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*Yolanda Melero, Pere Aymerich, Juan
Jose Luque-Larena & Joaquim Gosàlbez*

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New insights into social and space use behaviour of the endangered Pyrenean desman (*Galemys pyrenaicus*)

Yolanda Melero · Pere Aymerich ·
Juan Jose Luque-Larena · Joaquim Gosàlbez

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Abstract We describe novel aspects of the social organisation of the Pyrenean desman, *Galemys pyrenaicus*, by studying home range and shelter use behaviour in a local population. A total of 45 individuals were trapped of which 20 provided informative radiotracking data. In contrast to the currently accepted hypothesis [Stone RD. The social organization of the Pyrenean desman (*Galemys pyrenaicus*) as revealed by radiotelemetry. *J Zool* 212:117–129; 1987b; Stone RD, Gorman ML. Social organization of the European mole (*Talpa europaea*) and the Pyrenean desman (*Galemys pyrenaicus*). *Mammal Rev* 15 (1):35–42; 1985] individuals were not strictly territorial. Notably, there was no aggression between conspecifics, with simultaneous use of resting sites (shelters used for more than one hour). Resting sites were not permanent or exclusive for any individual. Individuals shared resting sites simultaneously, regardless of sex or age. Our observations recall for a new evaluation of the social structure and organisation of this species based on the new evidence that reveals

higher frequency of social interactions than previously described. Resting sites may play an important role in the social organisation of the species, for instance by allowing direct and indirect communicative interactions among neighbouring individuals. This finding is of significance for the management (e.g. census and population monitoring) and conservation (e.g. habitat suitability to allow social interactions) of this endemic and seriously threatened unique mammal.

Keywords *Galemys pyrenaicus* · Pyrenean desman · Social organisation · Resting site · Shelter use

Introduction

Small and threatened populations are currently the main focus of conservation biology due to their vulnerability to extinction. Strategies for their conservation entail the development of numerous conservation plans where the overriding factors to consider are the causes of decline and how to reverse them (Mills 2007). Conservation plans generally rely on ecological and management tools such as population viability analysis studies involving modelling and parameterisation of models with field data, genetic exchange programmes, habitat restoration or public education programmes (Beissinger and McCullough 2002). In any case, knowledge of the behaviour and ecology of a species is critical for the development and success of any conservation or management action (Sinclair et al. 2006).

The case of the Pyrenean desman (*Galemys pyrenaicus*) is no exception. This talpid (Mammalia; Insectivora) is currently listed as a vulnerable species in the Red List Categories by the UICN (UICN 2010) and is strictly protected under the Bern Convention (Appendix II) and

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Y. Melero (✉) · P. Aymerich · J. Gosàlbez
Department of Animal Biology (Vertebrates),
University of Barcelona,
Av. Diagonal 645,
08028 Barcelona, Spain
e-mail: melero@ub.edu

J. J. Luque-Larena
Depto. CC Agroforestales, E.T.S. Ingenierías Agrarias,
University of Valladolid,
Palencia, Spain

J. J. Luque-Larena
Instituto Universitario de Investigación
en Gestión Forestal Sostenible,
Madrid, Spain

the EU Habitats and Species Directive (Annexes II and IV). The Pyrenean desman is one of the last two extant species of the Desmanini tribe of Insectivora. The two genera *Desmana* and *Galemys* are unique mammalian taxa of extremely high biodiversity value, and each is currently represented by a single species with declining or unknown population trends (Nowak 1999). The fragile status of *G. pyrenaicus* populations, together with an almost complete lack of knowledge regarding their ecology and behaviour, has made their conservation and management a contemporary challenge for many scientists. Several aspects of the biology and conservation requirements of the species have been addressed in recent decades, including studies on its distribution (Bertrand 1993a; Queiroz et al. 1998; Aymerich et al. 2000; Palomo and Gisbert 2002), morphology (Richard 1986; Richard and Michaud 1975), diet (Bertrand 1993b; Casti n and Gos lbez 1995), general biology (Richard 1986), reproduction (Casti n 1994) and captive behaviour (Richard 1986; Queiroz and Almada 1993). However, understanding how individuals use, and interact in, space and time is an important yet unknown aspect, since may allow key parameters for population management and study, such as density or dispersal, to be determined with precision. The social organisation of *G. pyrenaicus* has only been investigated in a few seminal studies (Stone 1987b; Stone and Gorman 1985), but the successful conservation of targeted populations is difficult to achieve without knowledge of the social organisation of individuals (Caro 1999).

