

Short Note [Nota Corta]



Analysis of the frequency of wildlife seizures carried out by PROFEPA during the period 2008-2018 in Yucatán, Mexico†

[Análisis de la frecuencia de decomisos de fauna silvestre realizados por la PROFEPA durante el periodo 2008-2018 en Yucatán, México]

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SUMMARY

Background. Wildlife represents a natural resource of major ecological, economic, cultural, and social importance. However, illegal extraction and unauthorized trade constitute significant threats to many species. In Mexico, few studies have systematically documented wildlife seizures conducted by environmental authorities. **Objective.** To analyze wildlife seizures carried out by the Federal Attorney for Environmental Protection (PROFEPA) in Yucatán, Mexico, during the period 2008–2018 to identify temporal patterns and the faunal groups most affected. **Methodology.** Information was obtained through a request submitted to Mexico's National Transparency Platform. Records were taxonomically reviewed, updated, and organized into a database containing information on date, taxonomic group, species, life stage, condition at seizure, destination, and number of individuals. Additional data on geographic distribution, conservation status under NOM-059-SEMARNAT-2010, and inclusion in CITES appendices were incorporated. **Results.** A total of 467 seizure records from January 2008 to August 2018 were analyzed, involving 1,813 individuals belonging to 110 species of reptiles, birds, and mammals. Annual numbers of seized individuals and species exhibited a synchronous temporal pattern, with peaks in 2009, 2010, and 2013. Birds represented the most frequently seized group in terms of both species richness and number of individuals. Species naturally distributed in Yucatán, including endemic and quasi-endemic taxa, were more frequently represented than exotic species. Most seized individuals were adults and were alive at the time of confiscation. **Implications.** The findings identify priority groups for conservation and provide evidence useful for improving wildlife surveillance, management, and protection actions. **Conclusion.** Birds were the faunal group most affected by wildlife seizures in Yucatán. These results highlight the need to strengthen monitoring, documentation, and conservation strategies focused on species affected by illegal exploitation, particularly those included in threatened categories or protected under international agreements.

Key words: Wildlife seizures; Wildlife conservation; Temporal patterns; Yucatán.

RESUMEN

Antecedentes. La fauna silvestre constituye un recurso natural de gran importancia ecológica, económica, cultural y social. Sin embargo, la extracción ilegal y el comercio no autorizado representan amenazas significativas para numerosas especies. En México existen pocos estudios que documenten de manera sistemática los decomisos de fauna realizados por las autoridades ambientales. **Objetivo.** Analizar los decomisos de fauna silvestre realizados por la Procuraduría Federal de Protección al Ambiente (PROFEPA) en Yucatán durante el periodo 2008–2018 para identificar patrones temporales y los grupos faunísticos más

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afectados. **Metodología.** Se obtuvo información mediante una solicitud a la Plataforma Nacional de Transparencia de México. Los registros fueron depurados y actualizados taxonómicamente e integrados en una base de datos con información sobre fecha, grupo taxonómico, especie, etapa de vida, condición al momento del decomiso, destino posterior y número de individuos. Adicionalmente, se incorporó información sobre distribución geográfica, categoría de riesgo de acuerdo con la NOM-059-SEMARNAT-2010 y presencia en los apéndices de CITES. **Resultados.** Se analizaron 467 registros de decomiso correspondientes al periodo enero de 2008–agosto de 2018, que involucraron 1,813 individuos pertenecientes a 110 especies de reptiles, aves y mamíferos. El número anual de individuos y especies decomisadas presentó un patrón temporal sincrónico, con máximos en 2009, 2010 y 2013. Las aves constituyeron el grupo más representado tanto en número de individuos como de especies. Asimismo, las especies con distribución natural en Yucatán, incluidas las endémicas y cuasiendémicas, fueron más frecuentes que las especies exóticas. La mayoría de los ejemplares decomisados eran adultos y se encontraban vivos al momento de su aseguramiento. **Implicaciones.** La información generada permite identificar grupos prioritarios para la conservación y aporta evidencia útil para orientar acciones de vigilancia, manejo y protección de la fauna silvestre. **Conclusión.** Las aves fueron el grupo más afectado por los decomisos registrados en Yucatán. Los resultados resaltan la necesidad de fortalecer el monitoreo, la documentación y las estrategias de conservación dirigidas a especies sujetas a aprovechamiento ilegal, particularmente aquellas incluidas en categorías de riesgo o bajo protección internacional.

Palabras clave: Decomisos de fauna; Conservación de vida silvestre; Patrones temporales; Yucatán.

