



Bird trade in the markets of Mexico City for ornamental and companion use

Comercio de aves en los mercados de la Ciudad de México para uso ornamental y de compañía

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Abstract

Birds are among the most exploited animals due to their melodious songs and attractive plumage, but few studies explore the clandestine bird trade at local markets. To assess the bird trade in Mexico City, we recorded the number of individuals of each species for sale in three markets during two periods of 2012-2013 and 2015-2016. We recorded 74 bird species for sale, with a total of 20,388 individuals in 2012-2013 and 20,004 individuals in 2015-2016 of all species in the three markets. This included 11 species of native Psittaciformes whose sale is prohibited in Mexico, as well as eight internationally endangered or threatened species, and six species in CITES Appendix I prohibiting their trade. The overall number of birds for sale, and the number of non-native (15,000 – 18,000) birds for sale, remained constant between the two periods. However, we found a significant increase in the number of individuals of native bird species for sale, from 1,892 birds in 2012-2013 to 4,506 native birds in 2015-2016. We recorded 24 species of songbirds that also increased significantly between periods as almost all songbirds were native species. Our results demonstrate that the sale of companion, ornamental and songbirds has persisted in Mexico City markets, with non-native species selling in consistently high numbers, and a significant increase in the number of native birds for sale. This indicates a high demand for singing and ornamental birds, with associated risks of introducing non-native species, and illegal trade of species at risk that affects threatened populations.

Keywords: CITES, illegal bird trade, IUCN Red List, native and non-native birds, passerines, Psittacidae, songbirds, wildlife trade.

Resumen

Las aves son entre los animales más explotados por sus cantos melodiosos y plumaje atractivo, pero pocos estudios exploran el comercio clandestino de aves en los mercados locales. Para evaluar el comercio de aves en la Ciudad de México, registramos el número de individuos de cada especie en venta en tres mercados durante dos períodos de 2012-2013 y 2015-2016. Registramos 74 especies

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de aves en venta, con un total de 20,388 individuos en 2012-2013, y 20,004 individuos en 2015-2016 de todas las especies en los tres mercados. Esto incluyó 11 especies de Psittaciformes nativos cuya venta está prohibida en México, además de ocho especies amenazadas o en peligro de extinción a nivel internacional y seis especies en el Apéndice I de CITES que prohíben su comercio. El número total de aves y el número de individuos de aves no nativas (15,000-8,000) para la venta se mantuvieron constantes entre los dos periodos. Sin embargo, encontramos un aumento significativo en la cantidad de individuos de especies de aves nativas para la venta, de 1,892 aves en 2012-2013 a 4,506 aves nativas en 2015-2016. Registramos 24 especies de aves canoras que también incrementó significativamente entre periodos ya que casi todas fueron especies nativas. Nuestros resultados demuestran que la venta de aves de compañía, ornamentales y canoras ha persistido en los mercados de la Ciudad de México, con especies no nativas siendo vendidas en cantidades consistentemente altas y un aumento significativo en la cantidad de aves nativas. Esto indica una alta demanda de aves canoras y ornamentales, con riesgos asociados de introducción de especies no exóticas y comercio ilegal de especies en riesgo que afecta a las poblaciones amenazadas.

Palabras clave: aves canoras, aves nativas y no nativas, CITES, comercio ilegal de aves, comercio vida silvestre, Lista Roja UICN, passerinas, Psittacidae.

Introduction

Humans have used wildlife since time immemorial in a variety of ways: as food (Alves et al. 2013a; Jaimes-Yescas et al. 2014; Altaf et al. 2017), as medicine (Gómez-Álvarez et al. 2007; Alves and Rosa 2010; Jaroli et al. 2010; Alves and Alves 2011), and in mystical and religion practices (Guerro-Martínez et al. 2010; Alves et al. 2012). A deeply rooted daily practice is to have an animal that supplies companionship and that makes the domestic environment pleasant. Some species of birds, especially parrots and passerines (Gómez-Álvarez et al. 2005a; Gómez-Álvarez et al. 2005b; Cantú-Guzmán et al. 2007; Alves et al. 2016), have fulfilled these expectations due to their colorful plumage and their melodious songs, placing them among the most exploited vertebrates (Íñigo-Elías and Ramos 1991).

Birds are the third most-common companion animals, after dogs and cats, and from 2011 to 2014, a quarter of households had at least one of these an-

imals (Mitofsky 2019). Unfortunately, few studies in Latin America evaluate the use of wild birds as pets (Roldán-Clarà et al. 2014). Studies conducted in Brazil (Destro et al. 2012; Alves et al. 2013a; Rocha et al. 2017) and Nicaragua (Lezama et al. 2005) discuss the negative impacts of the wild bird trade and suggest measures to prevent this.

In Mexico, diverse studies have found that most of the birds in trade are passerines of the Mimidae and Cardinalidae families and parrots (Psittacidae) that are greatly appreciated (Corona-Martínez 2002, Gómez-Álvarez et al. 2005b; Roldán-Clarà et al. 2017). Over the last 15 years in Mexico, the commercial demand for some species, especially native and endemic parrots, has encouraged an excessive extraction of birds from their natural habitats. Cantú-Guzmán et al. (2007) mention that more than 70,000 birds from the 22 species of parrots and parakeets were captured in 2007. In 2008, national wildlife law in Mexico prohibited the extraction of all native parrot species for livelihood or commercial purposes (DOF 2008). However, the trade of Yellow-headed Parrots (*Amazona oratrix*), Red-shouldered Parrots (*A. autumnalis*), and Orange-fronted Parakeets (*Eupsittula cunicularis*) has been detected in markets of some states in the center and south of the country (Chávez-Ruiz and Gómez-Álvarez 2010; Jaimes-Yescas et al. 2014), where local inhabitants mentioned that these species were collected on a regular basis.

