Galemys, 26 : 49-56, 2014
ISSN 1137-8700
e-ISSN 2254-8408
DOI: 10.7325/Galemys.2014.A5

Algerian hedgehog (*Atelerix algirus* Lereboullet, 1842) habitat selection at the northern limit of its range

Sergi García-Rodríguez* **& Xavier Puig-Montserrat**

Galanthus. Centre per a l'Estudi i la Divulgació del Medi Ambient, Crta. de Juià, 46, 17460 Celrà, Girona, Spain

* Corresponding author: sergigarcia@asgalanthus.org

Abstract

The Algerian hedgehog is an endemic, Mediterranean, insectivorous mammal which inhabits North Africa, the Eastern Iberian Peninsula, the Canary and Balearic Islands and several Mediterranean islands. Given evidence of population declines coupled with the limited information available on this species, studies are needed to contribute to a better understanding of this hedgehog. With this aim, and in particular to understand biological aspects as well as those of habitat selection, 14 Algerian hedgehogs were radio tracked in the species' northern limit of distribution, (Baix Llobregat, a coastal district lying a few kilometres south of Barcelona City) between 2007 and 2010. The results showed that Algerian hedgehogs positively selected open grass areas and scrubs, and used fields when available, while rejecting forest and urban areas. No evidence for sex or age related patterns emerged from the data regarding home range size and overlap between individuals, although adult males have larger home ranges and move longer distances per hour than females.
Keywords: Algerian hedgehog, crops, habitat selection, open areas, radio tracking.

Resumen

El erizo moruno es un mamífero insectívoro, endémico de la cuenca mediterránea y cuya área de distribución comprende el norte de África, la costa mediterránea de la Península Ibérica, las Islas Canarias, Baleares y algunas otras islas del Mediterráneo. Dada la evidencia de cierto declive de las poblaciones, sumado al poco o nulo conocimiento que se tiene de la especie, se hace evidente la necesidad de acometer estudios que arrojen luz sobre su situación y biología. Con este propósito y especialmente para conocer aspectos relacionados con la selección de hábitat, se marcaron con radio-emisores, entre 2007 y 2010, 14 individuos del sector costero más septentrional de su área de distribución mediterránea, en concreto en la comarca del Baix Llobregat, a pocos kilómetros de la ciudad de Barcelona. Los resultados muestran que los erizos morunos seleccionan positivamente espacios abiertos ocupados por herbazales y matorral bajo, los campos de cultivo serían utilizados a disponibilidad, mientras que rechazarían bosque y zonas urbanas. Según los datos obtenidos no hay patrones significativamente diferentes en el uso del espacio entre sexos y edades, aunque los machos utilizan espacios mayores y tienen una movilidad mayor que las hembras.
Palabras clave: cultivos, erizo moruno, espacios abiertos, radio tracking, selección hábitat.

Introduction

The Algerian hedgehog is a nocturnal and terrestrial insectivorous mammal, member of the Erinaceidae family, which comprises 10 genera and 24 species. The Algerian hedgehog is smaller than the European hedgehog (*Erinaceus europaeus* Linnaeus, 1758), with larger ears and limbs (Macdonald & Barret 2005), and a coloration highly variable ranging from very dark specimens to very light ones, but the face and abdomen are usually whitish (Blanco 1998). According to our own observations, this species escapes when it is threatened, unlike the European hedgehog, rather than closing into a tight ball with the spines directed outward - the typical hedgehog strategy. It feeds on insects, worms, snails, fruits, carrion and occasionally small vertebrates. Although hedgehogs in captivity do not hibernate, they do so in the wild. During hibernation, body temperature falls from about 35ºC to between 15ºC and 20ºC (Merrit 2010). It is a Mediterranean endemism, inhabiting North Africa, the Canary and Balearic Islands and other Mediterranean islands, as well as the Iberian Mediterranean Coast, with a remarkable penetration into the Central Catalan Depression. Aridity determines its distribution in its Iberian range, becoming rare or disappearing where mean annual rainfalls rises above 600 mm (Ruiz-Romero 1995). It is therefore considered a dry and warm Mediterranean species, inhabiting open spaces such as cultivated fields, almond and olive plantations, or scrub and also pinewoods (Ruiz-Romero 1995). This habitat preference coincides with that of African populations, which thrive mostly in arid scrub (Corbet 1988).

