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Conservation

National illegal wildlife and threatened species trafficking: A descriptive study in Manabí (Ecuador)

Tráfico nacional de fauna silvestre y especies amenazadas: Un estudio descriptivo en Manabí (Ecuador)

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Abstract

Illegal wildlife trafficking has negative effects on biodiversity conservation at both global and local scale. Therefore, the establishment of appropriate conservation measures requires local studies that quantify this problem. The aim of this paper is to quantify and characterize the species of birds and mammals in the period 2016-2017, at Valle Alto Wildlife Rescue Center and Wildlife Refuge. The study showed that 212 specimens belonging to 41 different species were confiscated. More birds than mammals were confiscated, and a greater proportion of birds were included in a national and international threat category. A clear preference for primates, parrots and squirrels was found. Furthermore, the presence of species with a distribution range outside the study area revealed the existence of the transportation of species from other parts of the country. Although these data are only a sample of what is actually trafficked in the country, they provide an approach of the type of species that are illegally trafficked in this biodiversity hotspot.

Keywords: Illegal wildlife trafficking, endangered species, seizures, wildlife conservation, wildlife trade.

Resumen

El tráfico ilegal de vida silvestre tiene repercusiones negativas en la conservación de la biodiversidad a nivel global y también local. Por ello, el establecimiento de medidas oportunas de conservación requiere de estudios locales que cuantifiquen dicho problema. El objetivo de este trabajo fue cuantificar y caracterizar las especies de aves y mamíferos incautadas en el periodo 2016-2017, en el Centro de Rescate y Refugio de Vida Silvestre Valle Alto. El estudio

mostró que 212 ejemplares pertenecientes a 41 especies diferentes fueron confiscados. Se decomisaron más aves que mamíferos y una mayor proporción de aves estaban incluidas en alguna categoría de amenaza a nivel nacional e internacional. Se encontró una clara preferencia por primates, loros y ardillas. Además, la presencia de especies con un rango de distribución fuera del área de estudio reveló la existencia del transporte de especies desde otras zonas del país. Si bien estos datos son solo una muestra de lo que realmente se trafica en el país, dan una aproximación del tipo de especies que se trafican ilegalmente en este hotspot de biodiversidad.

Palabras clave: Especies en peligro de extinción, incautaciones, conservación de vida silvestre, tráfico ilegal de fauna silvestre, comercio de vida silvestre.

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1 Introduction

Damage caused by the international illegal trade in wildlife species may represent one of the greatest threats to biodiversity conservation (Robinson and Sinovas, 2018). This problem has greatly affected Latin America for many years (Mancera and García, 2008). So much so, that in the 1960s and 70s, the Amazon basin was the main source of primate extraction for export abroad (Mittermeier et al., 1994), and in the period 2006-2012, Central and South America were, together with the Middle East, the largest importers of birds (legal and illegal trade) (Bush et al., 2014). Furthermore, a review of global trends concerning wildlife confiscation during the period 2010-2014 published by CITES shows that 32% of the confiscated species were from wild populations in South America (D'Cruze et al., 2018). It is, therefore, possible to state that Latin America plays an important role in the legal and illegal trade of wild species, and that its countries participate as both exporters and importers (Bush et al., 2014; D'Cruze et al., 2018; Di Minin et al., 2019). Among the factors that could explain this phenomenon are poverty, the great biodiversity of the region, and socio-cultural dimensions (Duffy et al., 2016; Arroyave et al., 2020), being the root of the problem on the colonialism (Sollund and Runhovde, 2020). For example, hunting and illegal trade can become a sufficient source of income to finance subsistence expenses (Duffy et al., 2016; Rodríguez-Ríos and García, 2018).

