Causes of admission and outcomes of Long-eared Owl (*Asio otus*) in wildlife rescue centres in Italy from 2010 to 2014

Alessia Mariacher[a*], Riccardo Gherardi[b], Marco Mastrorilli[c] and Davide Melini[d]

[a]*Centro di Referenza Nazionale per la Medicina Forense Veterinaria, Istituto Zooprofilattico Sperimentale delle Regioni Lazio e Toscana, Viale Europa 30, 58100 Grosseto, Italy*
[b]*Via della chiesa XVIII 780, 55100 S. Angelo in Campo (LU), Italy*
[c]*Noctua srl, Piazza Visconti 11, 29020, Loc. Grazzano Visconti, Vigolzone (PC), Italy*
[d]*Loc. La Follonica 26/A, 58023 Gavorrano (GR), Italy*
**E-mail: alessia.mariacher@izslt.it*

ABSTRACT

Data obtained from wildlife rescue centres are a useful means of understanding threats posed to wild animal populations. Aims of the present study were to investigate the causes of admission and outcomes of Long-eared Owls (*Asio otus*) hospitalised in rescue centres in Italy. Data were collected from 13 centres form January 2010 to October 2014 using a web form. The following variables were considered: estimated age at admission; date of admission; habitat at finding location; main cause of admission; and outcome. Major causes of admissions were related to human activities, mainly consisting of collision trauma and collection of uninjured fledglings. Despite nocturnal habits of owls and their protection status, according to European Union Directive 2009/147/CE and to national Italian laws, gunshot wounds were also represented as an admission cause in adult animals. Overall mortality rate was 47.3%. Considering age classes, the majority of adult animals died while the majority of pulli survived and were later released. Both collisions and gunshot wounds contributed to the higher mortality in adult animals. We suggest that anatomopathological and toxicological investigation of dead casualties, along with post release monitoring of rehabilitated owls, would contribute to a better understanding of mortality causes and to the implementation of more successful rehabilitation techniques.

Keywords: *Asio otus*, Italy, Long-eared Owl, wildlife rescue centres

1. INTRODUCTION

In Italy, there are 100 wildlife rescue centres, which are managed independently mostly by animal rights associations or local authorities. Admitted casualties mostly belong to class Aves (birds). Information available about admissions and outcomes is not currently collected in a common national database, although these data could provide useful insights into morbidity and mortality for different wildlife species. Indeed, data obtained from rescue centres are considered a useful means to understanding threats posed to wild animal populations and to monitor ecosystem health (Sleeman, 2008; Molina-López and Darwich, 2011). In particular, among birds, owls are considered valuable sentinels of environmental changes because of their position in the ecological food chain (Sheffield, 1997). Italy is a very important wintering area for Long-eared Owls (*Asio otus*). The number of mature individuals is estimated at 15000–20000 in winter (Brichetti and Fracasso, 2006). The species is breeding and partially sedentary throughout the country as well as a regular migrant (Spina and Volponi, 2008). In Europe, the population trend appears to be slightly decreasing, but the species is overall evaluated as 'Least Concern' (BirdLife International, 2015). Local declines are thought to be due to various factors, such as expansion of competing species like the Tawny Owl (Strix aluco) (Hagemeijer and Blair, 1997), fluctuations in vole populations (Village, 1981; Tulis *et al.*, 2015), use of pesticides (Sheffield, 1997; Ruiz-Suárez *et al.*, 2014) and road traffic collisions (Baudvin, 1997; Erritzøe, 1999). Studies focusing on morbidity and mortality of the Long-eared Owl are scarce. Aims of the present study were to investigate the causes of admission and outcomes of Long-eared Owls hospitalised in wildlife rescue centres in Italy.

2. METHODS

Data were collected from January 2010 to October 2014 using a web form. Thirteen wildlife rescue centres in different regions of Italy took part in the survey. The following variables were considered: estimated age at admission; date of admission; habitat at finding location; main cause of admission; and outcome. Animals were assigned to an age class (adult, juvenile, pullus) based on morphology and plumage development. Habitats were categorised as follows: inhabited or uninhabited

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urban or rural buildings; industrial areas; roadside; woods; grasslands and pastures; croplands; wetlands; other or unknown locations. Causes of admission were identified based on case history and veterinary physical examination. Categories included: gunshot wound; collision trauma; healthy orphaned chicks; starvation; illegal captivity; natural disease; poisoning; predation; entanglement or dirty feathers; and unknown causes. The natural disease category included metabolic, nutritional, infectious, and parasitic diseases. The final outcomes were categorised into four entities: released; kept in captivity (for animals with a disability precluding the animal from being released); still being treated; or dead, the latter including both unassisted mortality and euthanised birds. Descriptive statistics, normality test and inferential analyses were done at 95% of confidence or higher with R software (R Development Core Team, 2015). A chi-square analysis was used to compare proportions when appropriate. Non-parametric Kolmogorov–Smirnov test (K–S test) was also used to test data distributions and to compare samples. Causes of admission were analysed for variations between age classes, season and habitat at finding location.

