



Research Article

Causes of admission and final dispositions of hedgehogs admitted to three Wildlife Rehabilitation Centers in eastern Spain

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Abstract

We studied hedgehog admissions to the three Wildlife Rehabilitation Centers of the Valencian Community (eastern Spain) over a five years period (2009–2013). A total of 490 hedgehogs were admitted: 84% corresponded to Western European hedgehogs and 16% to Algerian hedgehogs. A bimodal distribution of the admissions was observed along the year, with highest number of admissions during summer and a much smaller peak on winter, largely due to the arrival of young hedgehogs. Main reasons for admission were casual encounters (41%) and orphaned young (19%). In total, 69% of the individuals that arrive alive to the centers could be released successfully to the wild, with better recovery indices for animals accidentally found, previously held in captivity and orphaned young; and worst indices for parasitized hedgehogs, affected by infections and by road casualties. Finally, involving the general public in the rehabilitation process (e.g., returning animals to the wild, collaborating with “soft-releases”) proved to be very productive, for both environmental awareness purposes and for the rehabilitated animals.

Introduction

Hedgehogs are one of the most distinctive and familiar groups of mammals and are widely distributed throughout the Old World (Reeve, 1994). In Spain there are two species of hedgehogs: the Western European hedgehog *Erinaceus europaeus* (Linnaeus, 1758), whose distribution includes much of the countries of central and western Europe (Nores, 2007), and the Algerian hedgehog *Atelerix algirus* (Duvernoy and Lereboullet, 1842), present at North Africa, the south-eastern littoral fringe of the Iberian Peninsula and the Canary and Balearic Islands (Alcover, 2007). The latter represents the only species that is of North African genus that occupies continental Europe (Blanco, 1998). Both species prey mainly on macro-invertebrates but are characterized by their big potential of trophic adaptation, being generalist feeders (Hof and Bright, 2009; Ouarab and Doumandji, 2010). Although both species can be sympatric in some parts of their range (García et al., 2009), Algerian hedgehog seems to be stricter in its habitat requirements (Sans-Fuentes and Ventura, 2000) and it appears generally linked to more Mediterranean environments (Gosálbez and López-Fuster, 1985), rejecting urban areas (García-Rodríguez and Puig-Montserrat, 2014), unlike the Western European hedgehog, closely associated with green-spaces in built-up areas such as gardens, greens and parks (Huijser, 1999). Hedgehog populations in several West European countries are believed to be in decline (Holsbeek et al., 1999; Hof, 2009), and agricultural intensification, fragmentation of suitable habitat and roadkills have been suggested amongst the main causes of this decline (Wembridge, 2011).

Hedgehogs are one of the most common species of mammals admitted to wildlife hospitals (Morris, 1998; Bullen, 2002; Molony, 2006; GREFA, 2012; CITMA, 2014). Common causes of admission for these animals include skin, respiratory and gastrointestinal diseases, malnutrition, hypothermia, traumatic injuries or accidental poisoning (Robinson and Routh, 1999; Bunnell, 2001). Recovery process generally ends up with good survival rates (Morris, 1998), and it is hoped that, in some significant way, the balance that has been severely disturbed by human habitation is addressed by the care provided by wildlife rescue centers (Bunnell, 2001). Also, wildlife hospitals could develop an important contribution to public education on wildlife and wildlife damage (Siemer et al., 1991), raising awareness amongst the general public, which is likely to benefit wildlife in general and hedgehogs in particular (Hof, 2009).

Although substantial information on causes of mortality and general care of hedgehogs has been published, studies about admissions of these animals to rehabilitation centers are scarce, specially at the Mediterranean region. The main aim of this study was to collate data from hedgehog admittance records from three wildlife rehabilitation centers located at eastern Spain, describing admissions distribution, primary causes of injury and analyzing outcomes, to provide a comparison with other studies. Finally, we briefly discuss the advantages of involving members of the public in the recovery process of these species of conservation concern.

Methods

The Valencian Community (23 255 km² area) has three wildlife rehabilitation centers that receive and treat wild terrestrial vertebrates. These centers directly depend on the regional government Wildlife Ser-

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Table 1 – Reasons for admission for hedgehogs admitted at the Wildlife Recovery Centers of the Valencian Community.

