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Spatial behaviour of European mink *Mustela lutreola* and polecat *Mustela putorius* in southwestern France

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The European mink *Mustela lutreola* Linnaeus, 1761 and the European polecat *Mustela putorius* Linnaeus, 1758 are sympatric in southwestern France. They are related species but the former is highly threatened whereas the latter maintains good populations. Nine European mink and 14 polecats were radiotracked in the Landes de Gascogne region to compare their space use and to identify appropriate conservation measures for the European mink. Resting animals were located once a day and active animals were tracked by continuous monitoring. European mink had linear home ranges whose sizes were larger than predicted by Johnson's model (mean ± SD = 2971 ± 1888 ha in males and 257 ± 113 ha in females). They travelled long inter-day distances (1.4 ± 1.9 km in males and 0.4 ± 0.6 km in females). Polecats had home ranges of various shapes (linear, circular or combined) and their sizes were consistent with Johnson's model (707 ± 779 ha in males and 51 ± 58 ha in females). They also had shorter inter-day distances than mink (0.7 ± 0.9 km in males and 0.2 ± 0.4 km in females). However male polecats had longer activity bouts than male mink. Thus European mink exhibit large movements between small and distant activity areas while polecats compensate for their smaller range by a higher activity in restricted areas. The behaviour of the European mink appears to be an adaptation to habitats scattered over linear ranges. This extensive use of space suggests that conservation of this endangered species cannot be achieved in the confinement of Europe's natural reserves. Conservation plans should aim at maintaining high quality habitats along entire river networks and ensuring safe movements for the animals, preventing particularly the risk of collisions with vehicles.

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Introduction

Although the European mink *Mustela lutreola* Linnaeus, 1761 and the European polecat *Mustela putorius* Linnaeus, 1758 are closely related species (Youngman 1982, Davison *et al.* 2000, Sato *et al.* 2003, Lodé *et al.* 2005), they have very different conservation statuses. The European mink is an endangered species that has already disappeared from most of its former range (Youngman 1982, Maran and Henttonen 1995) and is declining in all its current range (Maran *et al.* 1998, Goeta and Kranz 1999, Tumanov 1999, Sidorovich 2000, Maizeret *et al.* 2002, Ceña 2003, Palazón *et al.* 2003). The European polecat seems to maintain good populations over most of its range (Blandford 1987) and is listed as "lower risk, least concern" by the International Union for the Conservation of Nature (2007 IUCN Red List of Threatened Species, www.iucnredlist.org). It is declining in some countries (Birks and Kitchener 1999, Baghli and Verhagen 2003) but is expanding in Eastern Europe and Britain (Walton 1970, Brzeziński *et al.* 1992, Birks 2000).

In the Landes de Gascogne region, southwestern France, local trappers frequently capture both species in the same places and this sympatry provided the opportunity to compare their habitat and spatial use. In a first paper (Fournier *et al.* 2007), we investigated the habitat utilisation of the two species and showed that European mink preferentially use flooded wetlands with dense vegetation whereas polecats balance terrestrial and aquatic habitats. These differences in habitat selection should have consequences on the spacing patterns of the animals and particularly on the size of their home range and the extent of their movements.

This question is of great importance for European mink conservation policies. In the highly artificial landscapes of Western Europe, conservation actions are usually implemented over small areas, distant from one another, and the problem of connectivity frequently arises for species like the European mink. Its solution is dependant on a better knowledge of animal requirements for space and travelling routes. In the present study, we compared the space use of the two species in order to assess if the strict association of European mink with watercourses causes an increase in movements of the animals.

In carnivores, the size of home ranges is generally considered to be positively correlated with body mass (McNab 1963, Harestad and Bunnell 1979, Gittleman and Harvey 1982, Lindstedt *et al.* 1986, Powell 1994, Kelt and Van Vuren 1999). In mustelids, Johnson *et al.* (2000) showed that the intra-specific variability of home range size pointed out by several authors (Thompson and Colgan 1987, Buskirk and MacDonald 1989, Herrmann 1994, Phillips *et al.* 1998) is too small to prevent a correlation of home range size of the different species to their body mass. They calculated that these two factors are linked by the function $HR = 2.26M^{1.31}$.