It was introduced in recent times, around the 13th century CE during the Almohad Dynasty, on the Balearic islands, according to evidence from fossil records and documentary data (Morales & Rofes 2008). The origin of its presence in the Iberian Peninsula and Southern France as well as in many Mediterranean islands is also probably due to artificial introductions (Lapini 1999). Whatever their origin, the Iberian and Balearic populations are legally protected by Spanish law and included in the List of Wildlife Species with Special Protection Regime in the Spanish Catalogue of Endangered Species (Real Decreto 139/2011). According to the UICN assessment information, there are insufficient data available to be able to estimate population densities (Amori *et al.* 2008). However, Algerian hedgehog populations appear to have declined and the species has even disappeared in some places where it had been cited in the past decades (Alcover 2007). In fact there are no recent recordings of the Algerian hedgehog north of the Llobregat river (García 2010) and the Southern French populations that once existed now seem to be extinct (Lapini 1999, Amori *et al.* 2008). In the southern range of its Iberian distribution a regressive trend has been observed, which has led to its inclusion in the Threatened Species list in the Autonomous Community of Andalusia (Soriguer & Palomo 2001). The habitat loss is the possible cause of the retreat of its European populations. However, despite the existence of some studies, there is not enough available data for this species, on, for example, habitat selection in its range, something which could clarify the issue and help solve problems affecting certain isolated populations. In summary, compiling this kind of information can help to define future conservation strategies, if its population decline is indeed confirmed. With the aim of better understanding habitat selections and spatial use patterns of the Algerian hedgehog, 14 individuals were radio-tracked on the Central Catalan coast, south of the Llobregat river (Barcelona). Taken together with those of the Central Catalan Depression, this area represents the northernmost European range of the Algerian Hedgehog (García 2010).

Material and methods

Study area

The study area belongs to the Baix Llobregat Agricultural Park (BLLAP) and the Campus of the Polytechnic University of Catalunya (PUC), both sites located some 20 km south of the city of Barcelona, capital of Catalonia, in the north-east of the Iberian Peninsula (41º 16' - 41º 17' N; 1º 58' - 2º 01' E). The annual average rainfall is 628.6 mm and the annual average temperature is 15.6ºC. The landscape of the study area, although a suburban district, is mainly agricultural, with plots to a greater or lesser extent separated by hedges or fences. There also are stands of Aleppo pine, (*Pinus halepensis* Mill.) and Stone pine (*Pinus pinea* Linnaeus, 1753) with small plots of Black poplars (*Populus nigra*, Linnaeus, 1753). Some agricultural plots are not in use or are left fallow, and so a dense herbaceous cover has developed. The PUC Campus is an ancient agricultural area partially converted into gardens, with a large area of grass around a large artificial pond, although also featuring plots with dense herbaceous cover, similar to those in the BLLAP.

Radio-tracking

The study was conducted between July and October from 2007 to 2010 using 14 Algerian hedgehogs (7 males and 7 females), found and caught with the aid of a tracking dog during night transects, which were equipped with backpack radio tags (TW-3 single celled, Biotrack Ltd., UK). Before release, the animals were weighed and sexed. The hedgehogs were classified as juveniles when the weight was less than 400 grams, the rest as adults. In Sweden the European hedgehog juvenile body weight increased linearly from about 280 grams in summer to about 600 g before hibernation (Kristiansson 1984). The Algerian hedgehog body weight also increased linearly, but his weight is about 40% lower than the European hedgehog. According Alcover (2007) Algerian hedgehog weights ranging from 280 grams to 657 grams, however we have found a male that weighed 865 grams. The tag was glued to the back spikes using cyanoacrylate and an activator. Permits and procedures were approved by the Wildlife Department of the Generalitat de Catalunya. The radio receivers used were multi-band ICOM R-20 (ICOM INC., Japan) equipped with a Yagi antenna (Biotrack Ltd., UK). Individual locations were obtained by homing in (White & Garrott 1990) every 15 minutes from sunset until dawn and recorded directly in a 1:5,000 orthophoto maps (source Departament de Medi Ambient i Habitatge, 2005). The hedgehogs appeared to show no alteration signs or modified behaviour during follow-up. An activity category was assigned to each recorded fix: animals at rest or showing no movements (still) and animals in motion (moving).