More than two decades have passed since Stone and Gorman's (1985) and (Stone 1987b) published novel data on the social organisation of the Pyrenean desman. These studies described the species as largely solitary with resident male and female couples occupying an exclusive range in which the male's range encloses that of the female, and individuals hold exclusive shelters. This type of organisation assumes that desmans are highly aggressive between conspecifics regardless of sex, except between reproductive couples during breeding bouts (Richard 1985; Richard and V lette Viallarda 1969) or when transient individuals are temporarily tolerated by resident adults (Stone 1987b). This social organisation and the resulting spatial pattern between and within sexes resemble that of other talpid species inhabiting different ecological scenarios, such as the strictly fossorial European moles *Talpa europaea* (Stone and Gorman 1985; Loy et al. 1994).

Stone's work also indicated that each desman maintains a single shelter used exclusively as a nesting site during its lifetime. Even members of reproductive pairs occupied separate individual nesting sites, and encounters were rarely recorded (Stone 1987a, b). The Russian desman *Desmana moschata* has similar adaptations to

semi aquatic life to *G. pyrenaicus* (Surhone et al. 2010). However, physical tolerance and non aggressive interactions between individuals unrelated to mating have been described in this ecologically similar species (Surhone et al. 2010; Nowak 1999).

To our knowledge, there have been no further studies of the behaviour of *G. pyrenaicus* since the late 1980s. The relic and endangered status of the species makes research difficult and scarce. Due to the protected status of the species very few licenses for the capture and tagging of individuals are authorised, and knowledge of its social and spatiotemporal behaviour has not expanded. Stone's (1987b) and Stone and Gorman's (1985) description of non-aggregated aggressive individuals has been the foundation of our current knowledge on the social organisation and spacing of the species and has been used for management purposes, such as estimating population densities (e.g. Nores et al. 1998).

In this study, we aimed to investigate the social and spatial ecology of a local population of *G. pyrenaicus*. Our aim was to contribute to the scarce research on space and shelter use behaviour by the species. This work improves current knowledge of *G. pyrenaicus* ecology and may also contribute to improve design of ongoing and future management and conservation actions.

Materials and methods

Study area

The study was conducted in the river Tor located in the mountainous habitat of the Eastern Pyrenees (UTM 31TCH61). We selected a 4-km stretch of the river, with a mean width of 4 m, mean depth of 0.1–0.4 m, mean slope of 6.5%, a rocky bed, and shoreline covered in dense vegetation. Within this 4 km stretch, we chose a central area of 2 km to carry out more intense annual surveys of individuals. The river Tor is a well-preserved river with no anthropogenic pressure. Winter snowfall and subsequent spring thaws maintain a constant high flow with a peak in April–May but without significant seasonal differences. The mean altitude of the area ranges between 1,200 and 1,400 m, and between 800 and 1,000 mm of precipitation falls regularly throughout the year, the highest levels falling between May and September. Temperatures in the area range from an average of 20 C in summer to –2 C in winter (data from the Catalonian Government, <http://www.gencat.cat>).

The aquatic and semi-aquatic vertebrates that share the habitat with the Pyrenean desman are the brown trout *Salmo trutta*, viperine snake *Natrix maura*, white throated dipper *Cinclus cinclus*, the Eurasian water shrew *Neomys*

fodiens, the water vole *Arvicola sapidus* and the Eurasian otter *Lutra lutra*.

Trapping and radiotracking

Two trapping sessions of 5–7 days each were conducted annually between 2002 and 2004 in the central area, with a total of 28–35 trap days per session, and once in spring 2003 and 2004 in the rest of the river area under study. Complementary trapping sessions of 2 days each were conducted during 2006–2009 with 28 trap nights per session. Trapping was carried out in spring (April to June) and in autumn (September to October) to cover both the reproductive and the non reproductive seasons (Casti n 1994).

Animals were live trapped at night in partially submerged unbaited modified mesh traps based on the design of eel traps. A more detailed description of the trapping methodology and manipulation can be found elsewhere (Aymerich and Gos lbez 2004). Traps were located at appropriate sites (e.g. narrow pathways within the river current), maintaining a separation of 30–300 m between mesh traps, and were checked every 3 h each night (traps were open during daylight hours). After veterinary had assisted immobilisation with anaesthetic, animals were measured, weighed, sexed, aged and classified as either a new capture or a recapture. All manipulated animals were released in the capture area once fully recovered. Animals were classified by sex and age based on the data of Peyre (1961) and Gonz lez et al. (2002). Captured animals were individually identified with a subcutaneous transponder (PIT; ID K162 FDX-B; AEG ID; Trovan Ltd., Madrid, Spain). The transponders weighed approximately 0.95 mg: <1.7% of the lightest individual (body weight 55 g). Individuals captured from 2002 to 2004 were marked with a subcutaneous radiotransmitter (frequency, 150–151; Pip model, BioTrack, Ltd., Wareham, Dorset, UK). These radiotransmitters weighed approximately 2.5–3 g: <5% of the weight of the smallest individual (55 g) and <4.6% of the heaviest individual (68 g).