In recent years, the wildlife authority PROFEPA has confiscated songbirds, parrots, and parakeets in markets of Mexico City (PROFEPA 2011, 2013, 2015). Despite the protective measures set-up by the Federal Government and international organizations, trade in protected wild bird species is still a daily activity in Mexican markets, which subsists due to a past legacy of wildlife use (Corona-Martínez 2002; Roldán-Clarà et al. 2017). Nevertheless, few studies explore the clandestine or semi-clandestine live bird trade at markets, and research evaluating this wildlife trade is necessary (Alves et al. 2013a). To assess the bird trade in Mexico City, we recorded the singing, ornamental, and companion bird species that were sold in three markets over two periods, identifying the endemic species and those that are considered nationally or internationally at risk.

Methods

Data collection

We carried out this study in three of the main markets in Mexico City, where wildlife is traded:

the Sonora market, which is considered the busiest center of wildlife commerce (Anzures and Bolaños 1991); the Nuevo San Lazaro market; and the Xochimilco market. The Xochimilco market is one of the oldest in the country (Colectivo Xochimilco no te mueras 2009), where bird traders' stalls have been bequeathed by their ancestors (Roldán-Clarà and Toledo 2017). We visited each market 10 times (once per month) during two periods: the first period spanned from September 2012 to June 2013, and the second period from September 2015 to June 2016. We only carried out 10 visits to the markets due to the difficulty of gathering direct information from interviews with merchants who were fearful of providing data on protected or prohibited species. We thereby made a total of 520 visits to the stalls of all three markets: 260 visits during the 10 months of each period.

We recorded birds being sold at 18 permanent stalls in the Sonora market, five stalls in the Xochimilco market, and three stalls in San Lazaro market. Observations were conducted by GGA and SRRG. During each visit, we identified each bird species for sale, and whether they were native (distribution area includes Mexico) or non-native species. All bird species and the number of individuals were identified by direct observation using bird field guides (Howell and Webb 1995; Sibley 2001). The scientific names were updated using the Birds of North and Middle America Checklist, from the American Ornithological Society (Chesser et al. 2019).

We grouped bird species into three categories (Gómez-Álvarez et al. 2005a,b): 1) ornamental and companion birds, which included members of the Psittaciformes (parrots) order, mainly the families of Cacatuidae, Psittacidae and Psittaculidae that are preferred by buyers because of their colors and ability to communicate with people; 2) ornamental birds including Columbiformes (Columbidae: doves) and Passeriformes (Corvidae, Sturidae, Thraupidae, Cardinalidae, Strilidae), generally with colorful plumage; 3) songbirds (Turdidae, Mimidae, Ptilonotidae, Emberizidae, Icteridae, Fringillidae) in demand because of their rich songs, and in some cases their attractive plumage.

Data analysis

Shapiro-Wilk test showed that data did not conform to a normal distribution. Therefore, to determine if there was an increase in the number of individuals and species traded in the markets over time, we used Wilcoxon tests to compare between

periods the overall number of individuals, as well as the number of individuals of native species, endemic species, non-native species, Psittaciformes, songbirds, and number of individuals of ornamental species between periods. All statistical tests were performed with Megastat ver. 10.4, and Past ver. 4.11, and were considered significant at alfa of 0.05.

Results

Number of species and individuals

We recorded a total of 74 bird species, 64 species in the September to June period of 2012-2013, and 62 species in the 2015-2016 period (Table 1). We recorded a total of 20,388 individuals comprising all species registered in 2012-2013 in the three markets, and 20,004 individuals of all species registered in 2015-2016 in the three markets. We found no significant differences in the overall number of individuals recorded for sale in markets between the two periods. The families with the highest number of species were Psittacidae with 16 species, Icteridae (blackbirds and orioles) with 12 species, and Cardinalidae (grosbeaks and buntings) with eight species. The families with the greatest number of individuals for sale were Fringillidae ($n = 8,808$ birds), Strilidae ($n = 8,621$ birds) and Psittacidae ($n = 8,289$ birds). The number of individuals by family also did not differ between periods for Psittacidae, Columbidae, Corvidae, Turdidae, Mimidae, Thraupidae, Emberizidae, Cardinalidae, Icteridae, Fringillidae, and Strilidae.

Companion, ornamental and songbirds

Regarding companion birds, we recorded a total of 22 species of Psittaciformes, most of which were from the Psittacidae family (17 species). The number of birds of parrot species for sale did not differ between the two survey periods ($W = 117$, $P > 0.05$). The non-native Budgerigar (*Melopsittacus undulatus*) had the largest number of 3,523 – 4,256 individuals for sale in markets (Table 1). Most of the individuals for sale in both periods were non-native species (*Myiopsitta monacus*, *Melopsittacus undulatus* and *Agapornis* spp.). However, we registered 11 native parrot species (Table 1), the sale of which are prohibited by Mexican law (DOF 2008). Of these, three species are endemic to Mexico and considered nationally threatened or endangered (DOF 2010): Red-crowned Parrot (*Amazona viridigenalis*; 4 birds), Lilac-crowned Parrot (*A. finschi*; 1 bird), and White-crowned Parrot (*Pionus senilis*; 1 bird). The most traded native parrot species was the Or-