Habitat selection

The available area for the studied animals was estimated from the Minimum Convex Polygon (MCP) encompassing 100% of the locations (Aebischer *et al.* 1993) (Fig. 1). Habitat availability was assessed using digital habitat maps adapted from 1:50,000 scale Catalan habitat maps (Departament de Medi Ambient i Habitatge 2005), along with 1:5,000 orthophoto maps from the same source. Available habitat types were then manually assigned to one of the following five categories within the population MCP: Forest (including all forested patches); Open (uncultivated open areas such a grassland, fallow land, and private gardens with sparse fruit trees); Crop (intensive arable lands); Urban (streets, buildings and spaces markedly disturbed); and Water (canals and ponds) (Fig. 1), the difference between Open and Crop being the herbaceous or shrubby coverage, which was close to 100% in the Open category, and the lack of protective vegetation stratum in the Crop category. All fixes were then assigned to one of the habitats categories described (Bontadina *et al.* 2002). The Water category was not calculated in the selection analysis because, despite accounting for 4.5% of the population MCP, it was not used by any individual. In order to determine habitat selection were used the method proposed by Neu *et al.* (1974). That method indicates if there are differences between the expected and observed resource use, even if the categorized habitats are selected, rejected or used to availability (Almenar *et al.* 2006). To identify the selected, rejected or used to availability categories was applied the Baylei's selectivity index (Cherry 1996). Selection analysis were conducted with Resource Selection for Windows 1.0 (Fren Leban©).

Space used and foraging distances

Distances travelled and area covered (estimated as the MCP encompassing all locations) was estimated for each individual and night, including only those nights where the individuals had been tracked during all their active hours. Nightly movement was estimated as the sum of minimal distances between correlative fixes, which were recorded every 15 minutes, hence representing a very conservative figure. Comparisons between means of the described measures were carried out using the four possible combinations of gender and age as a factor (Kruskall-Wallis test). Pairwise comparisons were then conducted to test for differences between categories (Mann-Whitney *U* test).

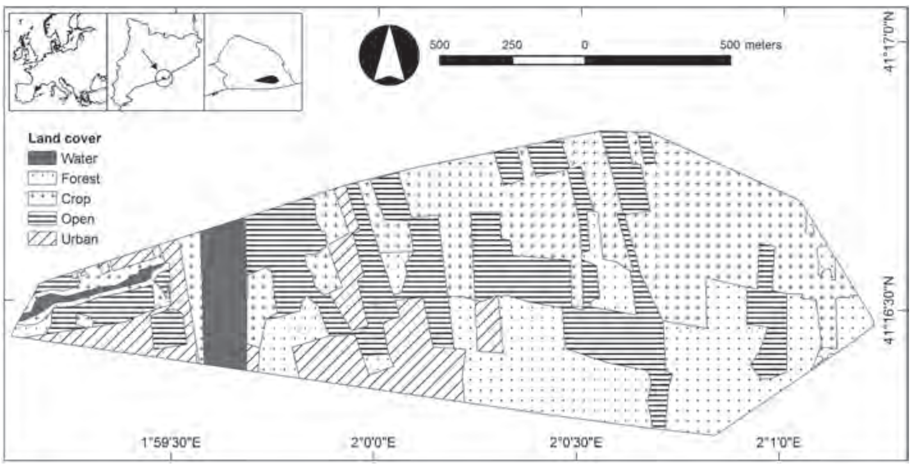

Figure 1. Available habitats enclosed in the communal Minimum Convex Polygon for the 14 radio-tracked Algerian hedgehogs (*Atelerix algirus*).