Reason for admission	2009 (N)	2010 (N)	2011 (N)	2012 (N)	2013 (N)	Total (N)
Casual encounter	48.6% (53)	38.4% (33)	54.1% (40)	32.2% (28)	34.3% (46)	40.8% (200)
Orphaned young	15.6% (17)	29.1% (25)	17.6% (13)	17.2% (15)	18.7% (25)	19.4% (95)
Held in captivity	5.5% (6)	4.7% (4)	10.8% (8)	10.3% (9)	9.7% (13)	8.2% (40)
Infectious/parasitic	6.4% (7)	5.8% (5)	4.1% (3)	2.3% (2)	9.7% (13)	6.1% (30)
Predation	5.5% (6)	7.0% (6)	6.8% (5)	5.7% (5)	3.7% (5)	5.5% (27)
Road casualties	3.7% (4)	3.5% (3)	2.7% (2)	10.3% (9)	6.0% (8)	5.3% (26)
Undetermined trauma	5.5% (6)	4.7% (4)	1.4% (1)	5.7% (5)	7.5% (10)	5.3% (26)
Other causes	5.5% (6)	3.5% (3)	2.7% (2)	6.9% (6)	4.5% (6)	4.7% (23)
Undetermined	2.8% (3)	3.5% (3)	0.0% (0)	5.7% (5)	2.2% (3)	2.9% (14)
Undernourishment	0.9% (1)	0.0% (0)	0.0% (0)	3.4% (3)	3.7% (5)	1.8% (9)
Total number of admitted hedgehogs	100% (109)	100% (86)	100% (74)	100% (87)	100% (134)	100% (490)

vices, and receive injured animals from different official organizations (Rangers, Police, etc.) or directly from members of the public. All three consist of adequate facilities to accommodate wildlife, and a team of technicians and veterinarians are in charge of care and rehabilitate the animals, according to legislation (R.D. 1201/2005, 2005). A database exists in order to register maximum information of the admissions.

For this study, we examined the admittance records of both species of hedgehogs from these wildlife rehabilitation centers between 2009 and 2013. Variables of interest analyzed were: arrival date, species, age, sex, primary cause of injury, outcome and date of release/death. When possible, animals were classified into three categories according to age: young, subadult and adult, based on the combination of some characteristics like body length/weight relationship, uniform presence of growing spines or external appearance (Morris, 1994; Bunnell, 2002; Jackson, 2006).

Primary cause of injury was also recorded as: (1) casual encounter; i.e. found in an exposed/vulnerable position but with no apparent damage, (2) held in captivity; i.e. hedgehogs found at the field and cared by

people during some time as a pet, but with no record of having suffered previous illness, (3) orphaned; i.e. young hedgehogs weighing less than 250 g (Bunnell, 2001, 2009), (4) undernourishment, i.e. thin in appearance, with protruding ribs and a tapering rear end (Bunnell, 2002), (5) predation; i.e. bite wounds from pets, (6) infectious/parasitic; e.g. pneumonia, myiasis, sarcoptic mange, ticks or presence of parasites (overburdening) in faeces examined by overt appearance, (7) road casualty, (8) undetermined trauma and (9) other causes (this last category included: drowning, burning, netting, seizure, etc.). Outcome of each hedgehog was categorized as follows: ED (enters dead), EU (euthanized within 24 hours due to the severity of injuries), DE (died during recovery process) and RE (released in good condition).

We examined yearly and seasonal variation of admissions, diagnoses, and evaluated final disposition regarding cause of injury, in order to compare percentages of rehabilitation by primary causes. Kruskal-Wallis tests were used to evaluate differences in the number of admitted individuals among years and seasons. Analyses were conducted using software and environment R (R Core Team, 2013). With regards to orphaned young hedgehogs, we describe admissions distribution along the year for both species. Descriptive statistics were calculated for arrival weight of young hedgehogs of both species, and also for number of days lapsed from admitting a young hedgehog to the date it died or was released. Due to the ecological similarities (Blanco, 1998), when it was appropriate, data for the two species of hedgehogs were treated jointly.