The daily travelling distance inside home ranges is also correlated with animal body mass in a large set of mammals (Garland 1983). Reviewing 27 species of carnivorous mammals, Goszczyński (1986) showed that daily movements increase exponentially with body mass according to the function aBM^b. Whereas the exponent b is approximately the same in mustelids, canids and felids (b = 0.58 to 0.60), the coefficient a is higher in mustelids (5.76) than in canids (3.23) and felids (1.69). This means that mustelids move over greater distances than animals with the same weight in other families of carnivorous mammals. This greater mobility must be taken into account when considering conservation policies of mustelid species.

In this study, we first considered the characteristics of home ranges (shape, association to watercourses and size), then the mobility of animals within their home ranges (daily travelling distance) and finally the duration of the activity bouts of animals.

Material and methods

Study area

The Landes de Gascogne region (44°20'N, 0°35'W, 2 to 180 m a.s.l.) of southwestern France occupies over 10 000 km^2 and is mainly covered by a highly productive pine forest *Pinus pinaster*. Whereas a vast sandy plateau is devoted to pine plantations, the river valleys are unsuitable for intensive forestry and are occupied by marshes and unexploited deciduous forests. Our study was mainly carried out in the valleys of the Eyre and Ciron Rivers (Fig. 1).

Captures and animal manipulations

Animals were captured from 1996 to 1999 with non--commercial live traps (60 × 15 × 15 cm) baited with sardines. Traps were set along rivers and streams and around marshes, where European mink are more likely to be present (Maizeret *et al.* 1998, 2002). Trapping sessions were organized from mid-September to early May, avoiding the breeding season. A total of 14 731 trap-nights resulted in the capture of 11 European mink and 15 polecats, all being at least eight months of age. Individuals captured were immobilized with 200 µg/kg of medetomidine combined with 10 mg/kg of ketamine, antagonized by 1000 µg/kg atipamezole (Fournier-Chambrillon *et al.* 2003a). Procedures included a clinical examination, tissue and blood sampling and radio-transmitter fitting. Animals were released on their capture site four or five days after manipulation. Captures and animal manipulations were licensed by the French Ministry of the Environment.

Radiotracking

Radiotracking operations were carried out from March 1996 to August 1999, out of the breeding season for females and during the rutting season for males in order to radiotrack each sex when it is most active (Table 1). Initially, we tried to fit animals with 20 g radiocollars (BIOTRACK, Dorset BH20 5AX, U.K. and AVM Instrument Compagny, LTD, Colfax, California 95713, USA) but all types of collars tested caused injuries (Fournier *et al.* 2007). Next, we successfully tested implantable transmitters: two models IMP/150/L-HP and IMP/150/L, weighing 18 g each, were provided by Telonics (Mesa, Arizona 85204-6699, USA), for an operational life of 2.4 and 4 months respectively. TRX 1000S receivers (Wildlife Materials, Carbondale, Illinois 62901, USA) were used, either connected to a 7-element yagi antenna mounted on a vehicle or to a 4-element yagi hand-held antenna.

Collar-injured animals were excluded from the analysis and, in total, 9 mink and 14 polecats provided data (Table 1). Each animal was located once a day, by triangulation from a vehicle, to identify its "diurnal location" during its resting period. To study spatial behaviour during activity, 2 or 3 continuous monitoring sessions of 8 to 12 hours were performed each month for each animal (ie a total of 24

