because owl monkeys are better adapted to flooded forest. Nonetheless, our higher densities in *Terra firme* forest might suggest that other variables such as resource availability and hunting pressure could also influence population densities, and *Aotus* are well adapted to both forest types. Further work to measure other environmental variables is needed for a fuller understanding of the habitat requirements of the genus *Aotus* in Amazonian ecosystems.

The local Tikuna inhabitants in Peru, just as in Colombia, do not usually eat owl monkeys as they have a sub caudal gland that produces a fetid odor making their meat distasteful [Aquino et al., 2009]. Also, traditional beliefs associate their consumption with curses and with the acquisition of diseases [Maldonado, 2012]. As a result, extraction is mainly for the biomedical research market with local collectors and traders in the Brazil–Colombia–Peru border area indicating that the primates were sold to the FIDIC laboratory in Leticia, Colombia.

The results suggest that not only a much larger number of owl monkeys were traded, but that this included other species (mainly *A. nancymae*) of

TABLE III. Comparison of Average Population Densities of Owl Monkeys in Flooded and *Terra firme* Forests, in Peru and Colombia

Densities	Aquino & Encarnacion [1988]—Peru		This study	
	<i>A. nancymae</i>	<i>A. vociferans</i>	Peru— <i>A. nancymae</i>	Colombia <i>A. vociferans</i>
<b>Flooded</b>				
Group/km <sup>2</sup>	11.3	10.0	6.8	13.3
Ind/km <sup>2</sup>	46.3	33.0	13.6	44.0
<b><i>Terra firme</i></b>				
Group/km <sup>2</sup>	5.9	2.4	—	9.5
Ind/km <sup>2</sup>	24.2	7.9	—	24.9



which a substantial number of captures are from outside Colombia. Indeed, scientific publications resulting from research conducted by FIDIC indicate that *A. nancymae* and *A. nigriceps* have been used by them. All these publications have been reported to Corpoamazonia [e.g., Cardenas et al., 2005; Curtidor et al., 2007; Daubenberger et al., 2007; Patarroyo et al., 2006; Rojas-Caraballo et al., 2009; Suárez et al., 2011]. Ruiz-Garcia et al. [2013] conducted a molecular genetics analysis of mtDNA COII gene sequences reporting genetic evidence of the illegal trade conducted by FIDIC. In 2009 they sampled 24 animals from this laboratory as part of a study contracted by Corpoamazonia [Ruiz-Garcia, 2009]. Two of the samples presented sequences similar to *A. nancymae* sampled at Quebrada Yanayacu, Peru, analyzed in the same study. In addition, they pointed out that it is now clear that this species is not present inside Colombia as an indigenous species, as indicated by genetic evidence from the analyses of 111 *Aotus* samples. Despite this clear proof that FIDIC is using unauthorized species, Corpoamazonia renewed their permit in 2010 for the trapping of 800 *A. vociferans* per year [Corpoamazonia, 2010]. The UNAL/SINCHI study argues that it is highly probable that *A. nancymae* had a historical lineage north of the Amazon River, however it is important to note that the main limitations of their study are the short fieldwork period, the reduced number of sampling sites (5 out of 14) and the lack of independence, as no expert primatologists working with *Aotus* were involved in this research.

We still do not know the ecological impacts caused by the release of, for example a population of 278 animals subjected to investigations into malaria, on resident populations. As territorial species living in groups of no more than five individuals, there are likely impacts on; competition for food, territory, behavior and of course health [Aquino & Encarnacion, 1994; Fernandez-Duque, 2007; Fernandez-Duque et al., 2008]. Maldonado [2013] and Ruiz-Garcia et al. [2013] also suggested that the releases of *A. nancymae* in Colombia for more than three decades, not only created an introduced population of *A. nancymae*, but also might have displaced wild populations of *A. vociferans* at the release sites. None of the recent studies conducted at these sites reported the presence of *A. vociferans* in the last 6 years [e.g., FIDIC, 2007; Hernandez & Diaz, 2011; UNAL & SINCHI, 2013]. We strongly recommend a long-term study in the trapping/release sites in order to determine the status of *A. vociferans* to allow environmental authorities to implement a management plan for this species as it appears to be locally extinct. If the populations of *A. nancymae* in Colombian territory, identified by the UNAL-SINCHI study, are considered a naturally distributed species in Colombia its distribution area is extremely restricted and would be composed of a very small

population (Fig. 6). Therefore, it is suggested that this species should be included in one of the Endangered (EN) categories for Colombia, according to the criteria of the International Union for the Conservation of Nature (IUCN) and Appendix I of CITES. In addition, we recommend that Peru completes non-detriment finding reports to prove that international trade is not harming resident populations of regulated species [CITES, 1992]. Long-term field studies have already shown that even species that are common, such as the rhesus macaque (*Macaca mulatta*), can become endangered if hunting is carried out in an unsustainable manner [Southwick & Siddiqi, 2001].