Home range overlap

To determine the spatial overlap patterns of the individuals the Utilization Distribution Overlap Index (UDOI) was used (Fieberg & Kochanny 2005). Indices based on the utilization distribution, or the probability distribution of an individual or population in space, describe more adequately the overlap between individuals in terms of the amount of space shared rather than the more conventional home range indices (e.g. home range overlap proportion –HR- or home range overlap probability –HPR-), which account for the area covered by individuals regardless of the intensity of use (Fieberg & Kochanny 2005, Robert *et al.* 2012). The full home range was assessed using the 95% isophleth, and all computations regarding spatial use were conducted with the AdehabitatHR package (Calenge 2006, 2007) for R (version 3.0.1; R Development Core Team 2013). Each dyad of individuals was assigned a category according to the gender of its members (three possible outcomes: male-male, female-female or female-male) and a second category according to their age (three possible outcomes: young-young, adult-adult, adult-young), these two categories were then used as factors in the analysis of variance of the overlap index, in search for overlap patterns related to age or sex. Given the non-normal distribution of the overlap indexes, a non-parametric approach was used to test for the presence of such patterns (Kruskall-Wallis).

Results

A total of 1,621 fixes from 14 individuals were obtained, disregarding the four individuals for which fewer than 40 fixes were obtained. 668 fixes corresponded to resting or motionless animals and 953 to foraging or commuting individuals. Foraging areas, estimated as the 95% isopleths, ranged from 1.4 to 98.8 Ha (from 1.4 to 98.8 in adult males, from 4.3 to 29.4 in adult females and from 3.1 to 28.6 in juveniles, see Table 1).

Habitat selection

The considered habitat categories are not used in proportion to their availability (X^2= 32.4933, d.f.= 3, P< 0.0001), therefore selection does not occur at random. According to the simultaneous confidence intervals (Gadj= 541.05, d.f= 3, P< 0.0001) analysis shows significant results for 3 of the 4 categories considered (Table 2). Open category is positively selected and both Forest and Urban have a negative selection, the Crop category showing no significant results. When considering adult males, adult females

Table 1. Main descriptive attributes and statistics for the 14 radio-tracked *Atelerix algirus.*

Ind	Sex	Year	Age	Body mass (g)	Home range (ha[a])	Hours	Nights recorded	Fix rest[b]	Fix active[c]
1	M	2007	J	250	3.1	13:00:00	6	28	23
2	M	2007	A	500	13.5	53:14:00	6	91	49
3	M	2007	J	350	17.8	17:15:00	7	18	41
4	F	2007	A	530	10.4	23:45:00	7	15	72
5	F	2007	J	400	28.6	48:30:00	8	10	48
6	F	2008	A	640	29.4	72:54:00	22	11	124
7	F	2008	A	520	4.3	32:30:00	19	60	59
8	M	2008	A	658	98.8	42:00:00	8	52	110
9	F	2009	A	580	20.4	39:11:00	6	86	136
10	F	2009	A	525	9.0	50:45:00	10	97	116
11	M	2009	A	770	1.4	21:28:00	3	36	44
12	F	2010	A	513	17.3	22:00:00	3	28	45
13	M	2010	J	247	13.9	35:00:00	5	97	41
14	M	2010	A	865	5.6	21:45:00	3	39	45
AVERAGE						35:13:04	8.42	47.7	68.07

[a] Ha. Estimated from the 95% isopleth.
[b] Animal either resting or not showing spatial movement during night.
[c] Animal moving, either foraging or commuting.

and young individuals separately, the simultaneous confidence intervals show similar and significant results for all groups (Gadj= 89.57 - 258.07, d.f= 3, P< 0.0001), urban areas and forests being negatively selected (P< 0.0001), open areas positively selected (P< 0.0001) and only within the young individuals croplands also being negatively selected (P< 0.05), a trend not observed in the overall population or in adults.

Home range, movements and activity

Both distance run and area covered on a nightly basis differed significantly between sex and age groups ($H_{distance}$= 13.99, *d.f*= 3, *P*= 0.002 and H_{area}= 13.213, *d.f*= 3, *P*= 0.004), being the adult male group which showed the highest mobility and hence the largest MCPs (Table 3). Pairwise comparisons between groups showed significant differences between adult males and all other groups, and also between adult females and young males, although regarding only the distance run (Table 3). No significant differences related to age (*H*= 2.67, *d.f*= 2, *P*= 0.264) or gender (*H*= 1.02, *d.f*= 2, *P*= 0.600) were found in the overlap index (UDOI) of the overall home ranges. Animals remained active from June (68.7±12.0% of night time foraging or commuting) to October (55.56±25.83%), and activity clearly declined in November (17.65±4.69%). By the end of November no activity at all was recorded, and the same result was found during some occasional visits in December (n=3).