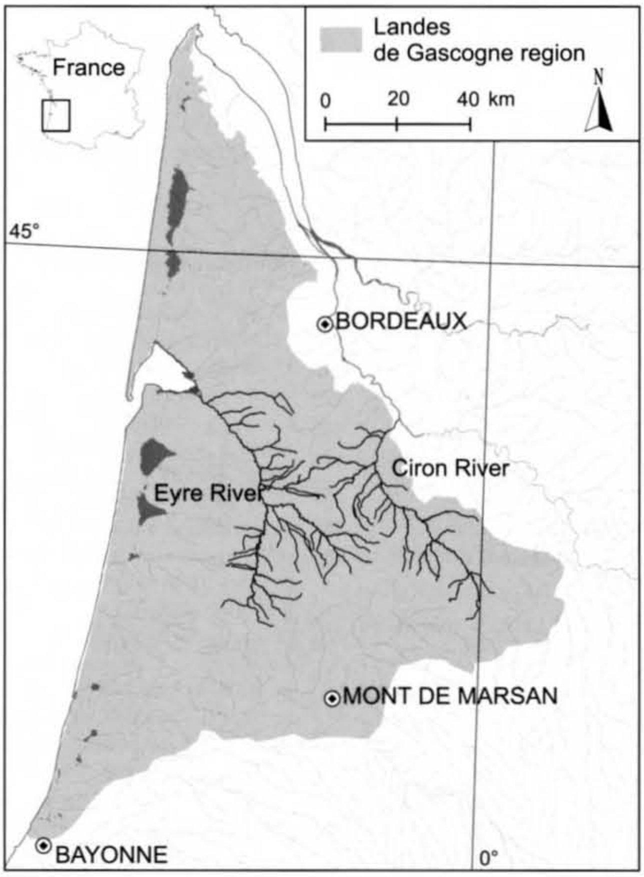

Fig. 1. The Landes de Gascogne region and the location of the Eyre and Ciron Rivers.

Table 1. Structure of European mink *Mustela lutreola* and polecat *Mustela putorius* home ranges in southwestern France as indicated by "cluster analysis" (with M1E for mink number 1, River Eyre, P2C for polecat number 2, River Ciron). Total home range size is given by the 100% minimum convex polygon. Shape of home range: 1 – linear home range, 2 – circular home range, 3 – combination of 1 and 2. Home range length means length of stream included and was therefore only calculated when home range was obviously extended out along a stream.

Animal ID	Sex	Body mass (g)	Tracking period	Number of fixes	Total home range size (ha)	Percentage of locations defining the core areas (%)	Number of core areas	Total core area size (ha)	Shape of home range	Home range length (m)
European mink										
Animals travelling over different river basin										
M5C	M	810	14/3/1998–7/10/1998 and 10/3/1999–20/5/1999	446	152 300	90	4	715		
M10C	M	770	6/3/1999–6/8/1999	151	5642	87	4	270		
Animals used for statistical analysis of home range (duration > 2 months on the same river)										
M5C	M	810	23/4/1998–29/7/1998	198	4856	98	2	567	1	13 300
M10C	M	770	2/5/1999–6/8/1999	124	1080	95	2	55	1	16 200
M3E	M	823	26/12/1996–25/3/1997	121	2978	85	1	66	1	9400
M1E	F	443	13/3/1996–17/5/1996	116	396	95	3	35	1	10 130
M2C	F	458	24/9/1997–26/4/1998 and 11/12/1998–19/03/1999	317	195	98	6	79	1	5620
M3C	F	540	19/12/1997–12/4/1998	127	141	98	2	23	1	2520
M4C	F	520	6/1/1998–26/3/1998	87	296	96	2	76	1	6110
Other animals										
M1C	M	940	24/2/1997–5/3/1997	43	20	100	3	20	1	1160
M6C	M	840	27/4/1998–13/5/1998	15	142	95	1	64	1	6670
Polecats										
Animals used for statistical analysis of home range (duration > 2 months on the same river)										
P1C	M	960	22/4/1997–19/6/1997	569	376	98	5	126	2	–
P4C	M	967	30/1/1998–5/8/1998	506	942	98	4	127	3	–
P12C	M	1250	22/3/1999–20/7/1999	136	2178	95	5	145	2	–
P4E	M	963	23/10/1996–16/1/1997	170	52	95	3	10	2	–
P6E	M	1304	24/2/1997–24/11/1997	665	454	95	4	23	3	–
P11E	M	895	3/10/1997–13/2/1998	179	242	95	1	9	1	3550
P2C	F	570	20/1/1998–25/3/1998	48	16	100	2	16	2	–
P3C	F	660	30/1/1998–16/4/1998	242	19	100	1	19	1	1060
P5C	F	510	4/12/1998–16/3/1999	321	117	95	3	33	3	–
Other animals										
P11C	M	1070	12/3/1999–2/4/1999	59	896	98	4	336	3	–
P1E	M	777	9/3/1996–29/3/1996	15	2	–	–	–	–	–
P2E	M	965	13/1/1997–19/2/1997	111	20	100	1	20	1	600
P10E	M	915	5/5/1997–26/5/1997	173	137	95	1	9	2	–
P14E	F	640	22/11/1997–30/12/1997	19	19	100	1	19	1	1100