### Implications for Regulation of Wildlife and Effectiveness of CITES

Prior to initiation of the public benefit law suit, whilst informing the environmental authorities about the trade in owl monkeys, we identified several administrative and hierarchical inconsistencies inside the structure of the Colombian Environmental System and CITES. For instance, the Ministry of Environment as the ultimate environmental authority (and CITES administrative authority), always replied to our freedom of information requests that Corpoamazonia, as all the regional authorities, are autonomous and independent, and that all the issues related to permits granted to FIDIC have to be directly addressed to Corpoamazonia. However, on July 1, 2009, the Ministry of Environment closed an investigation against the FIDIC for international wildlife trade, arguing lack of evidence regarding the distribution of *A. nancymae* [MAVDT, 2009]. At the same time, Corpoamazonia stated that any issue related to international trade of *A. nancymae* (even under permits granted by them), has to be addressed directly by the Ministry of Environment as the CITES administrative authority. For the reasons mentioned above, we sued all these organizations as it was evident they were evading their obligations under each ones jurisdiction.

The trade in owl monkeys can be used as a case study to reflect on the effectiveness of CITES enforcement and the Colombian Environmental System as a mechanism for controlling illegal wildlife trade in a challenging and relatively porous border zone, exemplified by the Amazonian Colombian-Peruvian border region. Although geographically challenging, this study benefits by having a clear final market for the primates—FIDIC in Colombia. Considering implementation, compliance, and enforcement of CITES in the border area we can address and identify mechanisms to improve enforcement of environmental legislation [Vasquez, 2003].

As reported by WWF/Dalberg [2012], wildlife trafficking tends to thrive in places where corruption is widespread, government enforcement is weak and

there are few alternative economic opportunities. Under a weak government there is weak rule of law, physical and economic insecurity, and weak political accountability—all factors that support illicit wildlife trafficking and its impunity. Thus, it is vital to involve a wider range of non-governmental stakeholders in monitoring. Formation of partnerships with non-governmental organizations and academics, particularly those engaged in local community resource management, would be an effective means of identifying first-link wildlife trade as shown in this paper. Greater linkage to local-level networks also provides the required level of flexibility to allow monitoring strategies to keep up with the adaptive nature of the wildlife trade. The independent nature of these collaborations are particularly important in countries where the technical and administrative authorities for CITES are in the same governmental institution. In this case study, Corpoamazonia and the Ministry of Environment, the governmental bodies charged with issue of trapping permits and post-experimental release of owl monkeys failed to address basic requirements under CITES legislation. It was only the intervention of a non-governmental organization (Entropika), collecting field and trade data on the impacts to owl monkeys and the environment, which has demanded that obligations under national and international legislation are upheld.

### *Enforcement*

With ongoing calls for more effective strategies for addressing illegal wildlife trade many recognize the lack of resources in tropical countries that can undermine legal frameworks for preventing traffic. Additionally, local governments often pay little attention to the trade as it is not perceived to impact human well-being or biodiversity. In spite of this they still suggest that the key is for national environmental agencies to centralize collection to feed into international wildlife-trade databases such as CITES to identify species most threatened by trade and allow developing and developed nations to “weigh in with policy improvements” [Toledo et al., 2012]. In this case study we found that, even when authorities are informed of illegal trade activity, little action is taken—in effect policy does not result in action. With no action being taken by authorities against the FIDIC research laboratory for: exceeding the annual quota of owl monkeys than permitted; using unauthorized and illegally traded species from Peru without permits (*A. nancymaae*); and post-experimental release of *A. nancymaae* outside their historical distribution range the legal action filed by civil society proved to be more effective as trapping permits were revoked [Maldonado and Peck, 2013].

Of major concern in this case is that an independent non-governmental organization was

needed to activate the legislative enforcement process—even though the authorities responsible had access to all the data required to act. This action was taken at no small cost to the members of Entropika, including a number of anonymous threats that required members to leave Colombia for a period of time during the process. Wining this public benefit law suit, represents an historic precedent not only for the improvement of Colombian legislation regarding the sustainable use of natural resources, but also shows that conservationists can achieve effective law enforcement with the collaboration of a multidisciplinary team and long-term follow-up.

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