Although few studies characterize or contribute data on wildlife trafficking by the countries in the region at the national level, it is known that illegal trade at the national level exceeds international trade in all countries (Goyes and Sollund, 2016). The specimens involved in this type of trade do not appear in the CITES data since they do not cross borders, which makes them more difficult to account for. Since Ecuador is a mega-diverse country (Mittermeier et al., 1997) with a large social inequality and a high percentage of rural populations (World Bank, 2020), it suffers the consequences of wildlife trafficking for meat consumption, trade and economic sustenance (Sinovas and Price, 2015; Ministerio del Ambiente, 2017a). According to data provided by the Ecuadorian Ministry of the Environment, a total of 1,526 specimens of birds and a total of 1,709 specimens of mammals were confiscated in the period 2003-2014 at a national level (Ministerio del Ambiente, 2012, 2014, 2015). For example, wildlife trafficking that began in the mid-1990s in Yasuni National Park tripled between 2005 and 2007, due to increased demand and improved access to remote locations (Suarez et al., 2009). However, it is important to account that the number of confiscated animals represents a low proportion of the real number of trafficked animals, since not all trafficked animals are confiscated. For instance, national confiscations in Colombia represented 1-10% of the total number of trafficked animals during the period 1996-2004 (Mancera and García, 2008). In spite of being one of the great conservation problems (De la Torre, 2012; Tirira, 2013; Cervera et al., 2018), very few studies characterize the illegal wildlife trade in the country. The aim of this paper is to characterize the bird and mammal species that were trafficked in the province of Manabí, in the Coastal Region of Ecuador during 2016-2017, in terms of taxonomy, conservation status, original distribution range, and CITES listing. To do so, the data provided by the Valle Alto Wildlife Rescue Centre and Wildlife Refuge (the only rescue centre in the province during the study period) was used, which received all the confiscated animals from the province.

2 Material and methods

The study was carried out at the Valle Alto Wildlife Rescue Centre and Wildlife Refuge (Figure 1), located in the province of Manabí (Coordinates 1°5'37.13"S 80°16'16.57"W) in the Coastal Region of Ecuador (Zambrano et al., 2019), one of the world's biodiversity hot spots (Myers et al., 2000). This region, originally characterized by dry and humid forest, has been strongly transformed, becoming a mainly agricultural region, in which most of the forest remnants are small, fragmented patches (Rivas et al., 2020).

We employed the database of the Valle Alto Wildlife Rescue Centre and Wildlife Refuge of those bird and mammal specimens confiscated and received by the Centre during 2016-2017. The interception, confiscation and transfer to the Centre are carried out jointly by the police and the Ministry of the Environment. Once the animals arrive at the Centre, they are evaluated and remain confined until their recovery, to be released later. Those animals

that cannot be released are transferred to zoos. The taxonomy status of mammal species was assigned according to Version 2020.1 of the document Mammals of Ecuador: updated checklist species (Tirira et al., 2020), and the taxonomic status of birds was assigned according to the Red List of Birds of Ecuador (Freile et al., 2019).

For these species, we considered the national level of threat according to the Red Book of Mammals of Ecuador (Tirira, 2011) and the Red List of Birds of Ecuador (Freile et al., 2019); the international level of threat according to the IUCN red list; and the original distribution (Coast, Andean, Amazon). Although this study is focus on national trade, CITES listing (https://www.cites.org/eng/app/index.php) was also included in order to get a reference about the threat of international trade for each species. We calculated absolute and relative frequencies of the number of species and individuals with respect to their distribution, order, CITES Appendix and the threat category in Ecuador and at international level. Then, we performed Fisher tests to compare proportions between birds and mammals concerning the level of threat at national and international level, CITES listing and distribution range.

Figure 1. The map shows the three main biogeographical regions of mainland Ecuador, the location of the Manabí province (yellow) and the Valle Alto Wildlife Rescue Centre and Wildlife Refuge (black spot).

3 Results

Overall, 212 animal specimens from 41 species and 14 orders were confiscated by the Valle Alto Wildlife Rescue Centre and Wildlife Refuge during 2016 and 2017. Our analysis showed that there were more birds confiscated (25 species, 147 specimens), followed by mammals (16 species, 65 individuals). From birds, the most frequent order in the confiscations was *Psittaciformes* (121 specimens, 13 species), which accounted for 82.3% of the total number of confiscated birds, being *Brotogerys pyrrhoptera* (IUCN Endangered) the most frequently confiscated species (29.9%) (Table 1). It is important to note that 39.7% of the confiscated birds were listed in one of the national threat categories and 31.3% in one of IUCN risk categories.