Roost usage

Three different placement typologies were used to hide the den the animals used as a day roost, which was in 6 reported cases a spherical structure made of foliage, herbaceous vegetation and artificial elements such as waste (plastic strings from the nearby crops): 1) under dense vegetation, either on crop margins, giant canes or vegetated open areas; 2) in crevices of buildings (farm sheds, retaining walls or houses); and 3) piles of logs or wooden boxes. A total of 37 different placements were detected during 79 successful day roost controls, with dense vegetation being the most frequently used (83.8%); also used buildings (8.1%) and piles of logs or wooden boxes (8.1%) (see Table 4). Only three individuals happened to use the same roost on every monitored day. On average each animal was used 2.64 roost, with a maximum of 7 roosts and a minimum of 1 roost.

Table 2. Habitat selection results for *Atelerix algirus* for the analysis proposed by Neu *et al.* (1974). 95% Baylei's confidence intervals are shown for every category, along with their availability and selection.

Category	Confidence intervals		Available proportion	Selection	df	P-value
	Lower	Upper				
Forest	0. 1084	0. 1535	0. 2536	Negative	3	< 0.0001
Open	0. 4786	0. 5453	0.2801	Positive	3	< 0.0001
Crop	0. 3169	0. 3806	0.3439	Indifferent	3	
Urban	0. 0023	0. 0144	0.1224	Negative	3	< 0.0001

Table 3.- Distances travelled and area used on a nightly basis by individuals. Data is pooled according to the gender and age of each animal. Only full nights of radio-tracking are used. Significance of the pairwise comparisons between groups is shown, where *= *P*< 0.05 and ***= *P*< 0.001.

		Distance travelled per night (m)[a]					Area covered per night (Ha)[b]				
		Value		Pairwise comparison			Value		Pairwise comparison		
	Nr	Mean	SD	MJ	FA	FJ	Mean	SD	MJ	FA	FJ
MA	19	1017	615	***	*	*	4.84	5.79	***	*	*
MJ	13	386	357		*		0.59	0.78			
FA	34	694	479	*			1.70	2.04			
FJ	6	491	295				1.13	1.38			

[a] Sum of the distance between locations for the same night and individual.
[b] Minimum Convex Polygon (MCP) encompassing all nightly locations.
[c] number of nights used in the analysis.

Discussion

According to the data obtained, the optimal biotope for the population of Algerian hedgehogs under study is open spaces with plenty of herbaceous and shrub cover, such as fallow or uncultivated fields (environments frequently associated with agriculture), where they seek both shelter and food. Crops are basically a transit zone, where these animals occasionally find food, although less than in the areas with the highest plant cover. Results suggest that young individuals avoid the latter unsheltered spaces, in what may constitute predatory avoidance behaviour. Therefore, fallow fields and other open spaces with large vegetal covers (p.e. margins between fields or hedgerows) are important for their conservation, although, in the study area, and generally in their area of peninsular coastal distribution, loss of open habitats has been constant in recent years, due to building and infrastructure construction activity. In Catalonia, from 1993 to 2009, 171,576.76 ha of open areas have been lost, whereas 65,052.22 ha of urban land and 104,466.69 ha of forest added in the same period (CREAF 2013). Only in Costa Brava (Girona coast) 7,665.91 ha have been urbanized from 1957 to 2003, with subsequent landscape mosaic fragmentation (Martí 2005). The habitat fragmentation is probably the great conservation problem of the species (Fig. 2), as appears to be the case with the European hedgehog (Cahill 2011).

The European hedgehog, sympatric with the Algerian hedgehog in the study area, shows a different habitat selection, frequently foraging and

Table 4. Typology of roosts and number of roosts used per individual.