Results

Between January 2009 and December 2013, 490 hedgehogs were admitted to the Wildlife Recovery Centers of the Valencian Community, 98/year on average (SD=24). Of these, 412 were Western European hedgehogs (84%) and 78 were Algerian hedgehogs (16%). In 350 cases in which the age was recorded, 207 were adults, 33 were subadults and 110 were young hedgehogs. With regards to sex ratio, males accounted for 53% of the records (N=81 sexed individuals). Arrival weight of the hedgehogs was registered in 190 cases (Annex 1).

Yearly and seasonal variation

Along these five years there were on average five times more intake records of Western European hedgehogs than Algerian hedgehogs. Concerning total of admission numbers, 2013 was the year with highest number of individuals (Fig. 1), but we did not find significant differences in the admission of hedgehogs of each species among years ($\chi^2=4.4, p>0.1, df=4$ for *E. europaeus*; and $\chi^2=7.6, p>0.1, df=4$ for *A. algirus*).

While hedgehogs were admitted to the centers throughout the year, we observed a bimodal distribution, with larger number of admissions during the summer and a much smaller peak during the months of December and January (Fig. 2). A significant seasonal variation in the number of admissions was found for Western European hedgehogs ($\chi^2=11.4, p<0.01, df=3$), but not for Algerian hedgehogs ($\chi^2=1.5, p>0.1, df=3$).

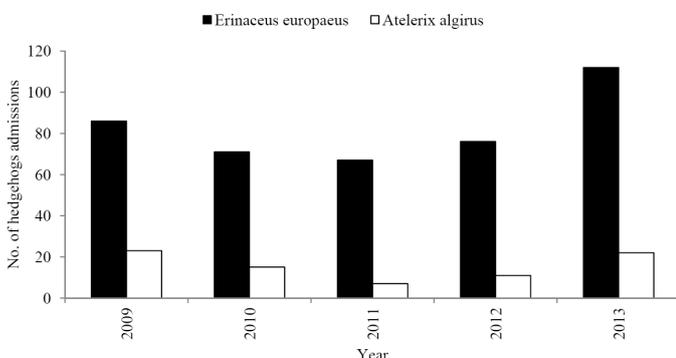


Figure 1 – Yearly variation in the number of Western European and Algerian hedgehogs admitted to the Wildlife Recovery Centers of the Valencian Community.

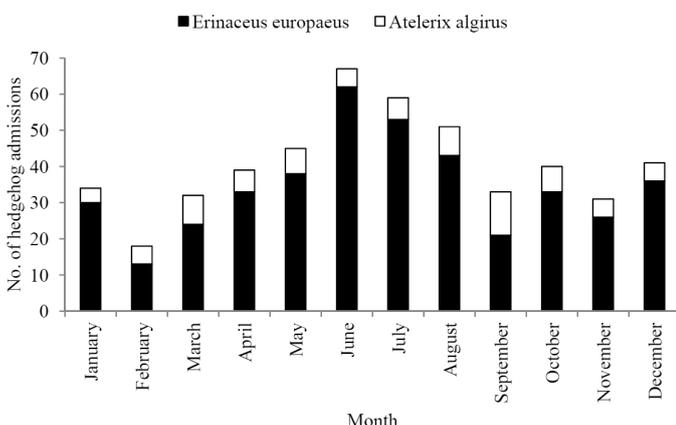


Figure 2 – Monthly variation in the number of hedgehog admissions, pooled for 5 years, 2009–2013.

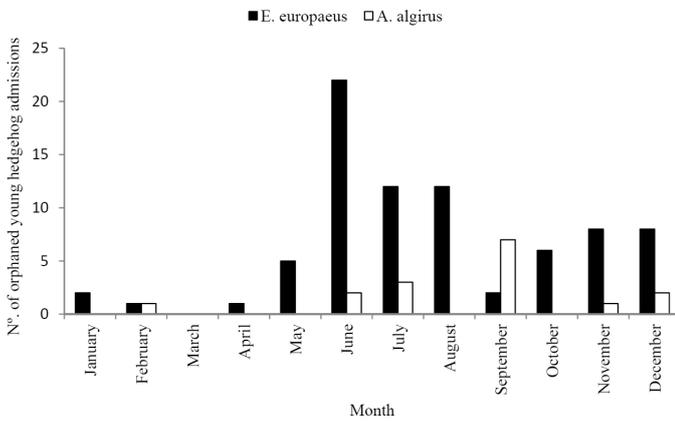


Figure 3 – Monthly variation in the number of orphaned young hedgehog admissions, pooled for 5 years, 2009–2013.

