

Causes of Admission for Raptors to the Tafira Wildlife Rehabilitation Center, Gran Canaria Island, Spain: 2003–13

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ABSTRACT: We report the causes of morbidity of 2,458 free-living raptors admitted to the Tafira Wildlife Rehabilitation Center on Gran Canaria Island, Spain, during 2003–13. The seasonal cumulative incidences were investigated while considering estimates of the wild populations in the region. These methods were used as a more accurate approach to assess the potential ecologic impact of different causes of morbidity. The most frequently admitted species were the Eurasian Kestrel (*Falco tinnunculus*; 53.0%), the Eurasian Long-eared Owl (*Asio otus canariensis*; 28.1%), the Canary Islands Common Buzzard (*Buteo buteo insularum*; 8.0%), and the Eurasian Barn Owl (*Tyto alba*; 4.4%). The most frequent causes of admission were trauma (33.8%), orphaned-young birds (21.7%), unknown (18.4%), and metabolic/nutritional disease (11.1%). Local morbidity caused by glue trapping and entanglement in burr bristlegrass (*Setaria adhaerens*) had prevalences of 5.0% and 1.8%, respectively. The highest number of admissions during the breeding and nonbreeding seasons was observed for the Eurasian Barn Owl and the Barbary Falcon (*Falco pelegrinoides*), respectively, mainly due to trauma of unknown origin.

Key words: Birds of prey, causes of morbidity, raptors, wildlife rehabilitation center.

The Canary Islands harbor 42 raptor species from five families, either as permanent residents or as migrants (Lorenzo 2007). Some subspecies are endemic, and six of the 11 breeding raptor species in the Canary Islands have an unfavorable conservation status (International Union for Conservation of Nature 2014). Raptors are especially sensitive to ecologic changes, and raptors living on islands with high human population density may be at higher risk (Rodríguez et al. 2010). Some raptors, such as the Red Kite (*Milvus milvus*), have disappeared in the past from the Canary Islands archipelago, whereas others, including

the Egyptian Vulture (*Neophron percnopterus majorensis*), have become locally extinct (Lorenzo 2007).

Long-term epidemiologic studies of wild raptor diseases covering more than a decade are scarce (Harris and Sleeman 2007; Molina-López and Darwich 2011; Molina-López et al. 2011) and only rarely have the data been referenced to the overall wild population (Molina-López et al. 2011). We analyzed the causes of morbidity in a large population of raptors admitted to the Tafira Wildlife Rehabilitation Center in Gran Canaria Island (27°73′–28°18′N, 15°35′–15°83′W), Spain, from 2003 to 2013, and we calculated the seasonal cumulative incidences (SCIs) considering estimates of the wild populations in the region.

We included 2,458 raptors in this study (Table 1). A standardized admission protocol was used (Wendell et al. 2002; Komnenou et al. 2005). We defined the primary cause of morbidity as the main condition responsible for the raptor's need for treatment (Molina-López et al. 2011) on admission (Table 2). The clinical assessment protocol included radiographs in all birds as well as necropsy and histopathologic examination of the birds that died or were euthanized. Chi-square and Fisher exact tests were used to compare datasets using SPSS v.22.0 (SPSS Inc., Chicago, Illinois, USA). Odds ratios (ORs) were estimated for disease comparisons. Statistical significance was set at $P < 0.05$. We calculated SCI for the resident species for the breeding and nonbreeding seasons as reported by Molina-López et al. (2011). Population data were obtained from Lorenzo (2007). To study differences among years, trend analyses were

TABLE 1. Demographic data of the free-living raptors admitted to the Tafira Wildlife Rehabilitation Center in Gran Canaria Island, Spain (2003–13).