Ind.	Sex	Age	Nests	Nest type		
				Vegetation	Building	Log piles
1	M	J	2	1	1	
2	M	A	4	3		1
3	M	J	1	1		
4	F	A	2	2		
5	F	J	1		1	
6	F	A	7	7		
7	F	A	6	3	1	2
8	M	A	2	2		
9	F	A	1	1		
10	F	A	2	2		
11	M	A	3	3		
12	F	A	2	2		
13	M	J	2	2		
14	M	A	2	2		
Total			37	31 (83.8%)	3 (8.1 %)	3 (8.1%)

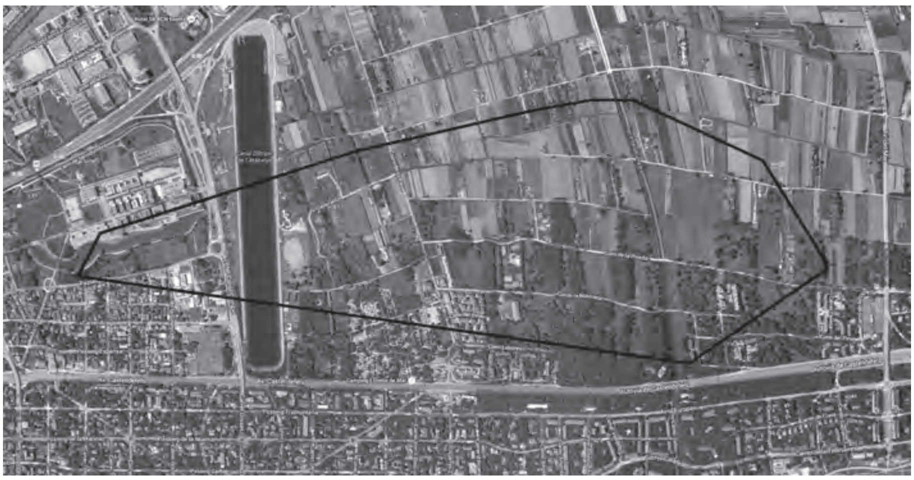

Figure 2. Study area surrounded by infrastructure and urban layout.

roosting in the forest ecotone (Riber 2006, García *et al.* 2009). Moreover, the European hedgehog tends to use a wider range of habitats, from forest to humanized environments, as referred by Reeve (1994). This greater flexibility in habitat selection seems to also exist in Algerian hedgehog populations in North Africa (Sayah *et al.* 2009). The reason for the difference in niche plasticity between populations of the Algerian hedgehog may lie in the sympatric coexistence with the European hedgehog in the studied region: similar ecological responses have been observed in other mammals, such as beech martens *Martes foina* (Erxleben, 1777) being more restricted in the range of habitats used when sympatric with pine martens, *Martes martes* (Linnaeus, 1758) (Virgos & Casanovas 1998, Posluszny *et al.* 2007).

Adult males show higher mobility and larger home ranges than females and youngs, a pattern observed in many other mammals including the closely related European hedgehog (Riber 2006, Haigh 2011). Distances travelled seem lower than those reported for the European hedgehog: 2,042 ± 860 m (Riber 2006) or 1,795 ± 630 m (Morris 1988), compared to the 1,017 ± 615 m obtained in this study for adult males. The difference is unlikely to be due to differences in the intensity of data collection, since fixes were taken every 5 minutes in Riber (2006), every hour in Morris (1988) and every 15 minutes in our study.

The lack of a clear pattern of home range overlap related to gender or age seems consistent with the observed tolerance between foraging individuals. Individuals seem to tolerate the presence of their congeners regardless of their sex or age, thus the home range of a particular individual may overlap with that of many others. Despite their tolerance they do not show any social behaviour except for the mating season, where courtship seems to last a few days (authors observations) and is therefore not limited to the mating alone. Up to three adults (two males and one female) were observed on 10 occasions feeding simultaneously at a cat feeding point, without any evidence of agonistic behaviour besides some snorting and occasional shoving when they came into physical contact, only resulting in the separation of the individuals but never in the expulsion of any of them. Similar behaviour was seen by these individuals towards the cats that frequented the feeder. No change in the foraging behaviour or any confrontation was observed in the 5 reported encounters between foraging hedgehogs. By late June a couple of tagged individuals (adult male and adult female) were observed foraging together for at least three consecutive nights: they remained close to one another (less than 50 metres apart) all night, showing the same activity patterns (foraging and resting at the same time), and using day roosts in the same areas. From the behaviour observed and paths tracked it was difficult to discern whether the male was following the female or vice versa. After 5 nights from the first observation of this social behaviour both individuals returned to their habitual solitary pattern. Females foraging with pups were observed from May to October.