INTRODUCTION

Wildlife is a valuable natural resource from various perspectives, such as existential, aesthetic, environmental, economic, and cultural (Aguilar-Cordero, 2000; Ulloa, 2012). Various studies (for example, Puc Gil and Retana Guascón, 2012; Lira-Torres *et al.*, 2014; Herrera-Flores *et al.*, 2019) document the importance that communities attribute to wildlife as a resource, a phenomenon not limited to Mexico alone. However, the relationship between wildlife and human societies is conflictive, as the aforementioned values also account for real or potential damages that wildlife causes to human goods and possessions (Flores-Armillas *et al.*, 2020).

One of the most relevant damages to wildlife, from the human side, is overexploitation, especially when carried out illegally and indiscriminately. Asprilla-Perea *et al.* (2013), analyzing wildlife seizures in the Chocó department (Colombia), indicated that the best-represented groups in the seizures were birds and mammals, with most species in some risk category. Petrossian *et al.* (2016), in an analysis of wildlife seizures at US ports of entry during the period 2003-2013, found that most seized species belonged to mammals, mollusks, birds, reptiles, fish, and corals, with mammals and reptiles highlighted in half of the seizures. Besides, Crespo-Gascón *et al.* (2022), characterizing the species seized at a rescue center in Manabí, Ecuador, found more birds than mammals and a higher proportion of birds in some threat category.

The mentioned studies emphasize the importance of documenting wildlife seizures and their impacts,

even if using data from the environmental protection agencies of each country, given the difficulties of conducting field evaluations on the matter. In Mexico, these studies are scarce (Sosa-Escalante, 2011; Antonio Guzmán, 2016; Carpio Domínguez *et al.*, 2021).

In this work, data on wildlife seizures carried out by PROFEPA in the state of Yucatán during the period 2008-2018 were analyzed to determine temporal patterns in the seizures and generate relevant information to identify the most affected wildlife groups, thus contributing to the improvement of conservation efforts.

MATERIALS AND METHODS

An online information request was made on the Mexican National Transparency Platform (www.infomex.org.mx) to obtain data on seizures conducted in Yucatán by PROFEPA, broken down by month and year, from January 2008 to August 2018.

The provided information was cleaned and updated for the common and scientific names of each wildlife species seized during the mentioned period, taking into account the following works: List of Amphibians of Mexico (CONABIO, 2014), Reptiles of Mexico (Naturalista, 2013), Birds of Mexico: Updated List of Species and Common Names (Berlanga *et al.*, 2019), and Updated List of Mammals of Mexico (Ceballos and Arroyo-Cabral, 2012).

The cleaned and updated information was organized into a database with the following fields: 1) year, 2) month, 3) vertebrate group to which the

seized individual belongs (amphibians, reptiles, birds, mammals), 4) species and common name, 5) life stage, 6) condition upon receipt of the specimen, 7) destination of the specimen after seizure, and 8) number of seized individuals.

This database was enriched with information on the distribution of species concerning the state of Yucatán, classifying them into three categories: a) species with natural distribution, found in the wild within Mexican territory, including Yucatán; b) endemic species, with exclusive distribution in the wild in Yucatán; and c) exotic species, naturally distributed outside national territory.

Finally, the risk category of each species according to NOM-059-SEMARNAT-2010 (SEMARNAT, 2010) was included, as well as the appendix in which they are considered according to CITES (CONABIO, 2023).

To determine the existence of patterns in terms of biological variables related to wildlife seizures, various data visualization techniques were employed using the R programming environment (R Core Team, 2023), version 4.3.1.

RESULTS

A total of 467 seizure records from January 2008 to August 2018 were analyzed, within which 1,813 individuals corresponding to 110 species of reptiles, birds, and mammals were registered. Detailed information about species names, conservation status and other relevant data are include in the supplementary table 1.

The number of seized species and the number of seized individuals per year show a synchronous pattern (Figure 1): high values in 2009, 2010, and 2013, with lows in 2011, 2017, and the first part of 2018.

Birds stand out in the seizures carried out, both in individuals and species (Figure 2). Mammals rank second in terms of species, while reptiles have the second highest number of seized individuals.

Most seized individuals were adults (Figure 3), with birds being the most represented, followed by reptiles.

A large proportion of the individuals were seized alive (Figure 4), with birds again being the most frequent group.