Species	No. admissions (%)	Sex		Age		
		M/F ^a	Unknown	<1 Yr	>1 Yr	Unknown
Order Falconiformes	1,652 (67.2)	311/234	1,107	641	470	541
Family Accipitridae						
Eurasian Sparrowhawk (<i>Accipiter nisus granti</i>)	63 (2.6)	20/22	21	23	21	19
Eurasian Griffon (<i>Gyps fulvus</i>)	1 (0.0)	0/0	1	0	0	1
Black Kite (<i>Milvus migrans</i>)	3 (0.1)	0/0	3	1	0	2
Egyptian Vulture (<i>Neophron percnopterus majorensis</i>)	26 (1.1)	4/7	15	7	12	7
Canary Islands Common Buzzard (<i>Buteo buteo insularum</i>)	196 (8.0)	42/31	123	59	61	76
Short-toed Snake-eagle (<i>Circaetus gallicus</i>)	1 (0.0)	0/0	1	0	0	1
Family Falconidae						
Barbary Falcon (<i>Falco peregrinoides</i>)	47 (1.9)	10/18	19	16	11	20
Peregrine Falcon (<i>Falco peregrinus</i>)	1 (0.0)	0/1	0	1	0	0
Eurasian Hobby (<i>Falco subbuteo</i>)	3 (0.1)	0/0	3	1	0	2
Eurasian Kestrel (<i>Falco tinnunculus</i>)	1,302 (53.0)	234/152	916	530	361	411
Eleonora's Falcon (<i>Falco eleonorae</i>)	5 (0.2)	0/2	3	1	3	1
Lesser Kestrel (<i>Falco naumanni</i>)	1 (0.0)	1/0	0	0	1	0
Family Pandionidae						
Osprey (<i>Pandion haliaetus</i>)	3 (0.1)	0/1	2	2	0	1
Order Strigiformes	806 (32.8)	7/7	792	236	177	393
Family Strigidae						
European Scops-owl (<i>Otus scops</i>)	5 (0.2)	0/0	5	1	1	3
Short-eared Owl (<i>Asio flammeus</i>)	1 (0.0)	0/0	1	1	0	0
Eurasian Long-eared Owl (<i>Asio otus canariensis</i>)	692 (28.1)	5/4	683	213	153	326
Family Tytonidae						
Eurasian Barn Owl (<i>Tyto alba</i>)	108 (4.4)	2/3	103	21	23	64
Total	2,458	318/241	1,899	877	647	934

^a M/F = male/female ratio.

applied for specific causes with a minimum of 50 cases.

The number of cases and frequency distribution by causes of admission are shown in Table 2 and in the Supplementary Table. No statistical differences were found when sexes and age groups were analyzed according to the different causes of admission, except for the orphaned-young category. Determining the causes of morbidity and mortality of raptors presented to rehabilitation facilities can provide some insight into these factors for wild populations if the biases of such data are acknowledged (Wendell et al. 2002). Data are usually biased by visibility and behavior of the birds (Richards et al. 2005), public awareness

(Wendell et al. 2002; Komnenou et al. 2005), and age groups with a high proportion of juveniles (Molina-López et al. 2011).

Admissions were distributed by season as follows: 38.0% ($n=933$) in summer, 23.4% ($n=574$) in fall, 23.5% ($n=579$) in spring, and 15.1% ($n=372$) in winter. Table 3 shows the SCIs of the causes of admission of the breeding species with >10 admissions. The highest incidences during the breeding and nonbreeding seasons were for the Eurasian Barn Owl (*Tyto alba*) and the Barbary Falcon (*Falco peregrinoides*), respectively, mainly due to trauma of unknown origin.

Trauma occurred frequently during all seasons but was significantly more frequent

TABLE 2. Primary causes of morbidity for 2,458 free-living raptors admitted to the Tafira Wildlife Rehabilitation Center in Gran Canaria Island, Spain (2003–13).