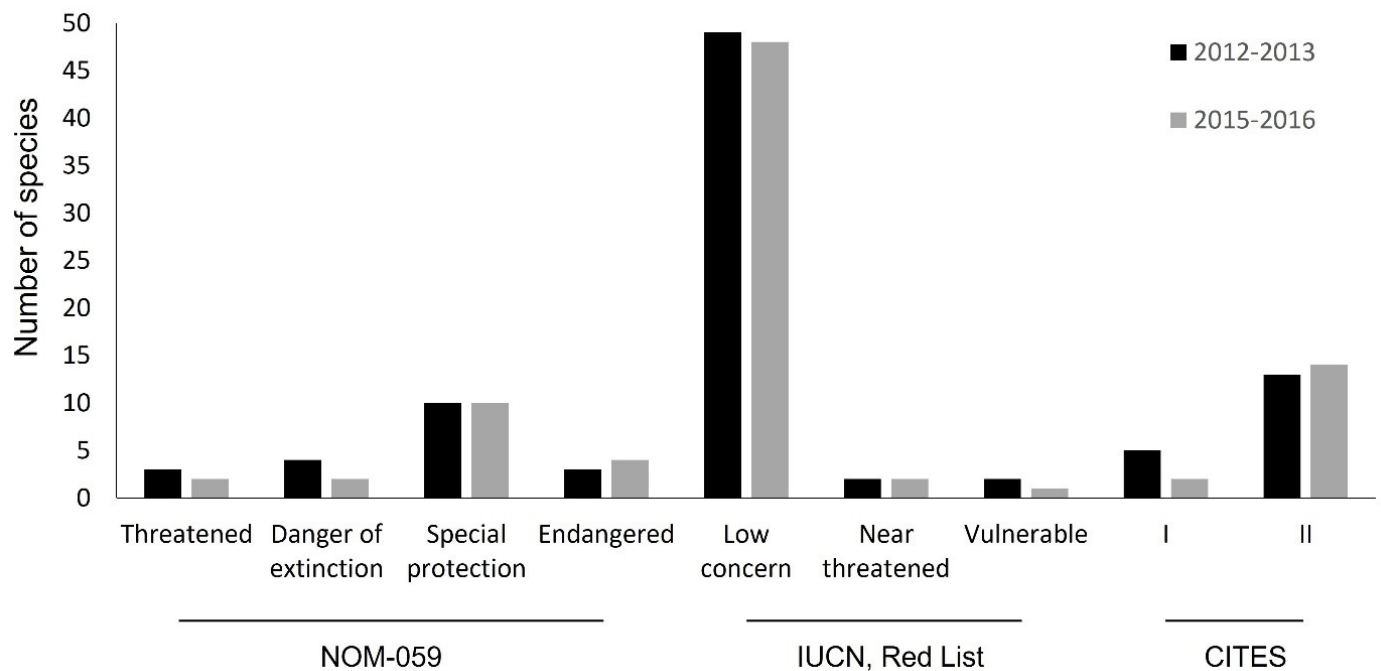


Figure 1. Number of bird species for sale in Mexico City markets during two survey periods, grouped by national at risk categories (NOM-059-2010), international IUCN Red List, and in the CITES Appendices.

ange-fronted Parakeet (*Eupsittula canicularis*) with a total of 55 individuals recorded for sale (Table 1). Notably, the Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*) was the second-most traded native parrot species ($n = 20$ birds; Table 1). I

We also recorded a total of 24 species of songbirds, almost all of which were native species. The non-native songbird species that was most abundant in markets was the Island Canary (*Serinus canaria*), with 2,824 individuals for sale in 2012-2013 and 2,487 individuals for sale in 2015-2016 (Table 1). We found significant differences between both survey periods in the number of individuals of songbirds for sale ($W = 228$, $P < 0.05$), increasing from 3,625 individuals in 2012-2013 to 4,109 individuals in 2015-2016. Five native songbird species are in a risk category, with the Slate-colored Solitaire (*Myadestes unicolor*) considered nationally Threatened (DOF 2022), and four species in Special Protection status (DOF 2010): *Icterus pustulatus* (2012-2013: 51 birds, 2015-2016: 43 birds); *I. spurius* (2012-2013: 15 birds, 2015-2016: 93 birds); *Turdus rufopalliatus* (2012-2013: 20 birds, 2015-2016: 130 birds); and *Myadestes occidentalis* (2012-2013: 18 birds, 2015-2016: 151 birds).

On the other hand, we did not find significant differences between survey periods in the number of individuals of ornamental birds for sale. We recorded 10 native species, of which the Green Jay (*Cyanocorax yncas*) had the highest number of individuals with 153 and 183 individuals in the 2012-

2013 and 2015-2016 survey periods respectively (Table 1). The non-native species, the Zebra Finch (*Taeniopygia guttata*), had the highest number of individuals for sale in the 2012-2013 and 2015-2016 periods, with 3,285 and 2,730 individuals respectively (Table 1). Regarding the Passeriformes we found significant differences between both survey periods in the number of individuals recorded for sale ($W = 630$, $P < 0.05$), with 2,058 birds in 2012-2013 and 2,917 birds in 2015-2016.

Conservation status

For both periods, most of the avian species registered for trade in markets were classified as Least Concern in the IUCN Red List (Fig. 1). Nevertheless, six species classified internationally as Endangered (IUCN Red List 2022) were also traded, mainly parrots (Table 1). Of these, the Thick-billed Parrot stands out as having the most individuals for sale ($n = 20$ birds). Other internationally endangered species found for sale were the Java Sparrow (*Lonchura oryzivora*; 5 birds), Sun Parakeet (*Aratinga solstitialis*; 3 birds), and Yellow-headed Parrot (*Amazona oratrix*; 3 birds), as well as the Lilac-crowned Parrot and Red-crowned Parrot.

Another two parrot species are internationally considered Vulnerable (IUCN Red List 2022), predominantly the Orange-fronted Parakeet with 55 individuals registered for sale, and one individual of the Salmon-crested Cockatoo (*Cacatua moluccensis*). Eight species were also nationally considered

Table 1. Number of birds of each species recorded in three Mexico City markets during two periods (2012-2013 and 2015-2016). Markets: **S** = Sonora, **X** = Xochimilco, **SL** = San Lázaro. Protection status: **SP** = Special protection, **T** = Threatened, **DE** = Danger of extinction (NOM-059-2010); **LC** = Least concern, **EN** = Endangered, **VU** = Vulnerable, **NT** = Near threatened (IUCN-Red List 2022). *Sale of the species is prohibited by Mexican law (DOF 2008).