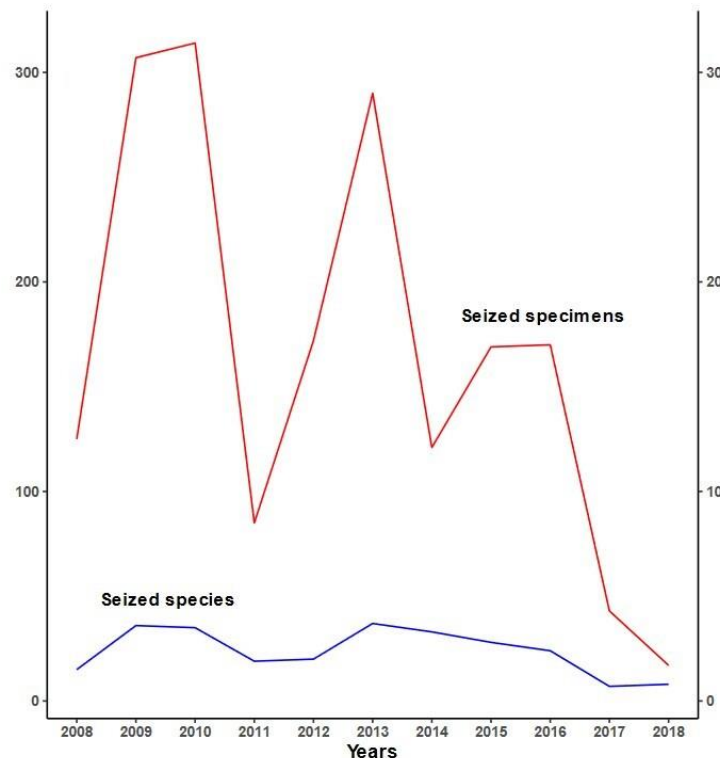


Figure 1. Annual variation in the number of wildlife species and individuals seized by PROFEPA in Yucatán, Mexico, from 2008 to 2018.

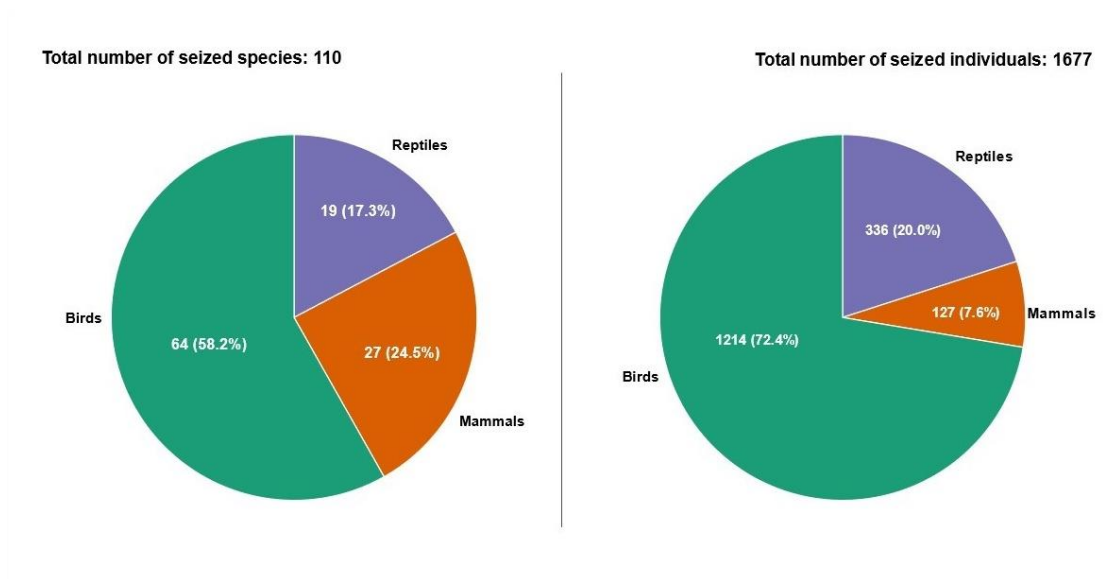


Figure 2. Relative contribution of birds, mammals, and reptiles to wildlife seizures in Yucatán based on (a) number of species and (b) number of individuals recorded during 2008–2018.

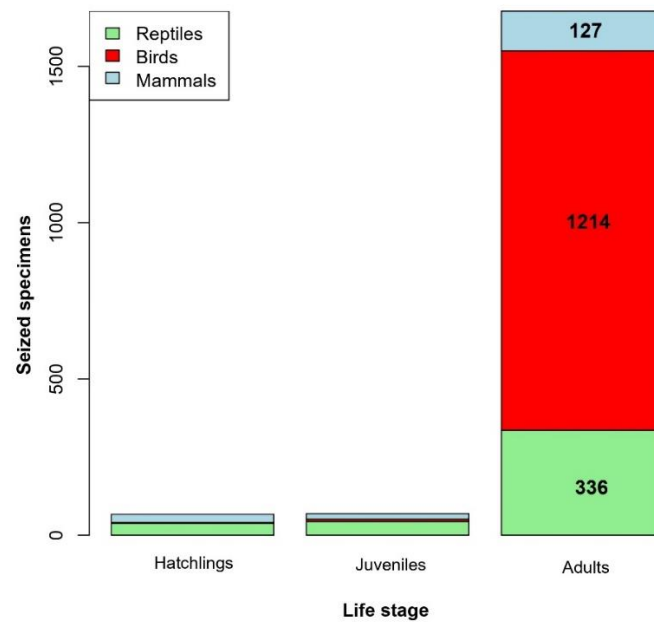


Figure 3. Number of seized individuals by life stage (hatchling, juvenile, and adult) and faunal group recorded in wildlife seizures in Yucatán during 2008–2018.