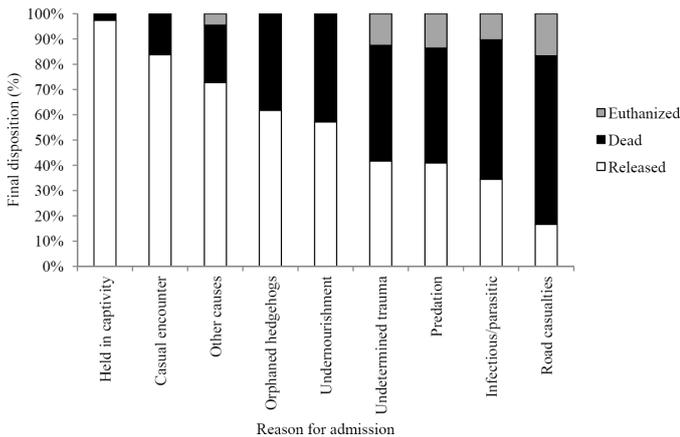


Figure 4 – Final disposition of hedgehogs regarding reason for admission, pooled for 5 years, 2009–2013.

Reasons for admission

The major reason for admission was casual encounter (40.8%, $N=200$), corresponding to animals accidentally found by public (inside gardens, urban parks...) but with no associated medical primary cause. Next reason was orphaned young (19.4%, $N=95$): unweaned hedgehogs found by members of the public, probably because their parents were dead or had abandoned the nest. Remaining admissions (39.8%, $N=195$) were distributed among different minority causes: held in captivity, infectious/parasitic, predation, road casualties, etc. (Tab. 1).

Admission of orphaned young

Orphaned young hedgehogs were brought to the centers throughout most of the year (March was the only month without young individuals records), but summer period was the season with greater number of young (54%, $N=51$). While June was the month with higher young Western European hedgehog admissions, most of young Algerian hedgehogs arrived to the centers at September (Fig. 3). Descriptive statistics for the registered arrival weights of young hedgehogs of both species are exposed in Tab. 2.

Table 2 – Descriptive statistics for the arrival weight of young hedgehogs.

	<i>Atelerix algirus</i>	<i>Erinaceus europaeus</i>
Min	52	19
Mean	112	145
Median	110	148
SD	60	61
Max	200	249
	$N=11$	$N=54$

Average time of recovery until final release for young hedgehogs (joint data of both species) was 44 days (Median=42 days; $SD=28$; $N=44$); while young hedgehogs that failed to survive, usually died shortly after arrival (Mean= 6 days; Median=1 day; $SD= 10$; $N= 28$).

Outcomes

Analysis of the final disposition showed that 69% of the hedgehogs that arrived alive to the centers could be rehabilitated and released back to the wild, while 28% died despite trying to rehabilitate them and 3% had to be euthanized due to the severity of their injuries. In relation to the reason for admission, less successful recovery indices corresponded to hedgehogs affected by road casualties and animals parasitized or with infectious diseases (Fig. 4).

Discussion

Hedgehogs admission and rehabilitation

Proportionally, admittance numbers were similar for both species in all years of the study; although total intake records of Western European hedgehogs, more abundant and widely distributed throughout the region, were five times higher than those for Algerian hedgehogs. Most of the admissions corresponded to ostensibly healthy animals (no ailments of any kind, not malnourished and normal faeces) accidentally found and caught, that did not usually require any medication or special treatment and were promptly released, although in some cases it was advisable to keep the animals for a short period, i. e. when they were slightly (but not pathological) underweight and/or the weather was too cold. Similar results have been observed in other wildlife hospitals, where admissions of healthy hedgehogs accounted more than half of the total intake records (Cahill et al., 2011).