Individuals frequently change their day roost and may use several different roosts within a short period of time (7 for a single individual was recorded), a behaviour also observed in the closely related European hedgehog (Reeve 1994). The roost changes should not attributed to troubles produced by monitoring, since in a suburban or agricultural environment, animals have to be accustomed to human presence nearby. Furthermore, the roost detection was made at a certain distance.

Acknowledgements

We are most grateful to all the field assistants who contributed to the data collection (Albert Peris, Adrià López-Baucells, Ruth G. Ràfols, Andrés Guinea, Josep Torrent, Júlia Lucena, Lara Delgado, Alexis Ribas, Óscar Franco, Mónica Navarro, Nick Lloyd and Víctor Pelayo). To Catalunya Caixa and the Parc Agrari del Baix Llobregat (thanks Anna and Maria Helena for your support) who funded the project. Finally, we are also grateful to the dogs Arboç, Canela and Irlanda.

References

Aebischer N.J., Robertson P.A. & Kenward R.E. 1993. Compositional Analysis of Habitat Use From Animal Radio-Tracking Data. *Ecology,* 74: 1313-1325.

Alcover J.A. 2007. *Atelerix algirus* (Lereboullet, 1842). Pp: 83-85. In: L.J. Palomo, J. Gisbert y J.C. Blanco (eds). *Atlas y Libro Rojo de los mamíferos terrestres de España.* Dirección General para la Biodiversidad-SECEM-SECEMU, Madrid, 586 pp.

Almenar D., Aihartza J., Goiti U., Salsamendi E. & Garin I. 2006. Habitat selection and spatial use by the trawling bat *Myotis capaccinii* (Bonaparte, 1837). *Acta Chiropterologica*, 8(1): 157–167.

Amori G., Hutterer R., Kryštufek B., Yigit N., Mitsain G. & Palomo L.J. 2008. *Atelerix algirus*. The IUCN Red List of Threatened Species. Version 2014.2.<www.iucnredlist.org>. Downloaded on 07 August 2014.

Blanco J.C. 1998. *Mamíferos de España I - Insectívoros, Quirópteros, Primates y Carnívoros de la península Ibérica, Balerares y Canarias*. Editorial Planeta, 457 pp.

Bontadina F., Schofield H. & Naef-Daenzer B. 2002. Radio-tracking reveals that lesser horseshoe bats (*Rhinolophus hipposideros*) forage in woodland. *Journal of Zoology* 258: 281-290.

Cahill S., Llimona F., Tenés A., Carles S. & Cabañeros L. 2011. Radioseguimiento post recuperación de erizos europeos (*Erinaceus europaeus* Linnaeus, 1758) en el Parque Natural de la Sierra de Collserola (Barcelona). *Galemys*, 23 (NE): 63-72.

Calenge C. 2006. The package "adehabitat" for the R software: A tool for the analysis of space and habitat use by animals. *Ecological Modelling,* 197: 516-519.

Calenge C. 2007. Exploring habitat selection by wildlife with adehabitat. *Journal of Statistical Software,* 22: 1-19.

Cherry S. 1996. A comparison of confidence interval methods for habitat use-availability. *Journal of Wildlife Management,* 60: 653-658.

Corbet G.B. 1988. The Family Erinaceidae - a Synthesis of Its Taxonomy, Phylogeny, Ecology and Zoogeography. *Mammal Review,* 18: 117-172.

CREAF 2013. *Mapa de Cobertes del Sòl de Catalunya, MCSC 4ª Edició*. http://creaf.uab.es/mcsc.

Fieberg J. & Kochanny C.O. 2005. Quantifying home-range overlap: The importance of the utilization distribution. *Journal of Wildlife Management,* 69: 1346-1359.