Cause of admission	No. admissions	%
Trauma		
Gunshot	117	4.8
Collision	93	3.8
Fences	3	0.1
Power lines	7	0.3
Motor vehicles	58	2.4
Buildings	25	1.0
Predation	10	0.4
Electrocution	10	0.4
Unknown origin	601	24.4
Total trauma with bone fracture	555	22.6
Total trauma with soft tissue damage	276	11.2
Total trauma	831	33.8
Nontrauma admissions		
Infectious/parasitic disease	18	0.7
Metabolic/nutritional disease	273	11.1
Glue trap	124	5.0
Orphaned young	533	21.7
Healthy young birds	322	13.1
Injured birds	211	8.6
Poisoning	48	1.9
Entanglement in <i>Setaria adhaerens</i>	44	1.8
Other causes	135	5.5
Unknown	452	18.4
Total nontrauma admissions	1,627	66.2

in summer (35.1%, $n=292$; $\chi^2=79.6$, $P<0.001$). The prevalence of trauma (33.8%) in our study was lower than that reported in surveys in the US (Deem et al. 1998; Wendell et al. 2002) and Europe (Komnenou et al. 2005; Molina-López et al. 2011). The unknown origin of the traumas causing the highest SCI values during the breeding and non-breeding seasons makes it difficult to suggest specific preventive measures. However, if we discard gunshot (when no radiographic evidence was observed), many of these unknown traumas were probably due to collision. Molina-López et al. (2011) reported that the Eurasian Barn Owl had the highest risk of trauma (OR=2.4), reinforcing the major vulnerability of this species for collision trauma.

Gunshot was the second most common cause (4.8%) of trauma, with significant differences detected between seasons ($\chi^2=60.6$, $P<0.001$), being most prevalent in fall (55.6%, $n=65$). This prevalence was lower than that reported in other surveys in Europe (Martínez et al. 2001; Komnenou et al. 2005; Molina-López et al. 2011). All raptors are protected from hunting, and it is disturbing to find that 41.9% of gunshot cases took place out of hunting season, indicating deliberate persecution. Although the Canary Islands Common Buzzard (*Buteo buteo insularum*) had the highest risk of gunshot (OR=8.3), some cases of gunshot were found in raptor species catalogued as “in danger of extinction” (Barbary Falcon and Egyptian Vulture) and “vulnerable” (Osprey [*Pandion haliaetus*]) in the Spanish List of Wildlife Species with Special Protection (Ministerio de Medio Ambiente y Medio Rural y Marino 2011).

Orphaned-young birds were the second most common cause of admission (21.7%), with a significantly higher number detected in summer and spring ($\chi^2=390.2$, $P<0.001$). Remarkably, 60.4% of the total orphaned birds were healthy. People with good intentions often confuse fledglings (with limited ability to fly) with orphaned birds (Komnenou et al. 2005). The prevalence of orphaned-young birds in our study was higher than that reported by Wendell et al. (2002) and Komnenou et al. (2005) but lower than that reported by Molina-López and Darwich (2011) and Molina-López et al. (2011).

The metabolic/nutritional disease category represented an important cause of admission (11.1%) with considerably higher prevalence than that reported in other surveys (Wendell et al. 2002; Molina-López et al. 2011). However, the prevalence of infectious/parasitic disease as a primary cause of admission was very low in our study (0.7%). The impact of underlying infectious or parasitic diseases was probably underestimated because no complete microbiologic or parasitologic analyses were done routinely because of financial constraints. Many of these cases may have contributed to increasing the prevalence of the metabolic/nutritional category.

TABLE 3. Seasonal incidence rate values of the breeding raptor species admitted to the Tafira Wildlife Rehabilitation Center, Gran Canaria Island, Spain from 2003 to 2013.^a

Breeding raptor species	SCI ^b																							
	Total no. admissions		Estimated population		Overall causes		Trauma		Infectious/ parasitic disease		Metabolic/ nutritional disease		Glue trapping		Orphaned young		Poisoning		Entanglement in <i>Setaria adhaerens</i>		Other causes		Unknown/ undetermined	
	B	NB	B ^c	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB
<i>Accipiter nisus granti</i>	1	62	1,875	1,250	0.0	4.5	0	1.4	0	0.1	0	0.4	0	0.1	0	0.6	0.0	0	0	0.1	0	0.7	0	1.1
<i>Buteo buteo insularum</i>	3	193	1,875	1,250	0.1	14.0	0	4.9	0	0.2	0.0	1.5	0	0	1.8	0	1.5	0	0	0.0	0.7	0.0	3.3	
<i>Falco peregrinoides</i>	4	43	357	203	1.0	19.2	0.25	10.3	0	0.4	0.5	1.3	0	0	0.4	0	0.4	0	0	0	3.6	0.2	2.2	
<i>Falco tinnunculus</i>	93	1,209	25,000	12,500	0.3	8.8	0.1	2.3	0	0.0	0.0	1.1	0.0	0.3	0.1	2.6	0	0.1	0	0.0	0.0	0.5	0.1	1.7
<i>Asio otus canariensis</i>	85	607	12,140	6,070	0.6	9.1	0.35	3.8	0	0.0	0.0	0.8	0.1	0.9	0.0	1.6	0	0.1	0	0.5	0.0	0.2	0.1	1.2
<i>Tyto alba</i>	45	63	2,250	900	1.8	6.4	1.01	3.3	0.05	0.1	0.1	0.5	0	0.1	0.1	0	0.1	0.1	0	0.5	0.2	0.2	0.3	1.5