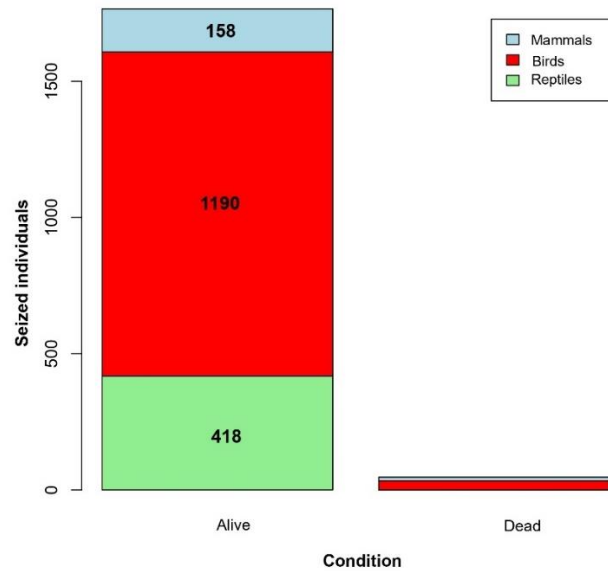


Figure 4. Number of seized individuals by condition at the time of seizure (alive or dead) and faunal group in Yucatán, Mexico, during 2008–2018.

Most of the seized individuals were donated (Figure 5), while release and destruction options had much lower frequencies. Species with natural distribution in Yucatán, including endemic and quasi-endemic species, were more represented in seizures than exotic species (Figure 6).

Birds had the highest number of species listed in some risk category according to NOM-059 (Figure

7), especially in the threatened and specially protected categories.

Regarding the number of species included in CITES appendices, birds and reptiles stood out for their numbers in Appendix II, while mammals had more species in Appendix I (Figure 8).

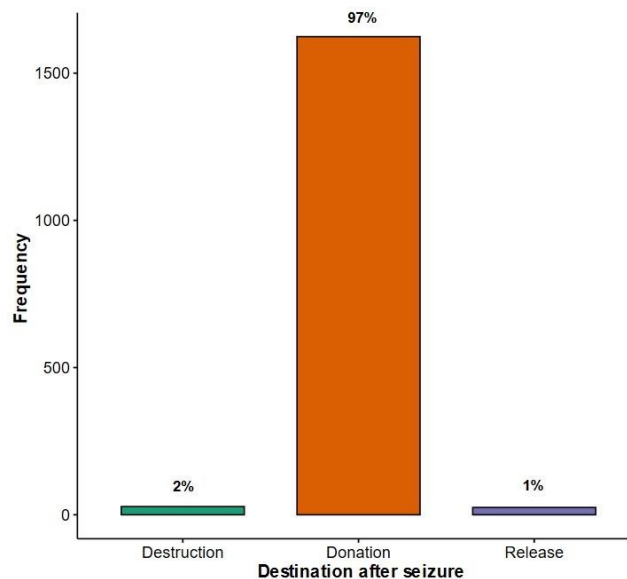


Figure 5. Final destination assigned to wildlife individuals after seizure, expressed as the percentage of records corresponding to donation, release, and destruction.