hours per month). During these sessions animals were located every 10 minutes using 2 vehicle-mounted receivers. Assuming a maximum receiver-transmitter distance of 500 m (most bearings were recorded within 500 m from the animal), and a bearing uncertainty of ± 10° for the peak signal, the linear uncertainty was approximately ± 50 m, according to Janeau's (1998) assessment of radiotracking accuracy.

Data processing

Firstly, we examined the size and shape of the home ranges. We ordered all available radio-locations by date for each individual (diurnal locations of resting animals and continuous tracking of active animals). Data were processed using RANGES V® software (Kenward and Hodder 1996). We selected the "Cluster analysis" method (Kenward 1987), with the nearest-neighbour rule, this method being the most suitable for fitting complicated home ranges and for separating range cores. The "Kernel" method was exceedingly sensitive to initial parameters (smoothing factor and dimensions of the grid), and consequently made it difficult to compare individuals and species. RANGES V® gives the contour lines at 5% intervals or according to user's choice. We examined the overall perimeter (100%, ie total home range size), then the contour lines for levels 70, 80, 85, 90, 95, 98%, and selected the contour that gave the best fit with visible clusters of locations (that we named core areas).

We compared the home range sizes between species and sexes using a Kruskal-Wallis test, and compared them with the theoretical values provided by the function of Johnson *et al.* (2000) using the Wilcoxon's signed-ranks test (SPSS® 9.0 1999). We also examined the distribution of the locations and the shape of the home ranges according to the position of the major bed of the rivers. We categorized the home ranges by considering three classes of shapes: 1 – linear home range spreading out along rivers and streams, 2 – circular home range and 3 – combination of shapes 1 and 2. We estimated the home range length when this parameter made sense, ie in cases where the home range obviously stretched along a stream. For all statistical analyses, we excluded animals located over less than 2 months.

Secondly, we considered the distance between diurnal locations as an index of mobility. Contrary to home range size, this index is not biased by the duration tracking periods. We selected the "diurnal locations" recorded at one-day intervals of all animals. Distances between successive locations were calculated. We analysed the fidelity of animals to their diurnal location through the percent of locations being identical to the previous day. We categorized the successions of diurnal locations into three groups: 1 – less than 800 m (movements within core areas), 2 – 800 to 2000 m (mainly movements from a core area to another), 3 – more than 2000 m (long range movements, including exceptional movements). Thereby we distinguished between periods of "sedentarity" (class 1), "mobility" (class 2), and "long range movements" (class 3), and calculated their duration. All comparisons between individuals, sexes and species were tested using a factorial analysis of variance (SPSS® 9.0 1999) after rank transformation (Iman 1974, Skillings and Mack 1981). Differences in fidelity to diurnal location between sex-species groups were tested by a χ^2-test followed by a multiple comparison test (Sokal and Rohlf 1995).

Finally, we considered the locations collected during the activity bouts. We defined the "prospected area" as the zone within 50 m (on both sides) of the observed trajectory (Fournier *et al.* 2007). We also calculated the duration of the activity bouts, the travelling distance (sum of all the distances between successive locations) and their relation. Relations between duration of activity bouts and travelling distance were computed using regression analysis: the slopes were compared using the *t*-test. Mean values are given with standard deviations; tests were considered significant if $p < 0.05$.

Results

Area and structure of home ranges

Two male mink M5C and M10C moved over very large areas, 152 300 ha and 5642 ha respectively (Table 1). M5C moved westward from the Ciron River to the Eyre River basin (35 km apart) at the end of March 1998 and came back four months later. In mid-March 1999, M10C also left the Ciron River and moved eastward to two other valleys before coming back two months later. The structure of M5C and M10C home ranges was only taken into account for the periods in which they stayed on the same river for more than two months.