^a B = breeding season; NB = nonbreeding season.

^b Seasonal cumulative incidence (SCI) cases per 1,000 birds/yr=[(total season cases/estimated season population)×1,000]/11.

^c Estimated population at the breeding season: number of pairs multiplied by the number of chicks.

Glue traps are commonly used in the Canary Islands for domestic rodent control, and raptors usually suffer from plumage damage when they attempt to capture rodents caught in these traps (Rodríguez et al. 2010). Glue trapping had a prevalence of 5.0%, and was significantly more prevalent in winter (37.1%, $n=46$) and fall (29.8%, $n=37$) as compared to spring (16.1%, $n=20$) and summer (16.9%, $n=21$; $\chi^2=15.5$, $P=0.001$). The Eurasian Long-eared Owl (*Asio otus canariensis*) showed the highest risk of being trapped in glue traps (OR=3.6). Eurasian Long-eared Owls and Eurasian Kestrels (*Falco tinnunculus*) had the highest SCI for this category during the nonbreeding season. Particularly interesting is the prevalence (1.8%) of the admission of raptors with plumage damage due to entanglement in burr bristlegrass (*Setaria adhaerens*). Eurasian Long-eared Owls and Eurasian Barn Owls were most frequently affected. This plant is possibly native to the Canary Islands and it flowers and dries during spring and early summer. The dry plant retains adhesive ripe seed heads that are adapted to exozoochore dispersal (passive dispersal using animal surface such as skin and plumage; Rodríguez et al. 2010). The entanglement of raptors could also be a consequence of anthropogenic perturbations in the Canary Islands, because the densities of burr bristlegrass are highest in human-transformed areas (Rodríguez et al. 2010).

The number of admissions peaked during 2005–07 and then decreased. The period 2005–07 was the time of greatest economic activity in Gran Canaria Island, with significant investment in insular environmental awareness campaigns. Economic activity increases anthropogenic threats for raptors, and environmental awareness campaigns promote greater participation in collection of injured raptors. A consistent decrease in cases of trauma and orphaned-young raptors occurred during the 11-yr study. However, an increasing tendency was observed in the number of raptors admitted because of unknown causes. There was an annual variation of gunshot cases: 73.5% ($n=86$) of gunshot admissions

occurred from 2003 to 2008, followed by a notable decrease starting in 2009, probably because of the shortening of the hunting season (currently only 20 September to 30 October). However, because gunshot cases out of hunting season were more numerous than those during the hunting season, particularly in 2009, 2011, and 2012, increased enforcement of existing poaching laws could reduce the incidence of gunshot cases during the nonhunting season.

This long-term study provides useful information for the conservation of raptors in Gran Canaria Island, given the particular vulnerability of insular raptor species. Although a similar study was conducted in Tenerife Island (Rodríguez et al. 2010), this is also the only survey in the Canary Islands archipelago providing SCI for breeding species as a more accurate approach to assess the potential ecologic impact of the different causes of morbidity. Further estimations of the wild raptor populations are necessary to determine the real impact of the most relevant SCIs reported in this study.

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SUPPLEMENTARY MATERIAL

Supplementary material for this article is online at <http://dx.doi.org/10.7589/2015-09-255>.

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