Family/Scientific name	Common name	Distribución		Conservation category				Sept 2012-June 2013				Sept 2015-June 2016				
		NOM-059	Red List	CI- TES	S	X	SL	S	X	SL	S	X	SL	S	X	SL
Columbidae																
<i>Columbina inca</i>	Inca Dove		LC		24	0	0	0	0	0	2	4	0			
<i>Geopelia cuneata</i>	Diamond Dove		LC		15	0	0	0	20	2	0	0				
<i>Streptopelia roseogrisea</i>	African Collared Dove		LC		185	34	2	46	18	0						
Psittacidae																
<i>Agapornis</i> (sp.)	Lovebird			II	2367	64	106	2500	39	30						
<i>Amazona albifrons</i> *	White-fronted Parrot	SP	LC	II	1	2	1	2	1	0						
<i>Amazona autumnalis</i> *	Red-lored Parrot		LC	II	3	0	1	14	1	0						
<i>Amazona guatemalae</i> *	Northern Mealy Amazon	DE	NT	II	0	1	0	0	0	0						
<i>Amazona finschi</i> *	Lilac-crowned Parrot	DE	EN	I	0	0	0	1	0	0						
<i>Amazona ochrocephala</i>	Yellow-crowned Parrot		LC	I	0	4	0	0	0	0						
<i>Amazona oratrix</i> *	Yellow-headed Parrot	DE	EN	I	0	2	1	0	0	0						
<i>Amazona viridigenalis</i> *	Red-crowned Parrot	DE	EN	I	2	2	0	0	0	0						
<i>Ara ararauna</i>	Blue-and-yellow Macaw		LC	II	0	0	0	1	0	0						
<i>Aratinga solstitialis</i>	Sun Parakeet		EN	II	0	0	0	1	2	0						
<i>Cyanoliseus patagonus</i>	Burrowing Parakeet		LC	II	3	0	0	0	0	0						
<i>Eupsittula canicularis</i>	Orange-fronted Parakeet	SP	VU	II	5	2	2	27	19	0						
<i>Eupsittula nana</i>	Olive-throated Parakeet	SP	NT	II	0	0	0	3	0	0						
<i>Myiopsitta manachus</i>	Monk Parakeet			II	2613	70	46	276	44	1						
<i>Pionus senilis</i> *	White-crowned Parrot	T	LC	II	1	0	0	0	0	0						
<i>Psittacara holochlorus</i>	Green Parakeet	T	LC	II	0	5	0	3	0	0						
<i>Rhynchopsitta pachyrhyncha</i> *	Thick-billed Parrot	DE	EN	I	13	0	0	6	1	0						
Psittaculidae																
<i>Melopsittacus undulatus</i>	Budgerigar		LC	II	3582	361	313	2695	725	103						
<i>Platycercus eximius</i>	Eastern Rosella		LC	II	0	0	4	2	0	0						

Family/Scientific name	Common name	Distribución	Conservation category						Sept 2012-June 2013			Sept 2105-June 2016		
			NOM-059	Red List	CI- TES	S	X	SL	S	X	SL	S	X	SL
Cacatuidae														
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	Non-native		LC	II	2	0	0	3	0	0	0	0	0
<i>Cacatua moluccensis</i>	Salmon-crested Cockatoo	Non-native		VU	I	1	0	0	0	0	0	0	0	0
<i>Nymphicus hollandicus</i>	Valkparkiet	Non-native		LC	II	755	93	56	665	2	10			
Corvidae														
<i>Calocitta formosa</i>	White-throated Magpie-Jay	Native		LC		24	2	7	104	1	0			
<i>Cyanocorax sanblasianus</i>	San Blas Jay	Native		LC		1	3	4	0	0	0			
<i>Cyanocorax yncas</i>	Green Jay	Native		LC		99	34	20	138	34	11			
<i>Cyanocorax beecheii</i>	Purplish-backed Jay	Native		LC		1	0	0	26	3	0			
Turdidae														
<i>Myadestes occidentalis</i>	Brown-backed Solitaire	Native	SP	LC		11	4	3	88	46	17			
<i>Myadestes unicolor</i>	Slate-colored Solitaire	Native	T	LC		125	57	20	79	48	20			
<i>Turdus migratorius</i>	American Robin	Native		LC		13	3	0	33	49	9			
<i>Turdus rufopalliatus</i>	Rufous-backed Robin	Endemic	SP	LC		9	7	4	91	39	0			
Mimidae														
<i>Melanotis caerulescens</i>	Blue Mockingbird	Native				9	0	7	11	4	2			
<i>Mimus polyglottos</i>	Northern Mockingbird	Native		LC		81	26	16	155	39	11			
<i>Toxostoma curvirostre</i>	Curve-billed Thrasher	Native		LC		2	11	1	18	11	6			
Ptiligonatidae														
<i>Ptiligonys cinereus</i>	Gray Silky-Flycatcher	Native		LC		75	21	16	226	52	0			
Sturdidae														
<i>Sturnus vulgaris</i>	European Starling	Non-native		LC		22	17	4	24	36	3			
Thraupidae														
<i>Cyanerpes cyaneus</i>	Red-legged Honeycreeper	Native		LC		26	0	8	8	0	0			
<i>Sporophila torqueola</i>	Cinnamon-rumped Seedeater	Native		LC		0	6	0	40	0	0			
<i>Thraupis abbas</i>	Yellow-winged Tanager	Native		LC		0	0	0	0	2	0			
<i>Volatinia jacarina</i>	Blue-black Grassquit	Native		LC		2	7	0	0	0	0			