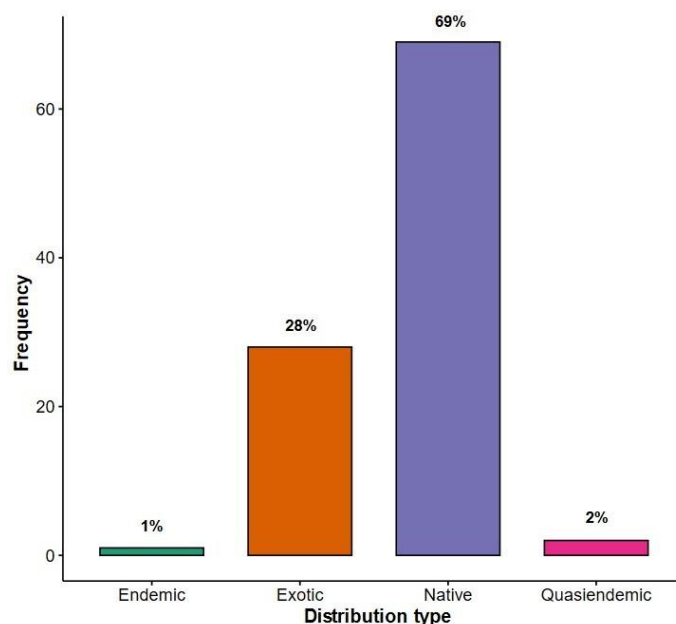


Figure 6. Percentage of seized species according to their distribution type in relation to Yucatán: endemic, quasi-endemic, native, and exotic species.

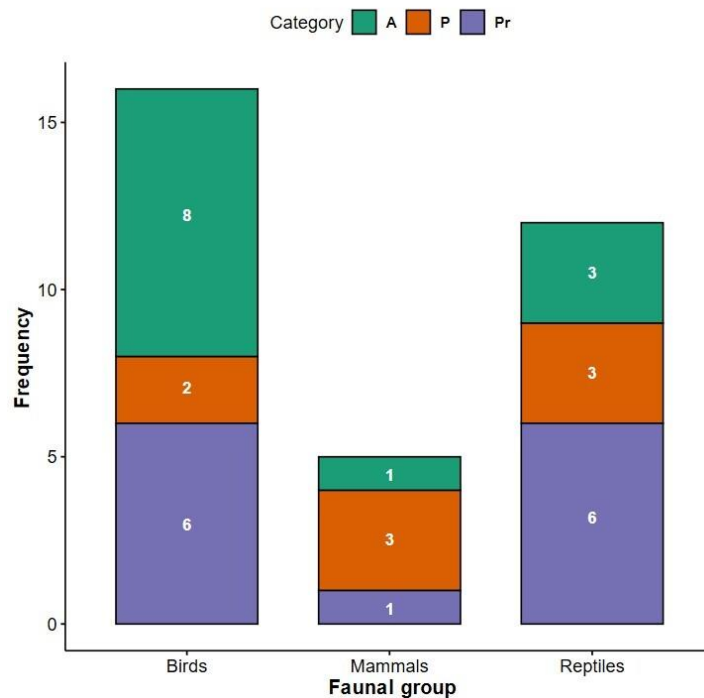


Figure 7. Number of seized species included in risk categories of NOM-059-SEMARNAT-2010 by faunal group. P = Endangered, A = Threatened, Pr = Subject to Special Protection.

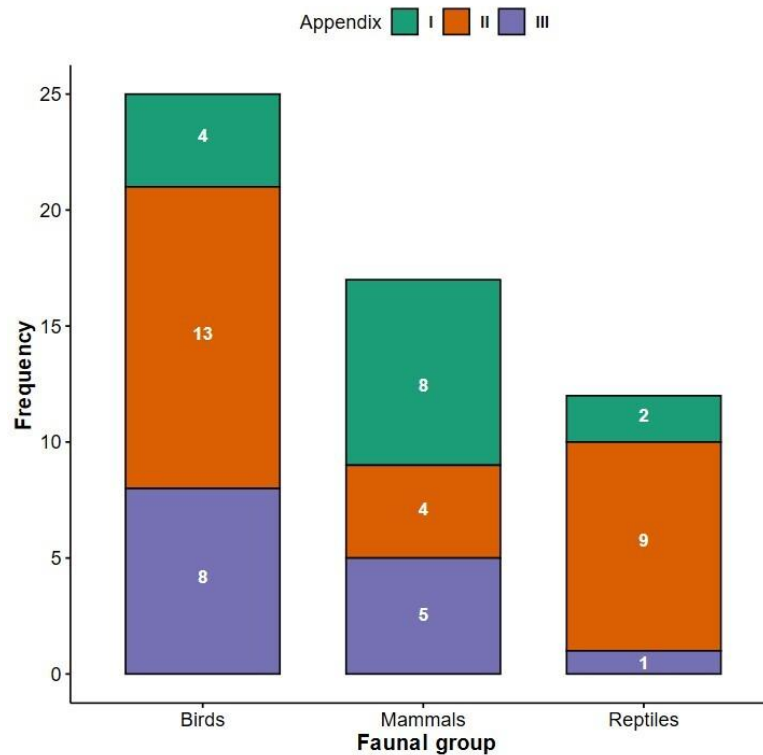


Figure 8. Number of seized species included in CITES Appendices I, II, and III by faunal group in Yucatán during 2008–2018.