Trapping was carried out by three accredited biologists and one accredited veterinary, but animal manipulation was carried out only by the veterinary. Approval and accreditations were provided by the Scientific Ethical Committee of the Department of Environment and Housing of the Catalan Government (<http://www20.gencat.cat/portal/site/DAR>), Spain (national article 58-42/2007).

Radiotracking was performed using a RX-8910HE receiver (Televilt International AB) and different multidirectional and bidirectional antennae (for long, medium and short distances) providing a mean accuracy of tagged individual locations of ± 0.2 m. The study area has an extensive arboreal canopy and is not covered by GPS

systems. Therefore, animal position was recorded and mapped using, as a reference, the 100-m signs on the road that runs parallel to the river (at a distance of 1–10 m away, mean=7 m). Radiotracking began 5–8 days after the animal was released to avoid bias due to recovery from manipulation. Animal location was recorded daily; at night, desmans were radiotracked every 1 to 2 h ($\bar{x} = 1.2 \pm 0.3$) when they were active and every 10–20 min when they were inactive-resting in the shelter, to enable prompt detection of renewed activity. During daylight, radiotracking was performed every 30–60 min to detect short bouts (0–4 h) of active behaviour. We used these times on the basis that the species is more active at night and more inactive (in shelter) during daylight. Nocturnal activity has been shown to have two bouts of 3.5 and 5 h in autumn–winter and one bout of 7 h in summer, while diurnal activity is divided in short activity bouts (Stone 1987a; Aymerich and Gos lbez 2004). Radiotracking data allowed us to map the home ranges of the individuals based on the linear distance of the most frequently used waterway (99% of the fixes) (Stone 1987a; Stone 1985).

Resting site sampling

Shelters were considered as resting sites, since we found no evidence of exclusivity of use or nesting behaviour. We considered those refuges that were used for at least 1 h and more than 1 day to be resting sites.

The location of resting sites was recorded using the radiotracking procedures described above. Information on the substratum, distance to the shore, distance between sites and distance of the entrance to the water surface were recorded for each shelter in order to make comparisons with previous descriptions of shelter use (Stone 1987b). Resting sites were grouped into three categories in relation to the location within the home range of the individuals using them: distal sites if located in the upper and lower 20% of the home range, central sites if located in the central 20% of the home range and intermediate sites when located at intermediate ranges. Differences on location of resting sites were analysed by means of *G* test analysis.

Resting site analyses

We built a general linear model (GLM) to assess which factors were associated with the fidelity to resting sites of radiotracked individuals (from 2002 to 2004 in the 4 km stretch) with fidelity as the dependent variable ($N=67$, power of test=0.82). Fidelity to a site is described here as the number of times a resting site was used per individual corrected according to the frequency of radiolocations for the individual. Prior to building the model, a principal

component analysis (PCA) was used to reduce the number of initial factors (sex, location, age, time, season, year and typology based on the substratum).

We also assessed which factors were connected with the number of resting sites used per individual with a GLM ($N=23$, since three individuals changed from juvenile to adult status during the study, power of test=0.73). Counts of the number of resting sites used per individual were also corrected according to the frequency of radiolocations for that individual. A PCA was also used to reduce the number of initial factors (sex, age, season and year).

Results

A total of 45 individuals were trapped, of which 30 were captured during 2002–2004 and 15 during 2006–2009. All individuals were trapped during the first three trapping days; thereafter, captures were always recaptures of tagged individuals. The recapture rate was low, with a total of six recaptured individuals in the central area (four males and two females; Fig. 1). In all cases,

individuals were recaptured within 11–27 weeks of their initial capture.

The 30 individuals trapped during 2002–2004 were marked with transmitters. Overall, we obtained useful radiotracking data from 20 Pyrenean desmans (11 males and nine females; Table 1), of which four males and one female were juvenile at the time of their capture. Individuals were tracked for at least 2 days and for a maximum of 33 days ($\bar{x} = 12.4 \pm 10.1$). The remaining individuals were not radiotracked due to transmitter failure. The tracked individuals used a total of 26 resting sites in the 4-km stretch of river, of which 12 were located in the central area.