Family/Scientific name	Common name	Distribución	Conservation category				Sept 2012-June 2013				Sept 2105-June 2016			
			NOM-059	Red List	CI-TES		S	X	SL	S	X	SL	S	X
Emberizidae														
<i>Junco phaeonotus</i>	Yellow-eyed Junco	Endemic	SP	LC		0	2	0	46	0	0	0	0	0
<i>Spizella passerina</i>	Chipping Sparrow	Native		LC		0	20	0	0	0	0	0	0	0
<i>Zonotrichia leucophrys</i>	White-crowned Sparrow	Native		LC		2	0	0	29	0	0	0	0	0
Cardinalidae														
<i>Cardinalis cardinalis</i>	Northern Cardinal	Endemic	SP	LC		134	1	6	9	7	3			
<i>Passerina amoena</i>	Lazuli Bunting	Native		LC		5	52	41	269	89	23			
<i>Passerina caerulea</i>	Blue Grosbeak	Native		LC		0	0	0	0	4	0			
<i>Passerina ciris</i>	Painted Bunting	Native	SP	LC		22	8	2	411	38	24			
<i>Passerina cyanea</i>	Indigo Bunting					114	0	0	0	0	0			
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	Native				0	4	3	32	40	1			
<i>Pheucticus melanocephalus</i>	Black-headed Grosbeak	Native				27	2	2	58	0	1			
<i>Piranga rubra</i>	Summer Tanager	Native		LC		1	27	24	277	39	10			
Icteridae														
<i>Agelaius phoeniceus</i>	Red-winged Blackbird	Native		LC		10	1	0	4	0	0			
<i>Cassidix melanicterus</i>	Yellow-winged Caticque	Native				0	0	5	61	6	0			
<i>Icterus cucullatus</i>	Hooded Oriole	Native		LC		1	4	0	35	2	0			
<i>Icterus galbula</i>	Baltimore Oriole	Native		LC		28	3	1	45	27	7			
<i>Icterus gularis</i>	Altamira Oriole	Native		LC		16	8	8	44	16	2			
<i>Icterus parisorum</i>	Scott's Oriole	Native		LC		0	1	1	7	0	1			
<i>Icterus pectoralis</i>	Spot-breasted Oriole	Native		LC		4	1	3	32	5	0			
<i>Icterus pustulatus</i>	Streak-backed Oriole	Endemic	SP	LC		8	33	10	33	5	5			
<i>Icterus spurius</i>	Orchard Oriole	Endemic	SP	LC		7	8	0	49	32	12			
<i>Molothrus aeneus</i>	Bronzed Cowbird	Native		LC		0	0	0	16	0	0			
<i>Molothrus ater</i>	Brown-headed Cowbird	Native		LC		0	0	0	46	0	0			
<i>Xanthocephalus xanthocephalus</i>	Yellow-headed Blackbird	Native		LC		70	14	11	1	0	0			

Family/Scientific name	Common name	Distribución	Conservation category						Sept 2012-June 2013			Sept 2105-June 2016						
			NOM-059	Red List	CI-TES	S	X	SL	S	X	SL	S	X	SL				
Fringillidae																		
<i>Haemorhous mexicanus</i>	House Finch	Native		LC		376	200	0	951	360	58							
<i>Hesperiphona abeillei</i>	Hooded Grosbeak	Native		LC		0	1	0	0	0	0							
<i>Serinus canaria</i>	Island Canary	Non-native		LC		2360	168	296	2051	383	53							
<i>Serinus sp.</i>	European Serin	Non-native		LC		313	12	48	1009	33	0							
<i>Spinus notatus</i>	Black-headed Siskin	Native		LC		0	0	0	0	4	0							
<i>Spinus psaltria</i>	Lesser Goldfinch	Native		LC		10	65	0	2	55	0							
Strildidae																		
<i>Chloebia gouldiae</i>	Gouldian Finch	Non-native		NT		940	0	7	1654	0	0							
<i>Lonchura oryzivora</i>	Java Sparrow	Non-native		EN	II	0	0	0	0	0	5							
<i>Taeniopygia guttata</i>	Zebra Finch	Non-native		LC		3222	25	38	2673	10	47							

Threatened or Endangered (DOF 2010), of which the Slate-colored Solitaire (*Myadestes unicolor*) stands out with the largest total number of 369 individuals for sale (Table 1). Finally, six species of Psittaciformes that are in CITES Appendix I prohibiting their trade were also for sale, where again the Thick-billed Parrot had the largest number of individuals for sale (Table 1).

Native and non-native birds

For native species, we found a significant increase in the number of individuals recorded for sale between the first and second survey period ($W = 854, P < 0.05$), from 1,892 individuals in 2012-2013 to 4,506 individuals in 2015-2016. The native species with the highest number of individuals in both periods was the House Finch (*Haemorhous mexicanus*) that increased from 576 individuals in 2012-2013 to 1,369 individuals in 2015-2016 (Table 1). The second-most abundant native species in 2012-2013 was the Slate-colored Solitaire with 202 individuals, while in the 2015-2016 period, the second-most abundant species was the Painted Bunting (*Passerina ciris*), increasing from 32 individuals in 2012-2013 to 473 individuals in 2015-2016.

On the other hand, although the number of individuals of endemic species increased between periods, from 234 individuals in 2012-2013 to 332 individuals in 2015-2016, this was not significantly different. In 2012-2013, the endemic species with the highest number of 141 individuals for sale was the Northern Cardinal (*Cardinalis cardinalis*), with other endemic species having an average 13.3 ± 18.3 individuals for sale. However, in 2015-2016, the Rufous-backed Robin (*Turdus rufopalliatus*) increased from 20 individuals in the first period to 130 individuals for sale, and the Orchard Oriole (*Icterus spurius*) increased from 15 to 93 individuals for sale.

Regarding non-native species, no significant differences were found in the number of individuals between periods, with 18,148 non-native birds in 2012-2013 individuals and 15,166 individuals in 2015-2016. In this case, the species that had most individuals for sale in both periods were the Budgerigar with 4,256 individuals in 2012-2013, and 3,526 birds in 2015-2016, and the Zebra Finch with an overall total of 6,015 individuals for sale (Table 1).