DISCUSSION

In this study, wildlife seizures carried out by PROFEPA during the period 2008 to 2018 in Yucatán were analyzed. The involved species and their status in NOM-059-SEMARNAT-2010 and CITES appendices were described to identify the group most affected by illegal exploitation in Yucatán.

A synchronous pattern was found between the number of individuals and the number of species present in the annual seizures. This type of pattern, where there is no lag between the time series, should be confirmed with appropriate statistical analysis (Guevara Díaz, 2014). Lacking external data to the seizures, it is difficult to provide a definitive explanation for the non-monotonic (ascending or descending) behavior, with peaks and troughs. However, the fluctuations are related to changes in bird representation, both in the number of individuals and species. Additionally, it should be considered that the data presented here do not fully reflect illegal wildlife exploitation activities in Yucatán but largely reflect PROFEPA's efforts in inspections or responding to complaints, which are simultaneously limited by

the institution's annually assigned budget and the number of inspectors available for these activities (Cantú-Guzmán *et al.*, 2007; Antonio-Guzmán, 2016).

In this case, it was possible to determine the pattern of seized individuals in terms of their life stage, condition at the time of seizure, and their destination after seizure, which is not common in such studies (Asprilla-Perera *et al.*, 2013; Carpio Domínguez *et al.*, 2021; Crespo-Gascón *et al.*, 2022). Most seized individuals were adults and were alive, but as with temporal patterns, it is challenging to establish precise causes due to the lack of documentation or observations indicating the purpose of possession at the time of seizure.

Regarding the destination of individuals, in this study, most were donated: through personal communication with PROFEPA employees, it was known that the living individuals were donated to institutions considered within the SEMARNAT register as premises or facilities capable of housing living specimens, such as UMA Parque Zoológico del Bicentenario Animaya and PIMVS Parque Zoológico del Centenario, both located in Mérida, Yucatán. This contrasts with the common practice

of releasing them into the wild, which is often done without proper considerations (Alvarado *et al.*, 2010). Additionally, the long interval to determine the destination of housed individuals represents a danger as it alters their natural behavior and may cause the loss of survival skills in their natural environment (Aprile and Bertonatti, 1996; Richard, 2000).

Undoubtedly, the most impacted faunal group was birds, considering all the evidence collected: high presence in seizures, both in species and individual numbers, species in some risk category (NOM-059-SEMARNAT), and species in CITES appendices. This pattern has been documented in other studies (Sosa-Escalante, 2011; Asprilla Perea *et al.*, 2013; Carpio Domínguez *et al.*, 2021; Crespo-Gascón *et al.*, 2022). The second most represented group in terms of seized species was mammals, while for seized individuals, it was reptiles. In both cases, the implications for species are grave, as one in three species in Yucatán is in some risk category (NOM-059-SEMARNAT) and under protection in some CITES appendix. Among the most represented species in seizures, it is worth mentioning that most of them belong to families Psittacidae (parrots), Icteridae (orioles), and Passeridae (house sparrows), which have previously been documented in bird trade reports (Asprilla Perea *et al.*, 2013; Sánchez-Mercado *et al.*, 2020).

CONCLUSIONS

Birds are the faunal group most affected by wildlife seizures in Yucatán during the period 2008-2018. This group not only presents the largest number of seized individuals, but also the largest number of species, many of which are categorized at some level of risk according to NOM-059-SEMARNAT-2010 and are found in the CITES appendices. There is a synchronous pattern in the number of species and individuals seized per year, with significant peaks in 2009, 2010 and 2013, and minimums in 2011, 2017 and the first part of 2018. These patterns reflect not only illegal exploitation activity, but also the efforts and resources available to PROFEPA to carry out seizures in those years. Most of the seized individuals were alive and adults at the time of seizure, and their main destination was donation to institutions registered with SEMARNAT, such as zoos. This contrasts with the common practice of releasing without proper considerations, which could negatively affect the animals' reintegration into their natural habitat. Detailed documentation of wildlife seizures is essential to understanding

and mitigating the impact of illegal harvest. The information obtained in this study highlights the need to improve conservation efforts and management strategies to protect the most affected species, especially those in risk categories and under international protection.

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Compliance with ethical standards. Given the nature of this work, bioethics committee approval was not required.

Conflict of interest. The authors declare that there is no conflict of interest.

Data availability. Data are available with the corresponding author of this publication upon reasonable request.

Authors contribution statement (CRediT). **Tifany Alejandra Andrade-Torres** – Conceptualization, Investigation, Methodology and Writing – original draft. **Roberto C. Barrientos-Medina** – Data curation, Formal Analysis, Methodology, Software, Visualization, Writing – original draft and Writing – review & editing.