Home ranges were significantly different between species and sexes ($H = 10.53$, df = 3, $p = 0.015$). The largest home ranges (Table 1) were observed in male mink (2971 ± 1888 ha, range = 1080–4856 ha, $n = 3$), far beyond male polecats (707 ± 779 ha, range = 52–2178 ha, $n = 6$), female mink (257 ± 113 ha, range = 141–396 ha, $n = 4$) and female polecats (51 ± 58 ha, range = 16–117 ha, $n = 3$). In mink, home ranges were larger than predicted by Johnson's model ($T = 28, p = 0.022, n = 7$), whereas in polecats, they were in agreement with the model ($T = 31, p = 0.343, n = 9$).

The animals did not use their home ranges in a homogeneous way and, for all individuals, it was possible to define core areas including more than 85% of the locations (Tables 1). Male mink had the largest core areas (229 ± 292 ha, range = 55–567 ha, $n = 3$) and only slight differences were noticed among the other groups (male polecats: 73 ± 66 ha, range = 9–145 ha, $n = 6$; female mink: 53 ± 28 ha, range = 23–79 ha, $n = 4$; female polecats: 23 ± 9 ha, range = 16–33 ha, n = 3): the differences were not significant (H = 3.35, df = 3, p = 0.341).

Figure 2 gives typical examples of the distribution of locations of several European mink and polecats in the Ciron valley, showing the shapes of their home ranges. In mink, all home ranges were linear (Table 1), spreading out from 2.5 up to 16.2 km along the flood plains of streams and rivers (mean: 13.0 ± 3.4 km, range = 9.4–16.2 km, n = 3 in males and 6.1 ± 3.1 km, range = 2.5–10.1 km, n = 4 in females). In polecat, three shapes of home range were observed (Table 1): four home ranges were linear but shorter than mink ranges (3.5 km and 1.1 km long respectively for one male and one female being radiotracked for more than two months), five were circular, tangential to the river, and four were a combination of the two previous shapes.

Mobility within the home range

In mink, the mean inter-day distance was 1.4 ± 1.9 km (range = 0–11.0 km, n = 385) for males and 0.4 ± 0.6 km (range = 0–3.9 km, n = 326) for females whereas in polecat it was 0.7 ± 0.9 km (range = 0–4.9 km, n = 464) for males and 0.2 ± 0.4 km (range = 0–2.0 km, n = 149) for females (Fig. 3). The test for between-subjects effects of sex and species confirmed significant differences (F = 8.93, df = 1, p = 0.007 between sexes; F =