Space use behaviour

Three pairs of individuals of opposite sex were found sharing space (F5–M4, F6–M5 and F8–M6) for 1-day radiotracking period, and two pairs of individuals of same sex were found sharing space (F1–F3 and M6–M15) for at least 24- and 7-day periods respectively (Fig. 1 and Table 1). Three adult males (M1, M6 and M8)

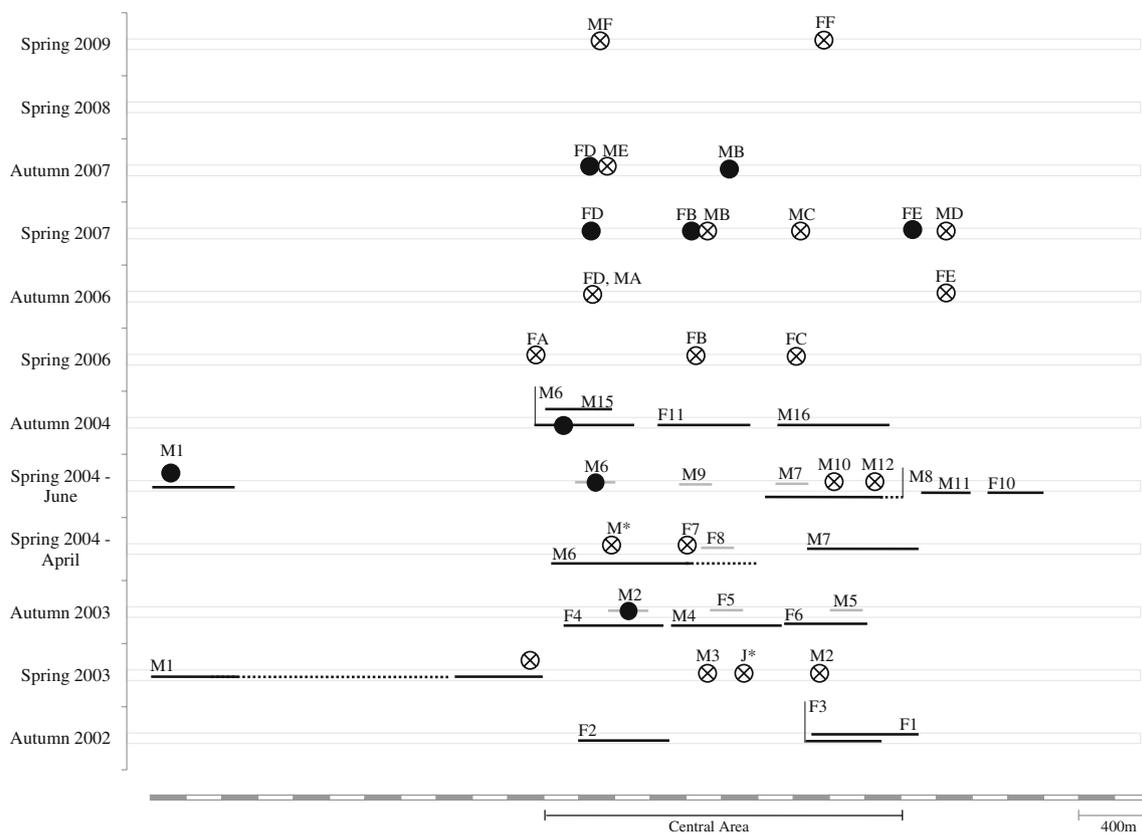


Fig. 1 Scheme of central area represented in a 1:200 scale. Home range of radiotracked individuals is shown as black lines. Grey lines are used when radiotracking data of individuals in the resting sites was obtained, but there was not enough data for home range analyses.

Dotted lines indicate exploratory movements. A crossed circle indicates capture location of not radiotracked individuals. Recaptures are marked as filled circles. Asterisk Juvenile found dead in the river

Table 1 Individual information, date of capture/recapture, size of the home range, number of tracked days and number of resting sites used of radiotracked individuals

Individual	Sex	Age at capture	Date of capture	Date of recapture	Home range (m)	Number of tracked days	Tracked period	No. of resting sites
F1	Female	Adult	24/09/2002		570	25	01–25/10/2002	2
F2	Female	Adult	24/09/2002		520	21	01–24/10/2002	3
F3	Female	Adult	25/09/2002		430	24	02–26/10/2002	3
F4	Female	Adult	06/10/2003		530	9	13–26/10/2002	1
F5	Female	Adult	07/10/2003		–	1	–	1
F6	Female	Adult	08/10/2003		450	8	14–22/10/2002	1
F8	Female	Adult	13/04/2004		–	1	–	1
F9	Female	Juvenile	02/06/2004		–	3	–	1
F10	Female	Juvenile	03/06/2004		350	17	08–03/07/2004	4
F11	Female	Adult	21/09/2004		660	19	27–23/11/2004	1
M1	Male	Adult	23/04/2003	01/06/2004	530–2,300	34	28–19/05/2003 07–04/07/2004	7
M2	Male	Juvenile	24/04/2003	05/10/2003	–	2	–	1
M4	Male	Adult	05/10/2003		620	20	10–05/11/2003	2
M5	Male	Adult	05/10/2003		–	2	–	2
M6	Male	Adult	13/04/2004	02/06/2004 29/09/2004	550–1,350	33	18–12/04/2004 04–30/09/2004	6
M7	Male	Adult	19/04/2004		670	4	26–29/04/2004	4
M8	Male	Juvenile	01/06/2004		650	16	07–02/07/2004	2
M9	Male	Juvenile	01/06/2004		–	3	–	2
M11	Male	Juvenile	03/06/2004		320	7	07–14/06/2004	2
M15	Male	Adult	19/09/2004		450	7	24–30/09/2004	2
M16	Male	Adult	23/09/2004		510	8	29–14/10/2004	1