3. RESULTS

A total of 402 birds were included in the study. Most animals (97.3%, n = 391) were alive on admission. There was a statistically significant difference between age classes, with adult animals accounting for 58% (n = 233) of the admissions, while 31.3% (n = 126) were pulli and 10.7% (n = 43) were juveniles (χ^2 = 31.89; P < 0.001). Analysis of the monthly distribution of admissions showed that frequencies differed between adults and pulli (K–S test, D = 0.75; P < 0.01). Adult animals were mostly admitted from December to February (during wintering season) and in May, while the highest number of chicks was concentrated during the breeding period (from April to June). The earliest chick was admitted on 2 February. The Long-eared Owl shows close contact with human activities, with a high proportion of animals found in inhabited urban (24%, n = 98) and rural (10.4%, n = 42) buildings, or along the roadsides (18.4%, n = 74). Habitat at finding location did not statistically differ among age classes. Overall, main causes of admission were collision trauma (42.8%, n = 172) and collection of orphaned chicks (25.4%, n = 102). The majority of collisions involved adult animals (87.8%, n = 151). Orphaned chicks belonged mainly to the pulli age class (96.1%, n = 98). Indeed, owlets were mainly admitted as healthy chicks after being found on the ground or on branches in the woods, or inside inhabited urban buildings. Only a small proportion of pulli were admitted for some kind of trauma or disease: 12 pulli presented with starvation (9.5% of admitted chicks); five with signs of collision trauma (4%); and five with predation wounds (4%). Sixteen animals, all adults, were admitted following gunshot wounds. Causes of admission and their distribution in age classes are summarised in Table 1. Overall mortality rate was 47.3% (n = 190), while 42.8% (n = 172) of animals were released. Considering mortality differences among age classes, the majority of adult animals died (63.9% of adult owls admitted, n = 149), while only 19.0% of pulli (n = 24) died (χ^2 = 66.03; P < 0.0001). Indeed the majority of pulli were released (70.6%, n = 89). Outcomes for different causes of admission in adult and pulli age classes are presented in Table 2.

4. DISCUSSION

Long-eared Owls were mostly hospitalised as adults following collision trauma or gunshot wounds, while pulli were mainly admitted as healthy chicks. Young owls normally leave the nest very early, before they are fully fledged. This behaviour could be aimed at avoiding parasitism and nest predators, or it may be due to human interference or a search for cooler roosts (Kristan *et al.*, 1996). These chicks still depend on their parents for food for the next few months, and may appear helpless by well-meaning passers-by who collect them (Southern *et al.*,

Table 1 Causes of admission of Long-eared Owls in wildlife rescue centres in Italy (2010–2014), and their distribution in age classes

	Total		Adult		Juvenile		Pullus	
	n	%	*n*	%	*n*	%	*N*	%
Gunshot wound	16	4.0	16	6.9	0	0.0	0	0.0
Collision trauma	172	42.8	151	64.8	16	37.2	5	4.0
Healthy orphaned chicks	102	25.4	0	0.0	4	9.3	98	77.8
Starvation	32	8.0	15	6.4	5	11.6	12	9.5
Illegal captivity	3	0.7	3	1.3	0	0.0	0	0.0
Natural disease	3	0.7	2	0.9	0	0.0	1	0.8
Poisoning	9	2.2	9	3.9	0	0.0	0	0.0
Predation	19	4.7	3	1.3	11	25.6	5	4.0
Entanglement or dirty feathers	10	2.5	8	3.4	2	4.7	0	0.0
Unknown causes	36	9.0	26	11.2	5	11.6	5	4.0
TOTAL	402	100.0	233	100.0	43	100.0	126	100.0

Table 2 Outcomes for different causes of admission in adults and pulli of Long-eared Owls in wildlife rescue centres in Italy (2010–2014)

		Gunshot wound		Collision trauma		Healthy orphaned chicks		Starvation		Illegal captivity		Natural disease		Poisoning		Predation		Entanglement or dirty feathers		Unknown causes	
Age class	Outcome	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Adults	Released	1	6.3	30	19.9	0	0.0	7	46.7	2	66.7	0	0.0	0	0.0	2	66.7	4	50.0	13	50.0
	Dead	13	81.3	101	66.9	0	0.0	8	53.3	1	33.3	2	100.0	9	100.0	1	33.3	4	50.0	10	38.5
	Kept in captivity	2	12.5	19	12.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Still being treated	0	0.0	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	11.5
	TOTAL	16	100.0	151	100.0	0	0.0	15	100.0	3	100.0	2	100.0	9	100.0	3	100.0	8	100.0	26	100.0
Pulli	Released	0	0.0	1	20.0	84	85.7	1	8.3	0	0.0	0	0.0	0	0.0	2	40.0	0	0.0	1	20.0
	Dead	0	0.0	1	20.0	7	7.1	11	91.7	0	0.0	1	100.0	0	0.0	1	20.0	0	0.0	3	60.0
	Kept in captivity	0	0.0	3	60.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Still being treated	0	0.0	0	0.0	7	7.1	0	0.0	0	0.0	0	0.0	0	0.0	2	40.0	0	0.0	1	20.0
	TOTAL	0	0.0	5	100.0	98	100.0	12	100.0	0	0.0	1	100.0	0	0.0	5	100.0	0	0.0	5	100.0