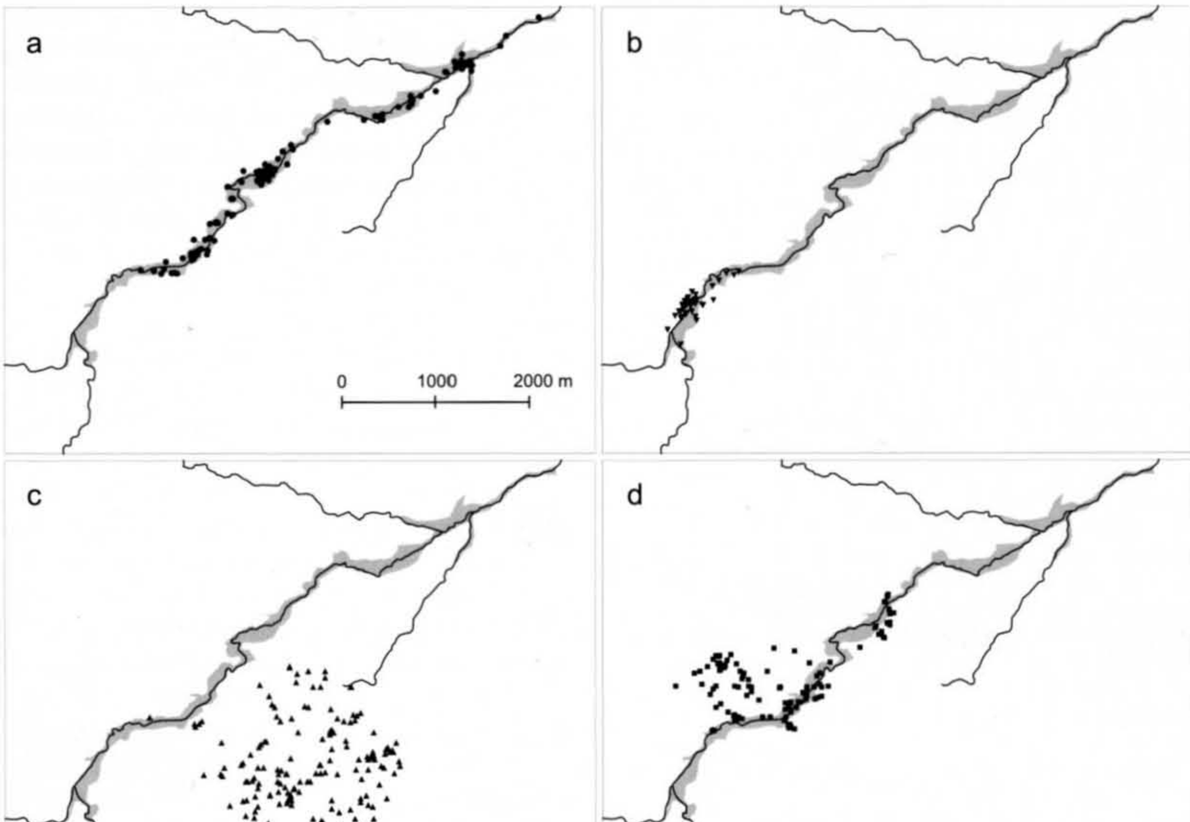

Fig. 2. Typical examples of the space pattern of the European mink *Mustela lutreola* and the polecat *Mustela putorius* in the Ciron valley, showing the shapes of their home ranges: a– Linear home range of an European mink; b– Linear home range of a polecat; c– Circular home range of a polecat; d– Combination of linear and circular home range of a polecat. Shaded: limits of the flood plain.

6.95, df = 1, $p = 0.015$ between species) with high individual variability. The sex-species interaction was not significant ($F = 0.05$, df = 1, $p = 0.825$). Mink were significantly more mobile than polecats, and males more than females in both species, female polecats being the least mobile. The same pattern was observed for the longest distances between successive locations, with 38 distances over 4000 m (9,8%) observed for male mink and only three (2.0%) for male polecats. There was no movement over 4000 m for female mink or female polecats, all distances for the latter being under 2000 m. Significant differences were observed in the fidelity to the diurnal location ($\chi^2 = 98.9$, df = 3, $p < 0.005$). Female polecats revealed a very high rate of reoccupation (63%), significantly higher than female mink ($\chi^2 = 37.5$, df = 1, $p < 0.005$), male polecats ($\chi^2 = 27.4$, df = 1, $p < 0.005$) or male mink ($\chi^2 = 97.3$, df = 1, $p < 0.005$). Conversely, male mink showed a low rate of fidelity to their diurnal locations (19%), significantly lower than female mink ($\chi^2 = 18.6$, df = 1, $p < 0.005$) or male polecats ($\chi^2 = 38.8$, df = 1, $p < 0.005$). Female mink (33%) and male polecats (39%) were intermediate and not significantly different ($\chi^2 = 2.5$, df = 1, $p > 0.1$).

The duration of "sedentary periods" (number of consecutive days within 0–800 m), was different between sexes and species (Fig. 4). Effects of species ($F = 4.27$, df = 1, $p = 0.044$) and sex ($F = 5.63$, df = 1, $p = 0.021$) were significant but once again, because of a high individual variability, the sex-species interaction was not significant ($F = 0.55$, df = 1, $p = 0.463$). Female polecats were sedentary for longer than the three other groups. For "mobility" and "long range movements", no significant difference of duration was noticed between sexes and species, except that no distance over 2000 m was registered for female polecats, as previously mentioned.