performed exploratory movements outside their home range for 1 or 2 days and were later found to have settled in the newly explored area. In addition, M1 and M6 changed their home ranges between seasons (Fig. 1). All cases of establishment of new individuals corresponded to adult individuals arriving in areas previously occupied by other adult or juvenile desmans. The mean home range was 523 ± 50.85 m.

Resting site location and typology

We recorded a total of 26 resting sites in the 4-km stretch of river, located at a mean distance of 64.40 ± 21.60 cm from the shore (range, 30–110 cm). The average distance between resting sites used by an individual was 248.33 ± 163.14 m, without taking into account three outlier cases at a distance of 2, 1,500 and 1,700 m. All entrances to the resting sites were submerged (54.54%) or partially submerged (45.46%). Resting sites were described based on their typology regarding the substratum as follows: type 1, cavities of rocks of width ≤ 0.5 m (13.04%); type 2, cavities of rocks of width ≥ 0.5 m (78.26%); and type 3, rocks that formed artificial structures such as walls or small dams (8.70%).

Resting sites were more frequently located in the distal and intermediate home range of male individuals during autumn ($G=60.86$, $p<0.001$), but no differences were found during spring ($p=0.11$). There were no differences for females in the location of their resting sites during spring or autumn ($p>0.98$; Fig. 2).

Resting site sharing behaviour

Radiotracking in the central area revealed that resting sites were used by more than one individual in the same season and in different years. This was observed for all sites except sites 10, 13, 14, and 26 (Fig. 3). We observed simultaneous use by more than one individual at five of the shared resting sites located in the central area. These individuals were of the same or opposite sex and all were adults (Table 2). The pair F1–F3 was found during autumn winter (October, 2002) on 21 occasions (61% of radiotracked days) on seven consecutive days. However, they were never found at the same site during brief nocturnal rest periods. The pair M6–M15 shared two different resting sites at which they were found resting together on two occasions during both diurnal and nocturnal resting periods.

Fig. 2 Percentage of number of sites in spring (a) and autumn (b) and frequency of use of the resting sites in spring (c) and autumn (d) related to their location by male and female