García S. 2010. Estudi sobre els eriçons dels Països Catalans. Pp. 389. In: Folch i Guillén, R. (Dir. Gral) *Història Natural dels Països Catalans. Volum (Suplement) Fauna i Flora*. Fundació Enciclopèdia Catalana, Barcelona.

García S., Puig X. & Peris A. 2009. Actividad y uso del hábitat por parte del erizo europeo *Erinaceus europaeus* Linnaeus, 1758 en el Parque Natural de la Serralada de Marina (Barcelona, Cataluña). *Galemys*, 21:12-23.

Haigh A.J. 2011. The ecology of the European hedgehog (*Erinaceus europaeus*) in rural Ireland. Thesis (Ph D), NUI, 2011 at Department of Biological, Earth and Environmental Sciences, UCC.

Kristiansson, H. 1984. Ecology of a hedgehog *Erinaceus europaeus* population in southern Sweden. Department of Animal Ecology University of Lund, Sweden.

Lapini L. 1999. *Atelerix algirus* (Lereboullet, 1842). Pp. 34-35. In: T. Mitchell-Jones *et al.* (eds). *The atlas of European mammals*. T & AD Poyser Natural History, London.

Martí C. 2005. La transformació del paisatge litoral de la Costa Brava: anàlisi de l'evolució (1957-2003), diagnosi de l'estat actual i prognosi del futur. Tesis doctoral, Universitat de Girona. Consultable a Tesis Doctorals en Xarxa. URL: http://www.tdx.cat/TDX-0510105-083923.

Mcdonald D. & Barret P. 1993. *Mammals of Britain and Europe*. Harper Collins Publishers. 384 pp.

Merrit J.F. 2010. *The biology of Small Mammals.* The Johns Hopkins University Press.

Morales A. & Rofes J. 2008. Early evidence for the Algerian hedgehog in Europe. *Journal of Zoology,* 274: 9-12.

Morris P.A. 1988. A Study of Home Range and Movements in the Hedgehog (*Erinaceus europaeus*). *Journal of Zoology,* 214: 433-449.

Neu C.W., Byers C.R. & Pech J.M. 1974. A technique for analysis of utilization-availability data. *Journal of Wildlife Management,* 38: 541-545.

Posluszny M., Pilot M., Goszczynski J. & Gralak B. 2007. Diet of sympatric pine marten (*Martes martes*) and stone marten (*Martes foina*) identified by genotyping of DNA from faeces. *Annales Zoologici Fennici,* 44: 269-284.

Reeve N. 1994. *Hedgehogs*. T & AD Poyser Natural History, London.

Riber A.B. 2006. Habitat use and behaviour of European hedgehog *Erinaceus europaeus* in a Danish rural area. *Acta Theriologica.* 51: 363-371.

Robert K., Garant D. & Pelletier F. 2012. Keep in touch: Does spatial overlap correlate with contact rate frequency? *Journal of Wildlife Management,* 76: 1670-1675.

Ruiz-Romero S. 1995. Eriçó clar. *Atelerix algirus* Lerebouillet, 1842. Pp. 41-45 In: J. Ruiz-Olmo & A. Aguilar (eds.). *Els Grans mamífers de Catalunya i Andorra*. Lynx Edicions, Barcelona.

Sayah C.M., Robin J.P., Pevet P., Monecke S., Doumandji S. & Saboureau M. 2009. Road Mortality of the Algerian Hedgehog (*Atelerix algirus*) in the Soummam Valley (Algeria). *Revue d'Ecolgie (Terre et Vie)*, 64: 145-156.

Soriguer R.C. & Palomo L.J. 2001. Erizo moruno *Atelerix algirus* (Lereboullet, 1842). Pp: 213-214. In: A. Franco & M. Rodríguez (eds). *Libro Rojo de los Vertebrados Amenazados de Andalucía*. Junta de Andalucía, Sevilla.

Virgos E. & Casanovas J.G. 1998. Distribution patterns of the Stone Marten *Martes foina* (Erxleben, 1777) in Mediterranean mountains of central Spain. *Zeitschrift fur Saugetierkunde-International Journal of Mammalian Biology*, 63: 193-199.

White G.C. & Garrott R.A. 1990. *Analysis of wildlife radio-tracking data*. Academic Press, San Diego.

Associate Editor was Ignasi Torre