The most frequent confiscated mammal order was Rodentia (50.8%), mainly the species *Simosciurus stramineus* (36.9%), followed by Primates (32.3%), mainly *Saimiri cassiquiarensis* (10.8%) and *Alouatta palliata* (9.2%) (Table 2). Five species (*Choloepus hoffmanni,Alouatta palliata, Cebuella pygmaea, Cebus aequatorialis* and *Cebus capucinus*) of the sixteen mammal species were categorized as species at risk (1 CR, 2 EN and 1 VU) in Ecuador (20.2% of all mammal confiscations), and 92.3% of mammal confiscations were as Least Concern (LC) by the IUCN Red List (Table 2). It is important to highlight that one species (*Cebus aequatorialis*) was classified as Critically Endangered (CR) by the IUCN Red List.

Our study found the following differences between the birds and mammals confiscated: with regard to CITES Appendix in which the confiscated species were found, the data showed that the majority of birds (89.1%) were included in Appendix II, whereas most of the mammal species confiscated (60.1%) were not included in any Appendix, nonetheless a significant number of mammal species were included in CITES Appendix I (13.8%). As for the National risk category, a greater percentage of birds confiscated are categorized as Vulnerable in Ecuador (34.1%), while the majority of mammal species are listed in the Least Concern category (61.5%). In the case of the IUCN threat category, most of mammal species (92.3%) are included in the Least Concern category (92.3%), and an important proportion of birds (29.9%) were classified as Endangered (Table 3).

As for the distribution range, 71.4% of bird species and 64.6% of mammal species have the coast as their natural distribution range. It should be noted that 12.2% of birds and 16.9% of mammals had the Amazon as their distribution range. Most of the mammal species (91%) from Amazon were primates, and all the bird's species whose distribution range is in the Amazon belonged to the Psittaciformes order. There were not differences between mammal species and bird species concerning the distribution range in any case (Table 4).

Table 1. Bird species confiscated in Manabí (Coastal Region of Ecuador) during 2016-2017, their risk categories, and CITES Appendix listing.

Order	Scientific name	Individuals (*n*)	Relative frequency (%)	National risk category	IUCN risk category	CITES Appendix
Accipitriformes	*Buteogallus anthracinus*	1	0.7	VU	LC	II
Accipitriformes	*Rostrhamus sociabilis*	2	1.4	LC	LC	II
Anseriformes	*Dendrocygna autumnalis*	1	0.7	LC	LC	NI
Caprimulgiformes	*Steatornis caripensis*	1	0.7	LC	LC	NI
Columbiformes	*Zenaida auriculata*	4	2.7	LC	LC	NI
Columbiformes	*Zenaida meloda*	2	1.4	LC	LC	NI
Galliformes	*Ortalis erythroptera*	2	1.4	VU	VU	NI
Galliformes	*Penelope purpurascens*	3	2	VU	LC	NI
Pelecaniformes	*Ardea cocoi*	1	0.7	LC	LC	NI
Piciformes	*Pteroglossus torquatus*	1	0.7	NT	LC	NI
Psittaciformes	*Amazona amazonica*	2	1.4	LC	LC	II
Psittaciformes	*Amazona autumnalis*	11	7.5	EN	LC	II
Psittaciformes	*Amazona farinosa*	4	2.7	NT	NT	II
Psittaciformes	*Amazona ochrocephala*	1	0.7	LC	LC	II
Psittaciformes	*Ara ararauna*	3	2	NT	LC	II
Psittaciformes	*Ara macao*	1	0.7	NT	LC	I
Psittaciformes	*Ara severus*	2	1.4	LC	LC	II
Psittaciformes	*Brotogeris pyrrhoptera*	44	29.9	VU	EN	II
Psittaciformes	*Brotogeris versicolurus*	11	7.5	NE	LC	II
Psittaciformes	*Forpus coelestis*	5	3.4	LC	LC	II
Psittaciformes	*Pionus chalcopterus*	11	7.5	LC	LC	II
Psittaciformes	*Pionus menstruu*	8	5.4	LC	LC	II
Psittaciformes	*Psittacara erythrogenys*	21	14.3	NT	NT	II
Strigiformes	*Ciccaba virgata*	1	0.7	LC	LC	II
Strigiformes	*Glaucidium peruanum*	4	2.7	LC	LC	II

CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient, NE: Not Evaluated. NI = Not included in CITES Appendices.