Analysis of activity bouts

The standard area associated with activity bouts (Fig. 5) showed a slight but significant difference between species ($F = 5.06$, df = 1, $p = 0.035$), polecats visiting larger areas than mink. No difference between sexes was significant ($F = 1.41$, df = 1, $p = 0.247$), although

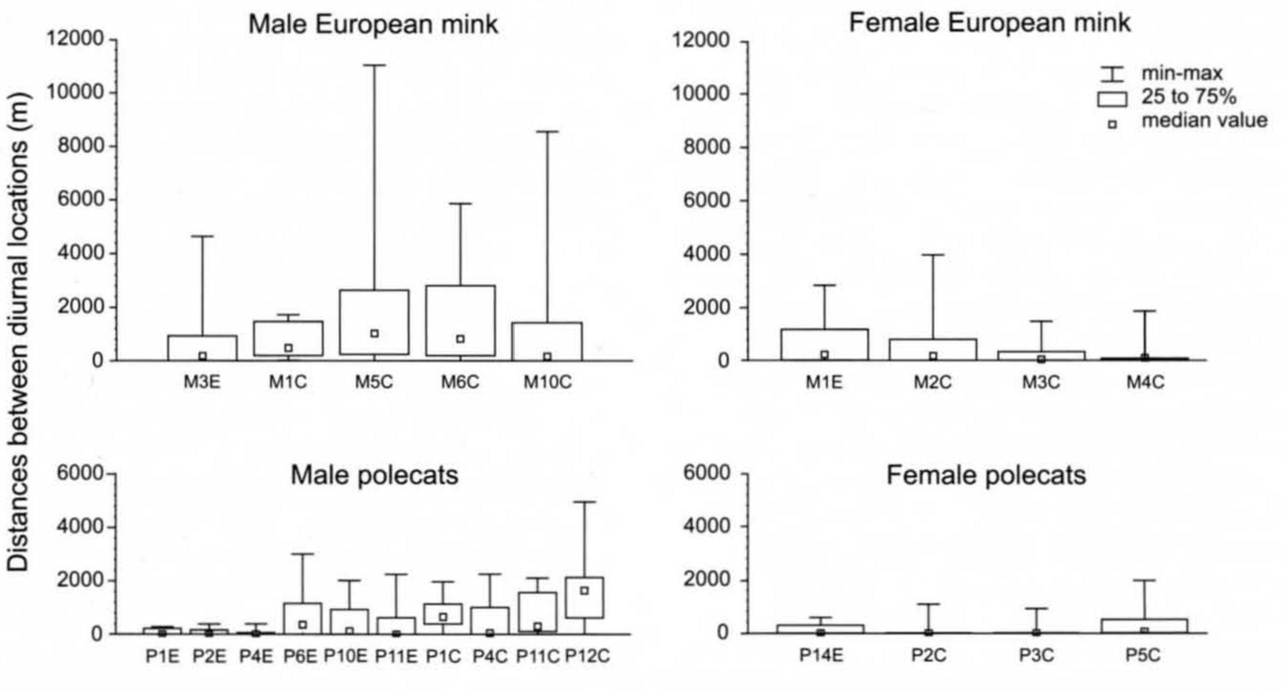

Fig. 3. Individual median values of the distance between diurnal locations of male and female European mink *Mustela lutreola* and polecats *Mustela putorius*.