With regards to the second leading reason for admission, orphaned young hedgehogs, 62% of the cases could be completely brought up, and the average time of recovery for juveniles until they reach the optimum release size was 44 days. Arrival of young individuals varied between seasons, and largely explained the bimodal distribution of the hedgehog total admissions observed along the year. Similarly to what has been reported in previous studies (Bunnell, 2001), a peak of young admissions was observed between June and August, and a later lower peak between October and December. These results suggest an extended breeding season in this area, according to other regions with similar mild climatic conditions that allow the occurrence of late litters and even second litters (Bunnell, 2009).

Remaining causes of injury had medium-high recovery indices (40–75%), except infectious/parasitic, that did not exceed 35%, and road casualties, which had the lowest rehabilitation success (17%). In fact, the latter was also one of the lowest reasons for entrance, because most of the animals affected by this cause would have died immediately or very quickly, so it was expected not to be a strong cause of admission to the centers (Bunnell, 2001), but one of the main causes of non natural mortality for these species (Rondinini and Doncaster, 2002; Mouhoub et al., 2009).

In these five years, 69% of the alive admitted hedgehogs could be returned to the wild (65 hedgehogs/year on average), similar percentage to that reported by Bunnell (2001). Although successful release of wildlife does not necessary equate to successful rehabilitation (Sharp, 1996), in the case of hedgehogs we could think that most of the animals released were successfully rehabilitated, firstly because both adult and naïve juvenile hedgehogs cope well with release (Morris et al., 1993; Morris and Warwick, 1994; Morris, 1997), and secondly because all the rehabilitated individuals were monitored in an outdoor acclimatisation facility for a period of time prior the final release, providing a reasonable indication of their survival capability in the wild (Bunnell, 2002; Molony et al., 2006). The use of photo-trapping infrared cameras with nocturnal video function was very useful to assess health status, motor skills or behavior of hedgehogs at the outdoor enclosure during this last stage of the rehabilitation process. In conclusion, we agree with other colleagues that rehabilitation of hedgehogs is a justifiable use of resources to the extent that full integration into the wild is an achiev-

able aim (Bunnell, 2001) and besides it represents a reinforcement of the natural population of these species, something especially important in the case of the Algerian hedgehog, with a more restricted distribution in our country and included in the Spanish List of Wild Species under Special Protection (R.D. 139/2011, 2011).

The value of closed collaboration between public and Wildlife Rehabilitation Centers

Wildlife hospitals activities arouse great curiosity among people. The knowledge of their daily work and projects is a powerful tool of environmental awareness (Siemer et al., 1991) and likewise the greatest benefit from wildlife rehabilitation is likely to come from the educational message it inspires (Tribe and Brown, 2000). In the case of hedgehogs, involving members of the public in the rehabilitation process has a big conservation value: on the one hand, it allows to influence public understanding of natural history, ecology and threats on these wild species, severely affected by anthropogenic causes (Reeve and Huijser, 1999), and also adequate information campaigns targeting people living in peri-urban and residential areas could help to reduce the capture of healthy hedgehogs accidentally found during the night (including young juveniles that have just reached independence) that should simply be left in the place, as it has been suggested by other authors for this and other species affected by this human *modus operandi* (Wimberger and Downs, 2010; Cahill et al., 2011). On the other hand, it allows returning the rehabilitated hedgehogs to the location where they were found, improving their survival chances (Morris et al., 1993), and, further, voluntary collaboration of involved people could be very helpful in that cases in which it is necessary to make a “soft release” of hedgehogs. For these reasons, we suggest public become involved as far as possible in this kind of activities, which will make a positive difference for their local hedgehog populations. Finally, the role of wildlife hospitals is newly reaffirmed, both in its animals rescue side and on their social function within the citizens, so it is necessary not to decrease the directed funds and even invest in the development of these types of infrastructures. ☞

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Supplemental information

Additional Supplemental Information may be found in the online version of this article:

- Raw data on species, month of admission, sex, age and arrival weight of admitted hedgehogs.
- Registered arrival weights per month by species and age class.