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Supplementary table 1. Seized species included in the information provided by PROFEPA (20082018), arranged by representation in database (frequency, abundance). Scientific name, common name (in Spanish), distribution (N= Native, E= Endemic, Q= Quasiendemic to Yucatan Peninsula, Ex= Exotic), conservation status according to NOM-059-SEMARNAT-2010 (Pr= Special protection, A= Threatened, P= Danger of extinction) and CITES appendix, for species included there in.

Number_ID	Scientific name	Common name (Spanish)	Distribution	NOM-059	CITES
Dominant species					
1	<i>Cardinalis cardinalis</i>	Cardenal rojo	N		
2	<i>Sporophila torqueola</i>	Semillero de collar	N		
3	<i>Tiaris olivaceus</i>	Semillero oliváceo	N		
4	<i>Passerina cyanea</i>	Colorín azul	N		
5	<i>Passerina ciris</i>	Colorín sietecolores	N	Pr	
6	<i>Spinus psaltria</i>	Jilguerito dominico	N		
7	<i>Pheucticus ludovicianus</i>	Picogordo degollado	N		
8	<i>Volatinia jacarina</i>	Semillero brincador	N		
9	<i>Euphonia affinis</i>	Eufonia garganta negra	N		
10	<i>Amazona albifrons</i>	Loro frente blanca	N	Pr	II
11	<i>Eupsittula nana</i>	Perico pecho sucio	N	Pr	II
12	<i>Meleagris ocellata</i>	Guajolote ocelado	E	A	III
13	<i>Melopsittacus undulatus</i>	Periquito australiano	Ex		
14	<i>Passerina caerulea</i>	Picogordo azul	N		
15	<i>Pavo cristatus</i>	Pavo real	Ex		III
16	<i>Ortalis vetula</i>	Chachalaca oriental	N		III
17	<i>Trachemys scripta</i>	Tortuga gravada	N	Pr	
18	<i>Rhinoclemmys areolata</i>	Tortuga mojina de monte	N	A	
19	<i>Crocodylus moreletii</i>	Cocodrilo de pantano	N	Pr	II
20	<i>Iguana iguana</i>	Iguana verde	N	Pr	II
21	<i>Python regius</i>	Pitón real africana	Ex		II
22	<i>Terrapene carolina</i>	Tortuga de caja	N	Pr	II
23	<i>Odocoileus virginianus</i>	Venado de cola blanca	N		III
24	<i>Ateles geoffroyi</i>	Mono araña centroamericano	N	P	I
25	<i>Nasua narica</i>	Coatí	N		III
26	<i>Atelerix albiventris</i>	Erizo de vientre blanco	Ex		
Common species					
27	<i>Dicotyles tajacu</i>	Pecarí de collar	N		II
28	<i>Mazama americana</i>	Venado temazate	N		
29	<i>Panthera tigris</i>	Tigre	Ex		I
30	<i>Boa constrictor</i>	Mazacuata	N	A	II
31	<i>Amazona autumnalis</i>	Loro cachetes amarillos	N		II
Ocasional species					
32	<i>Nymphicus hollandicus</i>	Ninfa cacaatúa	Ex		
33	<i>Colinus sp.</i>	Codorniz	N/Ex		
34	<i>Eophona sp.</i>	Picogordo oriental	Ex		
35	<i>Dendrocygna bicolor</i>	Pijije canelo	N		III
36	<i>Kinosternon scorpioides</i>	Tortuga pecho quebrado escorpión	N	Pr	
37	<i>Kinosternon sp.</i>	Tortuga casquito	N/Ex		
38	<i>Cuniculus paca</i>	Tepezcuintle	N		III
Rare species					
39	<i>Crax rubra</i>	Hocofaisán	N	A	III
40	<i>Dendrocygna autumnalis</i>	Pijije alas blancas	N		III