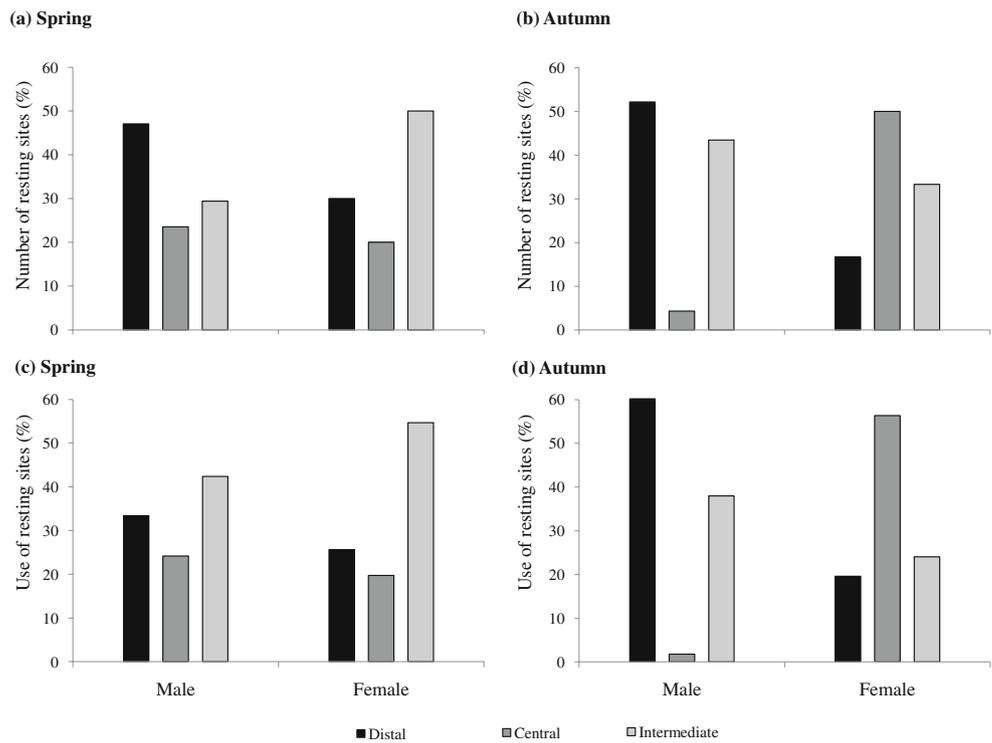


Fig. 3 Scheme of central area represented in a 1:200 scale. Seasonal location of the resting sites (*lower bar*) and individuals found per site (*seasonal bars*) are shown

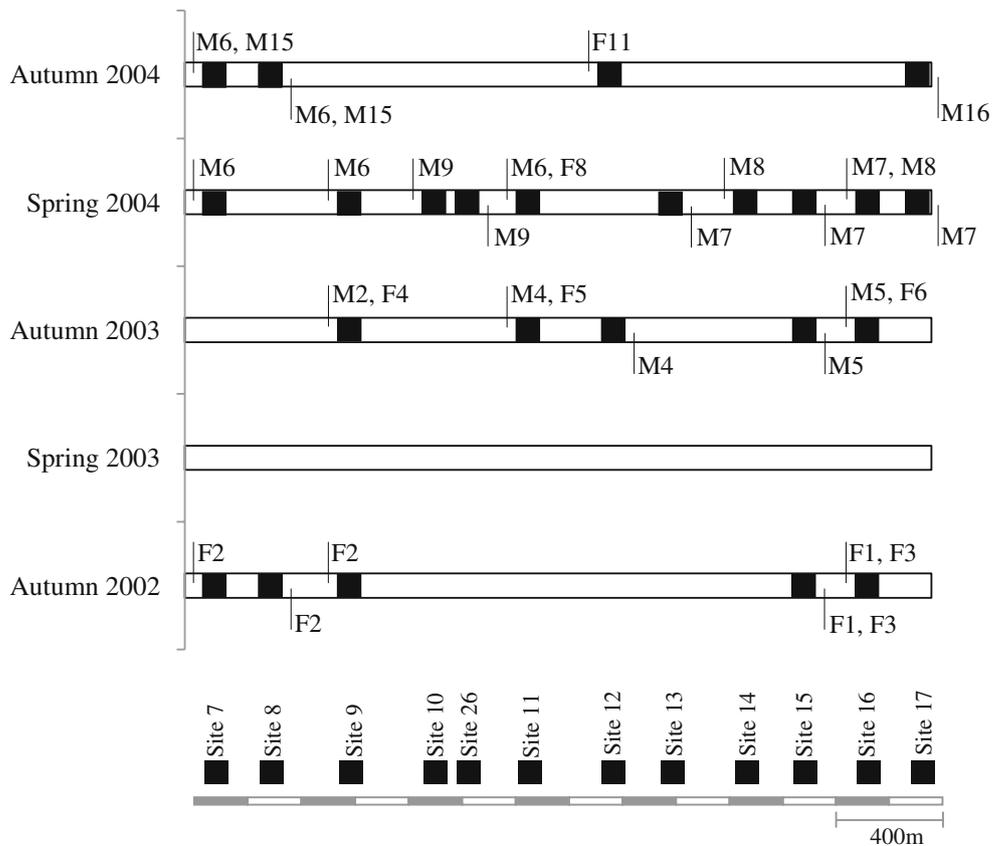


Table 2 Simultaneous sharing behaviour of resting sites in the central area

Resting site	Individuals	Season	Year	Time	Counts
Site 15	F1–F3	Autumn	2002	Day	7 (21)
Site 9	M2–F4	Autumn	2003	Day and night	1 (2)*
Site 11	M4–F5	Autumn	2003	Day and night	1 (2)*
Site 16	M5–F6	Autumn	2003	Day and night	1 (4)*
Site 7	M6–M15	Autumn	2004	Day and night	2 (7)

Counts stand for number of days individuals were found sharing the sites simultaneously versus number of radiotracking days (in parenthesis)

*One of the individuals could not be further radiotracked due to collar failure/lost

Resting site use

In regard to site fidelity, and based on the PCA, we reduced the number of factors to five (Table 3). We decided not to consider location since it was in correlation with sex ($p=0.02$) and year, which was correlated with season ($p<0.001$) in the GLM model. The model revealed that fidelity to the resting sites by individuals was affected by time ($p=0.0003$) but not by sex, age, season or substratum typology (all $p>0.14$; Fig. 4).