Table 2. Mammal species confiscated in Manabí (Coastal Region of Ecuador) during 2016-2017, their risk categories and CITES Appendix listing.

Order	Scientific name	Individuals (*n*)	Relative Frequency (%)	National risk category	IUCN risk category	CITES Appendix
Carnivora	*Leopardus pardalis*	3	4.6	NT	LC	I
Carnivora	*Nasua nasua*	1	1.5	LC	LC	NI
Carnivora	*Potos flavus*	3	4.6	LC	LC	NI
Cingulata	*Dasypus novemcinctus*	1	1.5	LC	LC	NI
Pilosa	*Bradypus variegatus*	2	3.1	LC	LC	II
Pilosa	*Choloepus hoffmanni*	1	1.5	VU	LC	NI
Pilosa	*Tamandua tetradactyla*	1	1.5	LC	LC	NI
Primates	*Alouatta palliata*	6	9.2	EN	LC	I
Primates	*Cebuella pygmaea*	1	1.5	VU	LC	II
Primates	*Cebus aequatorialis*	4	6.2	CR	CR	II
Primates	*Cebus capucinus*	1	1.5	EN	NE	II
Primates	*Leontocebus lagonotus*	2	3.1	NT	LC	II
Primates	*Saimiri cassiquiarensis*	7	10.8	NT	LC	II
Rodentia	*Dasyprocta punctata*	6	9.2	LC	LC	NI
Rodentia	*Notosciurus granatensis*	2	3.1	LC	LC	NI
Rodentia	*Simosciurus stramineus*	24	36.9	LC	LC	NI

CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient, NE: Not Evaluated. NI = Not included in any CITES Appendices.

4 Discussion

This work demonstrates the existence of illegal trade of a great variety of mammal and bird species in the province of Manabí (Ecuador). A similar work performed during the same period in the neighbouring province of Guayas also showed that a great number of birds and mammals were trafficked in that region (Bazurto, 2018). Our results concur with two surveys performed in the region which showed that possession of wild animals is frequent in rural communities (Corrales, 2018; Cedeño, 2020). In consequence, illegal wildlife trade can be considered as one of the main threats for birds and mammals in Manabí, and actions are needed to reduce the demand.

It terms of legislation, for the period 2016 and 2017, it is important to note that wildlife trafficking is typified as a crime by the Article 247 of the Comprehensive Organic Criminal Code (Código Orgánico Integral Penal), which states that: "The person who hunts, fishes, captures, collects, extracts, posses, transports, traffics, benefits from, permutes or commercializes, specimens or their parts, their constituent elements, products and derivatives, of terrestrial, marine or aquatic flora or fauna, of threatened, endangered and migratory species, listed at a national level by the National Environmental Authority, in addition to international instruments or treaties ratified by the State, will be sanctioned with a custodial sentence of one to three years" (Ministerio de Justicia Derechos Humanos y Cultos, 2014). This entails that the animal specimens detained during 2016-2017 in the Manabí region were trafficked despite the law in Ecuador, which is even more dissuasive than in other neighbouring countries (e.g., Brazil) (Sollund and Runhovde, 2020), suggesting that additional measures should be established to avoid this problem. Since illegal wildlife trafficking is a complex issue involving ecological, socioeconomic, and cultural factors (Phelps et al., 2016; Biggs et al., 2017), the solution cannot be based only on legal instruments and it is necessary to develop a holistic approach to reduce the demand.