Number_ID	Scientific name	Common name (Spanish)	Distribution	NOM-059	CITES
41	<i>Zenaida asiatica</i>	Paloma alas blancas	N		
42	<i>Ramphastos sulfuratus</i>	Tucán pico canoa	N	A	II
43	<i>Turdus grayi</i>	Mirlo café	N		
44	<i>Columba livia</i>	Paloma doméstica	Ex		
45	<i>Cairina moschata</i>	Pato real	N	P	III
46	<i>Psittacus erithacus</i>	Loro gris africano	Ex		I
47	<i>Myiopsitta monachus</i>	Perico monje argentino	Ex		II
48	<i>Euphonia hirundinacea</i>	Eufonia garganta amarilla	N		
49	<i>Buteogallus anthracinus</i>	Aguililla negra menor	N	Pr	II
50	<i>Spatula clypeata</i>	Pato cucharón norteno	N		
51	<i>Poephila cincta</i>	Pinzón gorginegro	Ex		II
52	<i>Streptopelia roseogrisea</i>	Paloma de collar africana	Ex		
53	<i>Aphelocoma unicolor</i>	Chara unicolor	N	A	
54	<i>Zenaida aurita</i>	Huilota caribeña	N	Pr	
55	<i>Taeniopygia guttata</i>	Pinzón cebrá	Ex		
56	<i>Icterus cucullatus</i>	Calandria dorso negro menor	N		
57	<i>Amazona xantholara</i>	Loro yucateco	Q	A	II
58	<i>Phoenicopiterus ruber</i>	Flamenco americano	N	A	II
59	<i>Himantopus mexicanus</i>	Monjita americana	N		
60	<i>Papio hamadryas</i>	Papión sagrado	Ex		II
61	<i>Camelus dromedarius</i>	Dromedario	Ex		
62	<i>Leopardus wiedii</i>	Tigrillo	N	P	I
63	<i>Lama glama</i>	Llama	Ex		
64	<i>Panthera leo</i>	León	Ex		I
65	<i>Cynomys mexicanus</i>	Perrito llanero mexicano	N	P	I
66	<i>Kinosternon acutum</i>	Tortuga pecho quebrado de Tabasco	N	Pr	
67	<i>Gopherus berlandieri</i>	Tortuga del desierto de Tamaulipas	N	A	II
68	<i>Eublepharis macularius</i>	Gecko leopardo	Ex		
69	<i>Chamaeleo calypttratus</i>	Camaleón velado	Ex		II
Very rare species					
70	<i>Epicrates cenchria</i>	Boa arcoiris	Ex		II
71	<i>Chelonia mydas</i>	Tortuga prieta	N	P	I
72	<i>Eretmochelys imbricata</i>	Tortuga carey	N	P	I
73	<i>Macrochelys temminckii</i>	Tortuga caimán	Ex		III
74	<i>Claudius angustatus</i>	Tortuga almizclera Chopontil	N	P	
75	<i>Centrochelys sulcata</i>	Tortuga africana de espolones	Ex		II
76	<i>Buteo plagiatus</i>	Aguililla gris	N		II
77	Subfamilia Anserinae	Ganso	N/Ex		
78	<i>Spatula discors</i>	Cerceta alas azules	N		

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79	<i>Falco sparverius</i>	Cernícalo americano	N		II
80	<i>Amaurospiza concolor</i>	Semillero azul	N	P	
81	<i>Cyanocorax yucatanicus</i>	Chara yucateca	Q		
82	<i>Agelaius phoeniceus</i>	Tordo sargento	N		
83	<i>Mimus polyglottos</i>	Centzontle norteño	N		
84	<i>Mimus sp.</i>	Centzontle	N/Ex		
85	<i>Pteroglossus torquatus</i>	Tucancillo collarejo	N	Pr	
86	<i>Ara chloropterus</i>	Guacamayo rojo aliverde	Ex		II
87	<i>Struthio camelus</i>	Avestruz	Ex		I
88	<i>Crypturellus soui</i>	Tinamú menor	N	A	
89	<i>Tinamus major</i>	Tinamú mayor	N	A	
90	<i>Streptopelia semitorquata</i>	Tórtola ojiroja	Ex		III
91	<i>Zenaida sp.</i>	Paloma	N/Ex		
92	<i>Colinus virginianus</i>	Codorniz cotuí	N		I
93	<i>Cyanocompsa parellina</i>	Colorín azulnegro	N		
94	<i>Lonchura sp.</i>	Ave isabelita	Ex		
95	<i>Vireo sp.</i>	Vireo	N/Ex		
96	<i>Melanerpes uropygialis</i>	Carpintero del desierto	N		
97	<i>Agapornis sp.</i>	Agapornis	Ex		II
98	<i>Urocyon cinereoargenteus</i>	Zorra gris	N		
99	<i>Panthera pardus</i>	Leopardo	Ex		I
100	<i>Puma concolor</i>	Puma	N		I
101	<i>Mustela putorius</i>	Turón europeo	Ex		
102	<i>Potos flavus</i>	Martucha	N	Pr	III
103	<i>Procyon lotor</i>	Mapache	N		
104	<i>Ursus americanus</i>	Oso negro americano	N		II
105	Orden Cingulata	Armadillo	N/Ex		
106	<i>Equus quagga burchellii</i>	Cebra	Ex		
107	<i>Saimiri sciureus</i>	Mono ardilla	Ex		II
108	<i>Sciurus deppei</i>	Ardilla tropical	N		III
109	<i>Sciurus griseus</i>	Ardilla gris	N	A	