In relation to the number of resting sites used per individual, the PCA reduced the number of factors to three (Table 3) since the analysis revealed a correlation between season and year ($p=0.02$). During the studied period, differences in the number of sites due to sex, age and season were not significant (all $p>0.35$; Fig. 5). Each individual used between one and seven resting sites with an average of 2.33 ± 1.68 shelters per individual ($N=20$).

Discussion

This study incorporates new preliminary data that question the broadly accepted view that the social organisation of the

Table 3 Principal component analysis results for factors affecting fidelity to resting site and number of resting site used

Component	Fidelity		No. of sites	
	Eigenvalue	Cumulative percentage	Eigenvalue	Cumulative percentage
1	2.30	32.95	2.08	52.01
2	1.31	51.70	0.93	75.35
3	1.06	66.85	0.59	90.20
4	0.85	79.04	0.39	
5	0.79	90.36		
6	0.37			
7	0.30			

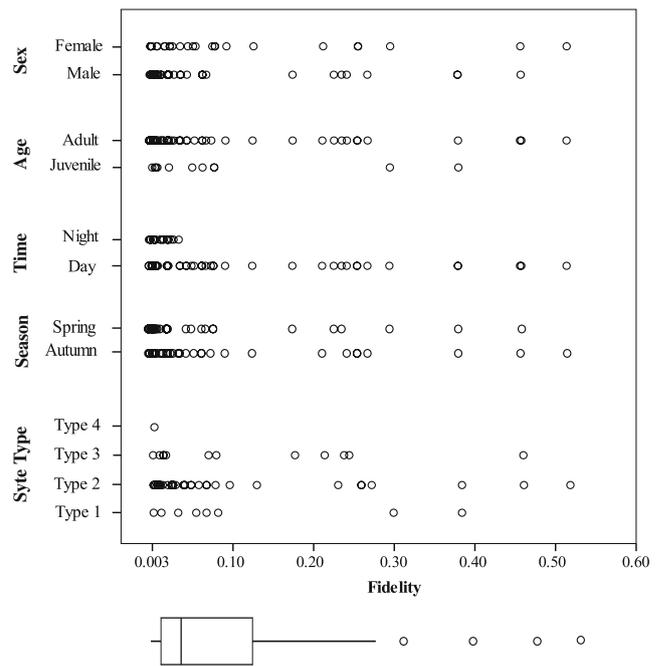


Fig. 4 Box plot of resting site fidelity and its distribution in relation to age and sex of individuals and to season and time

Pyrenean desman is based on strictly territorial and aggressive behaviour between individuals (Richard 1985; Richard and Valette Viallarda 1969) and the absence of simultaneous use of safe spaces such as resting sites among adult individuals, including male–female breeding couples (Stone 1987a, b; Stone 1985; Stone and Gorman 1985). Our findings also contradict the common view that each individual desman permanently uses a single resting site within its territory (Stone 1987b).

Space use behaviour

Although our study presents limitations due to few individuals being tracked simultaneously and the short

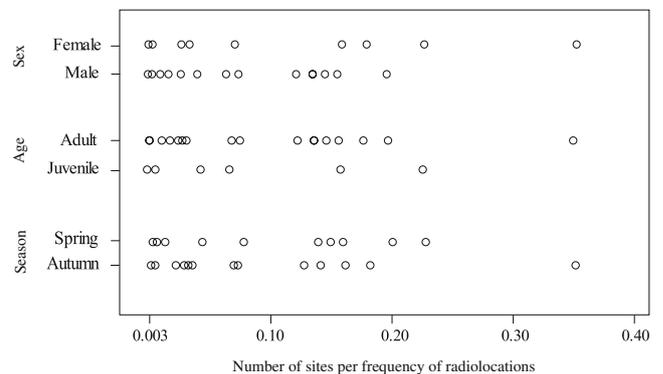


Fig. 5 Box plot of number of sites (per frequency of radiolocations per individual) and its distribution in relation to age and sex of individuals and to season

duration of the radiotransmitters, the trapping and radio-tracking data allowed us to observe a completely novel scenario regarding the social behaviour of *G. pyrenaicus* in which (a) the species uses specific home ranges but not a territorial behaviour (hence, individuals might share the space with several conspecifics of the same or opposite sex and age) and (b) the dispersal behaviour of this species may be more complex than previously accepted, and the establishment of new incoming individuals in locations previously occupied by other resident desman could be not exclusive to juveniles.