Discussion

Sale of companion, ornamental and songbirds

Psittacidae (parrots), Icteridae (blackbirds and orioles), and Cardinalidae (grosbeaks and buntings) were the families with most species for sale, while finches (Fringillidae and Strildidae) and parrots had the highest numbers of individuals for sale in Mexico City markets. These are mainly song and ornamental or companion birds that are likely to be the most exploited (Iñigo-Elias and Ramos 1991), particularly song and ornamental birds (Roldán-Clarà et al. 2014). López-Medellín (2003) also reported that one of the most commercialized families is the Cardinalidae (cardinals, grosbeaks and goldfinches).

We found a higher number of non-native parrots, clearly observed in the case of the Lovebird (*Agapornis* spp) from Africa, Budgerigar from Australia, and the Monk Parakeet (*Myiopsitta monachus*) originally from Uruguay, Bolivia, Brazil and Argentina (Forshaw 2010). The case of Monk Parakeet is relevant because the species was probably introduced to the national trade after 2005, since it was not registered by Gómez-Alvarez et al. (2005a) as a captive parrot species in Mexico. The Monk Parakeet has since been registered as a free-living non-native species in Mexico's central states (MacGregor-Fors et al. 2011), in the southern state of Oaxaca (Pablo-López 2009), and in the northern state of Sinaloa (Gurrola-López et al. 2023) and has now been reported in 97 cities across all 7 biogeographical regions in Mexico (Hobson et al. 2017). The predominant means of entry of the Monk Parakeet to Mexico may have been via the international pet trade, as over half a million Monk Parakeets were commercially imported to Mexico during 2000-2015 (Hobson et al. 2017). Sale of the Monk Parakeet in national markets then facilitates introduction of this exotic species after birds are intentionally released or escape from their cages, and successfully become established in the wild (Tinajero and Rodríguez-Estrella 2015).

Conservation status

Many parrot species that are considered internationally Endangered and included in CITES Appendix I prohibiting their trade were also found for sale in Mexico City markets. Notably, the Thick-billed Parrot and Orange-fronted Parakeet were sold in higher numbers (20 and 55 birds respectively). The nationally threatened Slate-colored Solitaire was also on sale (~150 birds per period). These birds are sold as pets (Iñigo-Elias and Ramos 1991) because of their colorful plumage, melodic songs, their attachment to humans, and because they can mimic the sound of human speech (López-Medellín 2003).

We recorded 11 native species of Psittaciformes on sale in this study despite the prohibition in Mexico (DOF 2008). The number of native parrots found for sale in markets during the present study may be lower than the real number captured, since there may be a mortality of 50% to 70% of birds within the commercial process (Cantú-Guzmán et al. 2007, SEMARNAT 2012). Taking this into account, the number of native and endemic parrots that could have been extracted from the wild is not negligible. Furthermore, most native parrot species have low population densities, reproductive rates, and a more precarious conservation status (Gómez-Álvarez et al. 2005a), making trade in these species detrimental to wild populations.

Supply and demand of native and non-native birds

We found no differences in the overall number of individuals and number of non-native birds sold in Mexico City markets between the 2012-2013 and 2015-2016 survey periods. These may represent birds that have remained unsold between the two survey periods, but the high numbers of non-native birds in both survey periods (~15,000 – 18,000 birds) suggests that there is high demand for these species and sellers constantly obtain new birds for sale. A lack of difference between periods in the numbers of individuals for sale of avian families that represent songbirds, parrots and ornamental passerines in Mexico City markets also reflects the persistence of buyers for acquiring birds that provide company, are attractive, and have melodious songs (Corona-Martínez 2002; Nijman 2010; Alves et al. 2013b, 2016; Nascimento et al. 2015; Rocha et al. 2017). The significant increase in numbers of native birds and of songbirds for sale in Mexico City markets further reflects a high demand for song and ornamental birds.

The high number of species and individuals of birds that we found for sale in markets demonstrates their continued high demand. Educational and outreach programs may help to reduce the trade of wild birds in markets, particularly for native or protected species with declining populations. Such campaigns have been implemented in Costa Rica (Nacimiento et al. 2015) and Brazil (Rocha et al. 2017) where they helped to raise awareness of the negative impacts of trade in native avifauna and reduce their demand in markets. Therefore, actions like this can be positive to decrease the commercial demand of wild species. The Center for Education and Training for Sustainable Development prepares and dis-

seminates educational materials that contribute to the sustainable use of our natural resources and to the formation of an informed, responsible, and participatory environmental citizenry (SEMARNAT 2023). However, such campaigns can be expensive, especially in big cities like Mexico City, therefore economic resources from the federal government and private institutions are needed as well as the participation of conservation and communications specialists.

Conclusions

Our results indicate that the sale of companion, ornamental and songbirds has persisted in Mexico City markets. This even includes endemic and threatened species, despite the protection measures implemented by the Mexican government (DOF 2008, 2010) and international institutions (IUCN Red List 2022) to highlight the conservation status of declining populations and regulate their trade (CITES 2022). The high numbers of non-native species for sale, such as the Budgerigar and Monk Parakeet increases the risk of undesired invasion of natural habitats by non-native species, possibly causing an ecological imbalance that is hard to resolve. Likewise, the increase in numbers of native and endemic birds for sale, particularly passerines, provides proof of a persisting demand for these attractive, singing birds, and the introduction to markets of high numbers of non-native ornamental and songbirds has not been an alternative for reducing the demand. The involvement of government authorities, private institutions, researchers, specialists, and conservation groups is urgently required to examine the current illegal commerce in avifauna, while taking into account the cultural, social and economic factors linked to this practice.