Table 3. CITES listing Appendix, and National and international risk categories of bird and mammal species confiscated in Manabí (Ecuador) during 2016-2017.

	Birds		Mammals		Fisher test
CITES appendix	*n*	%	*n*	%	P-value
I	1	0.7	9	13.8	p<0.0001
II	131	89.1	17	26.2	p<0.0001
III	0	0	0	0	–
Not included	15	10.2	39	60.1	p<0.0001
National risk categories					
CR	0	0	4	6.2	p=0.008
EN	11	7.5	7	10.8	p=0.594
VU	50	34.1	2	3.1	p<0.0001
NT	30	20	12	18.5	p=0.852
LC	45	30.6	40	61.5	p<0.0001
DD	0	0	0	0	–
NE	11	7.5	0	0	p=0.037
IUCN risk categories					
CR	0	0	4	6.2	p=0.008
EN	44	29.9	0	0	p<0.0001
VU	2	1.4	0	0	–
NT	25	17	0	0	p<0.0001
LC	76	51.7	60	92.3	p<0.0001
DD	0	0	0	0	–
NE	0	0	1	1.5	–

CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient, NE: Not Evaluated.
Notes: The last column shows the proportion differences according to the Fisher's exact test. The test was not performed in rows with "–" due to the low number of observations.

Table 4. Distribution Range of bird and mammal species confiscated in Manabí (Ecuador) during 2016-2017.

	Birds		Mammals		Fisher Test
Distribution Range	*n*	%	*n*	%	p-value
Amazon	18	12.2	11	16.9	p=0.389
Coast	105	71.4	42	64.6	p=0.336
Coast-Amazon	18	12.2	7	10.8	p=0.821
Coast-Andean	4	2.7	2	3.1	–
Coast-Andean-Amazon	0	0	3	4.6	–
No data	1	0.7	0	0	–
Andean-Amazon	1	0.7	0	0	–

Notes: The last column shows the proportion differences according to the Fisher's exact test. The test was not performed in rows with "–" due to the low number of observations.

According to our data, more birds were confiscated than mammals, and they had a more worrying conservation status, which entails that the illegal wildlife trade could have a greater effect on birds. This could be explained by the existing demand of birds as pets (Da Nóbrega and Pereira, 2007; Bush et al., 2014). As mentioned previously, the most frequently trafficked bird order was Psittaciformes (e.g., *Ara macao*, Figure 2a), data that coincides with reports from the Ecuadorian Ministry of the En-

vironment for 2013, which stated that 71% of seized birds nationwide were *Psittaciformes*; being also one of the most threatened order worldwide (Olah et al., 2016; Bird Life International, 2017). For instance, *Brotogeris pyrrhoptera* represented the 30% of the bird confiscated, and this species is classified as Vulnerable in Ecuador and Endangered by IUCN red list. Due to the preference of this order as a pet (Romero et al., 2020) these species are highly trafficked. Indeed, the current decline of Neotropical parrot population is closely related to the local parrot trade for use as pets, in addition to their capture for international trade (Berkunsky et al., 2017). This phenomenon is indeed reflected in our study, since most of confiscated bird species were Psittaciformes, moved from the Amazon to the Coastal Region, outside their natural range distribution, which can also have a negative impact as invasive exotic species (Bush et al., 2014; Zhou et al., 2015). This is the case of *Brotogerys versicolurus*, the third most confiscated bird species in our study, native to the Amazon and which introduced the New Castle disease into Peru through the release of confiscated and infected individuals (Daut et al., 2016).

Figure 2. The scarlet macaw (*Ara macao*) (a) and the Humboldt's squirrel monkey (*Saimiri cassiquiarensis*) (b), examples of native species from the Amazon confiscated in the Coastal Region, Ecuador.