1954; Petty and Thirgood, 1989; Fosco, 2007; Griffiths *et al.*, 2010; Molina-López and Darwich, 2011). Other nestlings can be found under the roof or in chimneys of urban or rural buildings, and are collected by the owners and brought to wildlife rescue centres. These owlets are usually healthy uninjured chicks therefore a high release rate can be reached (85.7%, $n = 84$), unlike adult animals that are often seriously injured or very sick (Griffiths *et al.*, 2010).

Collision injuries were suspected for every animal with signs of head trauma or fractures and could include different type of traumas such as motor vehicle collisions, or impacts against windows, fences or other obstacles. 39.1% ($n = 59$) of adult animals with signs of trauma were found along the roadsides, thus suggesting road traffic accidents. However, the ultimate cause of collision remained frequently unknown. It is already well known that nocturnal raptors are prone to collision trauma and highly vulnerable to the effects of road traffic. Possible explanations for this vulnerability have been proposed, including use by owls of support structures on the roadside (trees, fences or wires), foraging habits linked to small mammals abundance on the roadsides, or temporary blindness of owls when exposed to traffic lights (Hodson, 1962; Glue, 1971; Baudvin, 1997; Massemin and Zorn, 1998; Erritzøe, 1999; Erritzøe *et al.*, 2003; Erickson *et al.*, 2005; Molina-López *et al.*, 2011).

The nocturnal habits of owls reduce the chances of being accidentally shot, but still there is a considerable risk of poaching. Considering that only 13 centres contributed to our survey, the proportion of shot animals could be much higher on a national scale. Furthermore, it was not possible to perform X-ray examination on all admitted casualties, therefore numerous cases of owls surviving to previous shotgun wounds could have been missed. Both collisions and gunshot wounds produce a high mortality: 66.9% ($n = 101$) of adult animals with signs of collision trauma died, and mortality reached 81.3% ($n = 13$) in the case of shot adult owls (Table 2).

Overall mortality rate was high, but not surprising, since outcomes in wildlife rehabilitation centres are usually poor with reported release rates often about or lower than 50% (Fix and Barrows, 1990; Punch, 2001; Kirkwood, 2003; Ress and Guyer, 2004; Rodriguez *et al.*, 2010). Mortality rate cannot be regarded as a direct result of the main cause of admission, since causes here found to be associated with high mortality (*e.g.* collision trauma and gunshot wounds in adult animals) were often combined with malnourishment or other ailments, thus worsening the prognosis. Poor prognosis has been found to be related to neurological signs in *Athene noctua* and poor body condition in *Strix aluco* (Molina-López *et al.*, 2014). Furthermore, nocturnal raptors injured in road traffic accidents often suffer from ocular lesions (Seruca *et al.*, 2012; Williams *et al.*, 2012), and ocular damage should be thoroughly assessed and monitored since it could undermine the possibility of release (Cousquer, 2012).

In this respect, the limitations in obtaining a definitive diagnosis in wild birds in rescue centres remains a major problem. For example, it is still under discussion if food shortening, sub-lethal infectious diseases or poisoning may play a role in trauma-associated morbidity and mortality (Glue, 1971; Wendell *et al.*, 2002). It is known that nocturnal raptors are amongst secondary consumers with a high prevalence of pesticide exposure, especially to second generation anticoagulant rodenticides (Sánchez-Barbudo *et al.*, 2012; Ruiz-Suárez *et al.*, 2014). Although the diagnostic interpretation of liver anticoagulant rodenticide residues in the absence of clinical findings is challenging, a chronic exposure to these toxicants may predispose these animals to weakness, sickness and accidents (Albert *et al.*, 2009).

In order to gain a deeper understanding of ultimate mortality causes in owl casualties at a national scale, it would be very useful to perform a thorough necroscopic examination on all deceased casualties. Carcasses should be monitored for contaminants (especially anticoagulant rodenticides) to allow some insights into potential environmental problems and chronic sub-lethal poisoning. Anatomopathological investigation could also help to assess whether hospitalisation length predisposes birds to captivity-associated diseases (*e.g.* foot diseases, weight-related diseases, gout) that could impair the success of rehabilitation and release. Eventually post-release monitoring would be necessary in order to assess the actual effectiveness of rehabilitation and release techniques.

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