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Literature Cited

- Altaf M, Javid A, Umair MKJ, Rasheed Z, Abbasi AM. 2017. Ethnomedicinal and cultural practices of mammals and birds in the vicinity of river Chenab, Punjab-Pakistan. *Journal of Ethnobiology and Ethnomedicine* 13(1):1-24.
- Alves RRN, Alves HN. 2011. The faunal drugstore: animal-based remedies used in traditional medicines in Latin America. *Journal of Ethnobiology and Ethnomedicine* 7(1):1-43.
- Alves RRN, Rosa IL. 2010. Trade of animals used in Brazilian traditional medicine: trends and implications for conservation. *Human Ecology* 38(5):691-704.
- Alves RRN, Rosa IL, Neto NAL, Voeks R. 2012. Animals for the Gods: magical and religious faunal use and trade in Brazil. *Human Ecology* 40(5):751-780.
- Alves RRN, Leite RCL, Souto WMS, Bezerra DMM, Loures-Ribeiro A. 2013a. Ethno-ornithology and conservation of wild birds in the semi-arid Caatinga of northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine* 9(1):1-12.
- Alves RRN, Lima JRF, Araujo HFP. 2013b. The live bird trade in Brazil and its conservation implications: an overview. *Bird Conservation International* 23:53-65.
- Alves MM, Lopes SF, Alves RRN. 2016. Wild vertebrates kept as pets in the semiarid region of Brazil. *Tropical Conservation Science* 9(1):354-368.
- Anzures y Bolaños MC. 1991. El Mercado de Sonora. *Anales de Antropología* 28:273-290.
- Cantú-Guzmán JC, Sánchez-Saldaña ME, Grosset M, Silva-Gámez J. 2007. Tráfico ilegal de pericos en México. Una evaluación detallada. Teyeliz and Defenders of Wildlife. Washington, DC.
- Chávez-Ruiz JÁ, Gómez-Álvarez G. 2010. Uso tradicional de los vertebrados terrestres en dos comunidades zapotecas del istmo de Tehuantepec, Oaxaca. Pp. 403-414. In Moreno-Fuentes A, Pulido-Silva MT, Mariaca-Méndez R, Valadez-Azúa R, Mejía-Correa PT, Gutiérrez-Santillán TV (eds.). *Sistemas biocognitivos tradicionales: paradigmas en la conservación biológica y el fortalecimiento cultural*. Asociación Etnobiológica Mexicana, México.
- Chesser RT, Burns KJ, Cicero C, Dunn JL, Kratter AW, Lovette IJ, Rasmussen PC, Renssen JVV Jr, Stotz DF, Winker K. 2019. Sixtieth supplement to the American Ornithological Society's check-list of North American

- Birds. Auk 136(3):ukz042.
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). 2022. Appendices I, II, III. CITES. UNEP, Geneva, Switzerland. <https://cites.org/sites/default/files/esp/2017/s-appendices> (Retrieved May 22 2022).
- Colectivo Xochimilco no te mueras. 2009. Creación del Mercado de Xochimilco. <http://xochimilconotemueras.blogspot.mx/2009/11/creacion-del-mercado-de-xochimilco-ano.html> (Retrieved June 24 2020).
- Corona-Martínez E. 2002. Las aves en la historia natural novohispana. Instituto Nacional de Antropología e Historia, Universidad Nacional Autónoma de México, México.
- Destro GFG, Pimente TL, Sabaini RM, Borges RC, Barreto R. 2012. Efforts to combat wild animal trafficking in Brazil. Pp. 421-436. In: Lameed GA (ed.). Bio-enrichment in a diverse world. InTechOpen Book Series.
- DOF (Diario Oficial de la Federación). 2008. Decreto por el que se adiciona un artículo 60 Bis 2 a la Ley General de Vida Silvestre. México. Gobierno Federal. http://www.diputados.gob.mx/LeyesBiblio/ref/lgvs/LGVS_ref05_14oct08.pdf (Retrieved October 18 2021).
- DOF (Diario Oficial de la Federación). 2010. Norma Oficial Mexicana NOM-059-SEMAR-NAT-2010, Protección ambiental - Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo, México. Gobierno Federal. https://www.profepa.gob.mx/innovaportal/file/435/1/NOM_059_SEMAR-NAT_2010.pdf (Retrieved October 18 2021).
- Forshaw JM. 2010. Parrots of the World. Oxford, Princeton University Press.
- Gómez-Álvarez G, Valadez-Azúa R, Teutli-Solano C, Reyes-Gómez SR. 2005a. Manejo en cautiverio de psitácidos utilizados como aves de ornato y compañía. AMMVEPE 16:5-17.
- Gómez-Álvarez G, Teutli-Solano C, Reyes-Gómez SR, Valadez-Azúa R. 2005b. Pájaros y otras aves utilizadas como animales de ornato y compañía. AMMVEPE 16:129-139.
- Gómez-Álvarez G, Reyes-Gómez SR, Teutli-Solano C, Valadez-Azúa R. 2007. La medicina tradicional prehispánica, vertebrados terrestres y productos medicinales de tres mercados del valle de México. Etnobiología 5(1):86-98.
- Guerrero-Martínez F, Serrano-González R, Serrano-Velázquez R. 2010. Aves con atributos pronosticadores, medicinales y mágico-religiosos entre los tojolabales (Tojolwinik'otik) del ejido las Margaritas, Chiapas. El canto del Centzontle 1(2):190-203.
- Gurrola-López GH, Rivera-Rodríguez LB, González-Bernal MA, Medina-Osuna RE. 2023. Registros de la cotorra argentina (*Myiopsitta monachus*) en Culiacán, Sinaloa. Huitzil Revista Mexicana de Ornitología 24(1): e648. <https://doi.org/10.28947/hrmo.2022.24.1.657>
- Hobson EA, Smith-Vidaurre G, Salinas-Melgoza A. 2017. History of nonnative monk parakeets in Mexico. PLoS One 12(9):e0184771.
- Howell SN, Webb S. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press.
- Íñigo-Elías E, Ramos MA. 1991. The psittacine trade in Mexico. Pp. 380-392. In Robinson JG, Redford KH (eds.). Neotropical wildlife use and conservation. University of Chicago Press, Chicago.
- IUCN Red List (International Union for Conservation Nature, Red List). 2022. The IUCN Red List of Threatened Species. Version 2018-2. www.iucnredlist.org (Retrieved October 18 2021).
- Jaimes-Yescas MI, Gómez-Álvarez G, Pacheco-Coronel N, Reyes-Gómez SR. 2014. Uso y manejo de la avifauna en San Miguel Tzinacapan, municipio de Cuetzalan del Progreso, Puebla, México. Pp. 243-259. In Vázquez-Dávila MA (ed.). Aves, personas y culturas. Estudios de Etno-ornitología 1. CONACYT/Carteles Editores. Oaxaca, México.
- Jaroli DP, Mahawar MM, Vyas N. 2010. An ethnozoological study in the adjoining areas of