Concerning mammals, rodents were the most trafficked order, and among these squirrels were the most trafficked species. It is easy to find squirrels in international pet markets or being transported around the world (Bertolino, 2009), and it is not, therefore, surprising that it was also one of the main rodents confiscated in our study area. The second most trafficked rodent was *Dasyprocta punctata*, probably owing to the fact that it is consumed as bush meat in the region (Rodríguez-Ríos and García, 2018). After Rodentia, primates were the most seized mammal species in the region of Manabí, where they have been traditionally used as pets (De la Torre, 2012). A study about trafficking of native primates in Ecuador for 1989-2012, found that 98% of the primates were destined to be pets (Tirira, 2013). Also, a local study with data on illegal wildlife trafficking, revealed that 42% of the mammals subject to illegal trade were primates (De la Torre, 2012). Similarly, in 2013, a report by the Ecuadorian Ministry of the Environment stated that 30% of confiscated mammal species were primates.

In our study, the Humboldt's Squirrel Mon-

key (*Saimiri cassiquiarensis*; Figure 2b), native to the Amazon region in Ecuador, was the most trafficked primate, which coincides with national data as being the most trafficked primate species during 1989-2012 (Tirira, 2013). Moreover, De la Torre (2012), in a study in the Ecuadorian Amazon, reported that 40% of the primates confiscated by the Ministry of the Environment during the period 2008-2010 belonged to this same species. The demand for this species as pet is probably owing to its graceful appearance, small size and ability to adapt to different environments, along with a low-selective diet (De la Torre et al., 2011). Additionally, two species with natural populations in the Coastal Region, the mantled howler monkey (*Alouatta palliata*) and the white fronted capuchin (*Cebus aequatorialis*) were also confiscated during this study; *C. aequatorialis* is uncommon on the coast (Guerrero-Casado et al., 2020) and it is classified as critically endangered (CR) at national level (Tirira, 2011). In summary, our data confirm that there is a demand for primates mainly to be used as pets, thus reducing the trade of these species requires special attention.

Furthermore, we should not underestimate the fact that an important proportion of the confiscated species are classified at risk by IUCN, which suggests that the impact of national illegal trade on wild populations may be shattering. Although our study was focused on wildlife trade at a national scale, it is also important to highlight that the majority of the bird species seized are included in CITES Appendix II, which includes species that could be threatened if their international trade is not controlled. Furthermore, although most mammal species are not included in the CITES Appendices, it is worrying that 13.8% are listed in CITES Appendix I, which includes species threatened with extinction. Reducing national illegal trade could definitely contribute to improve the conservation status of these species.

Finally, although the Coastal Region is the natural distribution range of most of the seized species, our results showed that there is also trafficking from the Amazon area (11% of specimens), most of which were Primates and Psittaciformes. The introduction of exotic species can have negative consequences on the ecosystems of the coastal region (Bush et al., 2014), in addition to animal welfare concerns for the capturing (in the Amazon), transportation (to the coast region) and subsequent possession of specimens (Baker et al., 2013). Avoiding the movement of animals from the Amazon should be therefore considered a priority in a national strategy to reduce illegal wildlife trade.

5 Conclusión

Our data showed there is a great variety of bird and mammal species affected by illegal wildlife trafficking, many of which are threatened at both national and international level. National wildlife trade should be considered a major conservation concern, and further protection and conservation measures should be implemented to reduce the number of species subject to trade. In this regard, the objective of the National Policy for Wildlife Management (Ministerio del Ambiente, 2017b) is to allow the different governmental levels a coordinated exercise to control and monitor the use and commercialization of wildlife at a national and local level (Mestanza-Ramón et al., 2020) in order to fully reduce illegal and unsustainable wildlife trade in Ecuador. Although Ecuadorian law already considers the offence of wildlife trafficking with a custodial sentence, we believe that better controls and management information systems (e.g., improvement of data reporting) should be enforced together with the development of other complimentary actions, such as environmental education programmes with the aim of creating awareness about the negative consequences of wildlife exploitation on animal welfare, loss of biodiversity and human health. This last topic has been highlighted in the last year because of the Covid-19, and many researchers and doctors (e.g., Roe et al. (2020); Aguirre et al. (2020)) have claimed that it is necessary to reduce the illegal wildlife trade to prevent future pandemics under the one health perspective.

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