Resting site sharing and use

The fact that the use of refuges by radio-tagged desman differed from previous data (Stone and Gorman 1985; Stone (1987a, b) also gives support for a new social scenario. Specifically, based on our observations, (a) resting sites along the shores of the study area commonly being used by pairs of individuals, regardless of their sex and age and (b) resting sites being shared simultaneously by conspecific adults of the same or opposite sex, we believe that the species may not have the solitary and aggressive character previously accepted

Moreover, individuals had more than one main resting site revealing significant higher fidelity at night. This might be consequence of the species behaviour regarding timing of activity. Although a primary nocturnal species, individuals usually show short active trips during daylight (Stone 1987a) and, therefore, more frequent changes of resting than at night.

Resting sites were permanent structures between seasons and years, being continuously used by the different individuals established in the area at any point in time. This continuous use of these refuges by subsequent desmans suggests that these may constitute a key resource for the species. Based on our results, site characteristics and, in particular, the type of entrance may influence their choice of resting site. It is possible that resting sites not only play a role in individual protection and resting behaviour but may also have a role in communication and social cohesion among individuals. In any case, the relative value of refuge characteristics for desmans needs and deserves further study.

In concordance with (Stone 1987a), the entrances observed in our study were all partially submerged or completely submerged. Overall, resting site choice seemed to depend on the level of the entrance compared to the water surface and, in the case of males, to the location within the home range but not on the substratum at the resting site. The fact that males used resting sites on distal and intermediate locations more frequently during autumn but that both sexes do not show difference in the use of distal, intermediate and central sites during the spring reproductive season might be related to resources availability and social behaviour.

However, further investigation is needed to find the reason to this result since our data do not discern it.

Territorial and aggressive behaviour

In contrast to previous hypotheses, our results indicated that individuals are not territorial or aggressive with conspecifics of the same sex. Furthermore, during our studies, we observed non-aggressive behaviour in other rivers, such as the river Alp (Segre basin, Eastern Pyrenees), where we found two males and two females sharing their resting sites, and the river Castellana (Tet basin, France), with two females trapped concurrently in the river (Aymerich and Gosàlbez 2004). Previous results on aggressive behaviour among conspecific desmans (Richard and Valette Viallarda 1969; Niethammer 1970; Richard 1985) could have been influenced by an alteration in the behaviour of individuals as a consequence of their captive status. No other studies have been carried out in the wild until now, and thus, the territorial aggressive hypothesis (resembling mole behaviour; Stone and Gorman 1985) has been assumed to be correct (Cabral et al. 2005; Castián 1994; Queiroz et al. 1998).

Site and range fidelity

Until now, it has been assumed that desmans always show strong site fidelity towards their permanent resting sites and territories. However, we observed changes in the individuals' resting sites over time and (re-)utilisation of sites by different individuals. Furthermore, we obtained a low recapture rate throughout time. This might be explained by a semi-nomadic behaviour with plasticity to move to a different area depending on the resources availability and the sexual activity. However, this cannot be currently confirmed, and further investigation is being done to clarify these results.

Social organisation of Pyrenean desman

Based on our observations, we recall a new evaluation of the social structure and organisation of this species. We have provided, with preliminary data, evidence of social interactions between individuals, allowing direct and indirect communicative interactions among neighbouring individuals and non-territorial behaviour. Resting sites may play an important role in the social organisation of the species, for instance, by allowing direct and indirect communicative interactions among neighbouring individuals. Our finding is consistent with the behaviour of the most similar species, the Russian desman *D. moschata* (Onufrenya and Onufrenya 1993). *D. moschata* has been described as semi nomadic, social and non-territorial (Onufrenya and Onufrenya 1993; Nowak 1999). This similarity between the two species should not be surprising since the Russian

desman is phylogenetically the closest species to the Pyrenean desman (Nowak 1999). The social organisation of *D. moschata* is advantageous for fluctuating environmental conditions and has an adaptive role (Nowak 1999). *G. pyrenaicus* inhabits non-fluctuating habitats but depends on the fluctuating availability of aquatic macroinvertebrate prey (Casti n and Gos lbez 1995); the proposed social organisation of *D. moschata* might also be advantageous for the species by providing the flexibility to move and distribute along the river depending on prey availability and not on the presence of conspecifics.

Conservation implications

This finding is of significance for the conservation of this endemic and seriously threatened unique mammal. In general, water quality has been thought of as the main factor affecting its conservation; meanwhile, its habitat and the availability of resting sites have rarely been taken into account. If the sharing and use of the resting play a role in the social organisation of the species, they should be considered in conservation strategies. We recommend the incorporation of management guidelines for habitat suitability to allow social interactions, with a focus on riparian shorelines, given their relation with the availability of resting sites.

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