- Mount Abu wildlife sanctuary, India. *Journal of Ethnobiology and Ethnomedicine* 6: 1-8.
- Lezama M, Vilchez S, Mayorga M, Castellón R. 2005. Monitoreo de psitácidos 2004: estado actual y conservación. Primera edición Managua, Proyecto Araucaria-Río San Juan-Ministerio del Ambiente y los Recursos Naturales -MARENA. Managua, Nicaragua.
- López-Medellín X. 2003. Evaluación del comercio de aves canoras y de ornato en México 1970-2001 [Bachelor in Science Theses]. Universidad Nacional Autónoma de México, México, D.F
- MacGregor-Fors I, Calderón-Parra R, Meléndez-Herrada AS, López-López S, Schondube JE. 2011. Pretty, but dangerous! Records of non-native Monk Parakeets (*Myiopsitta monachus*) in Mexico. *Revista Mexicana de Biodiversidad* 82(3):1053-1056.
- Mitofsky. 2019. México um país pet friendly. <https://www.mitofsky.mx/post/mexico-pet-friendly> (Retrieved August 2 2023).
- Nascimento CAR, Czaban RE, Alves RRN. 2015. Trends in illegal trade of wild birds in Amazonas state, Brazil. *Tropical Conservation Science* 8:1098-1113.
- Nijman V. 2010. An overview of international wildlife trade from Southeast Asia. *Biodiversity Conservation* 19(4):1101-1114.
- Pablo-López RA. 2009. Primer registro del perico argentino (*Myiopsitta monachus*) en Oaxaca, México. *Huitzil Revista Mexicana de Ornitología* 10(2):48-51. <https://doi.org/10.28947/hrmo.2009.10.2.89>
- PROFEPA (Procuraduría Federal de Protección al Ambiente). 2011. Muy fructífero resultó el tercer Operativo Nacional Contra el Tráfico Ilegal de Vida Silvestre. http://www.profepa.gob.mx/innovaportal/v/4068/1/mx/muy_fructifero_resulto_el_tercer_operativo_nacional_contra_el_trafico_ilegal_de_vida_silvestre.html (consulted on October 24, 2019).
- PROFEPA (Procuraduría Federal de Protección al Ambiente). 2013. Operativo en la Merced asegura 83 aves de vida silvestre y detiene a presunto traficante. Gobierno Federal. http://www.profepa.gob.mx/innovaportal/v/5104/1/mx.wap/operativo_de_profepa_en_la_merced_asegura_83_aves_de_vida_silvestre_y_detiene_a_presunto_traficante.html (Retrieved October 24 2019).
- PROFEPA (Procuraduría Federal de Protección al Ambiente). 2015. Asegura PROFEPA 20 aves en el Mercado de Sonora, Distrito Federal. Gobierno Federal. https://www.profepa.gob.mx/innovaportal/v/6761/1/mx.wap/asegura_profepa_20_aves_en_el_mercado_de_sonora_del_distrito_federal.html (Retrieved October 24, 2019).
- Rocha JM, Santana A, Santos AE, Sales JKS, Santos JD, Filho JC, Oliveira LB, Pinheiro SA, Santana TM, Britto YB. 2017. Educação ambiental no combate ao comércio ilegal da avifauna silvestre em Sergipe. *Ethnoscintia* 2:2-15.
- Roldán-Clarà B, Toledo VM. 2017. Los pajarreros de México. *Semblanza de una actividad bio-cultural*. *Biodiversitas* 133:6-11.
- Roldán-Clarà B, Toledo VM, Espejel I. 2017. The use of birds as pets in Mexico. *Journal of Ethnobiology and Ethnomedicine* 13:1-8.
- Roldán-Clarà B, López-Medellín X, Espejel I, Arellano E. 2014. Literature review of the use of birds as pets in Latin-America, with a detailed perspective on Mexico. *Ethnobiology and Conservation* 3:5. <https://doi.org/10.15451/ec2014-10-3.5-1-18>
- SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales). 2012. Tráfico ilegal de especies silvestres y sus impactos. Seminario de divulgación. SEMARNAT, INE, PROFEPA, WSPA. <https://docplayer.es/12040130-Trafico-ilegal-de-especies-silvestres-y-sus-impactos.html> (Retrieved August 04 2021).
- SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales). 2023. Evitemos el tráfico ilegal de especies, México. <https://www.gob.mx/semarnat/articulos/biodiversidad-amenazada-trafico-ilegal-de-vida-silvestre> (Retrieved January 03 2023).
- Sibley DA. 2001. *The Sibley guide to birds*. 2da. Ed. Nacional Audubon Society, Alfredo A.

Knopf, New York.

Tinajero R, Rodríguez-Estrella R. 2015 Cotorra argentina (*Myiopstta monachus*), especie anidando con éxito en el sur de la península de Baja California. Acta Zoológica Mexicana (n.s) 31(2):190-197.