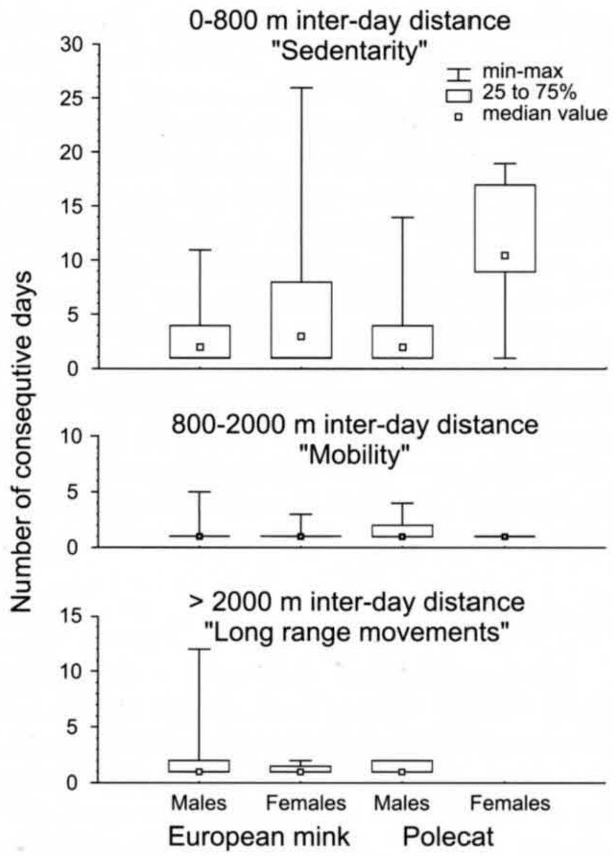

Fig. 4. Median number of consecutive diurnal locations within three classes of distance for 5 male and 4 female European mink *Mustela lutreola* and for 10 male and 3 female polecats *Mustela putorius*.

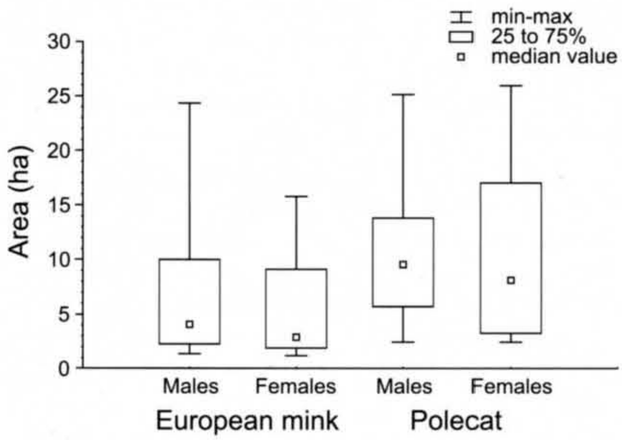

Fig. 5. Median prospected area during activity bouts by 3 male and 4 female European mink *Mustela lutreola* and 9 male and 2 female polecats *Mustela putorius*.

males visited slightly larger areas than females. The main difference was observed between male polecats and female mink (F = 8.03, df = 1, p = 0.008).

Duration of activity bouts and travelling distance were highly correlated (Fig. 6) and the comparison of regression slopes effect of sex and species. Male polecats showed a steeper slope than females of both species and male mink (t = 2.611, p < 0.01 and t = 2.845, p < 0.01, respectively). No difference occurred between females (t = 0.014) nor between male and female mink (t = 0.076). Male polecats covered longer distances throughout longer activity bouts.

Discussion

It is difficult to compare our home range areas with literature data because of a lack of consistency in evaluation methods. Most studies used the minimum convex polygon method, either on European mink (Ceña 2003) or on polecats (Weber 1989a, Roger 1990, Brzeziński *et al.* 1992, Lodé 1993 and 1996, Birks and Kitchener 1999, Baghli and Verhagen 2004). For linear home ranges, home range length is less ambiguous. In European mink, Palazón and Ruiz-Olmo (1998) in Spain reported values ranging from 2.9 to 11.4 km for males (n = 4) and 5.14 km for one female but most individuals were radiotracked only for a few days. Garin *et al.* (2002) recorded lengths ranging from 11.1 to 16.8 km for 5 males and lengths ranging from 3.6 to 6.0 km for 2 females, individuals being radiotracked for 2 to 8 months. Ceña (2003) was able to track larger numbers of individuals for 3 to 34 months and he found average home range lengths of 9.7 ± 4.9 km for males (n = 21) and 4.9 ± 4.9 km for females (n = 25). Our data are close to these results, even slightly higher.

In polecats, available data about home range lengths are very scarce. Only Brzeziński *et al.* (1992) studied polecats living in riparian habitats and measured winter home range lengths ranging from 1.0 to 3.5 km in males and from 0.7 to 1.7 km in females, close to our results.

European mink home range areas were larger than predicted by Johnson's model whereas

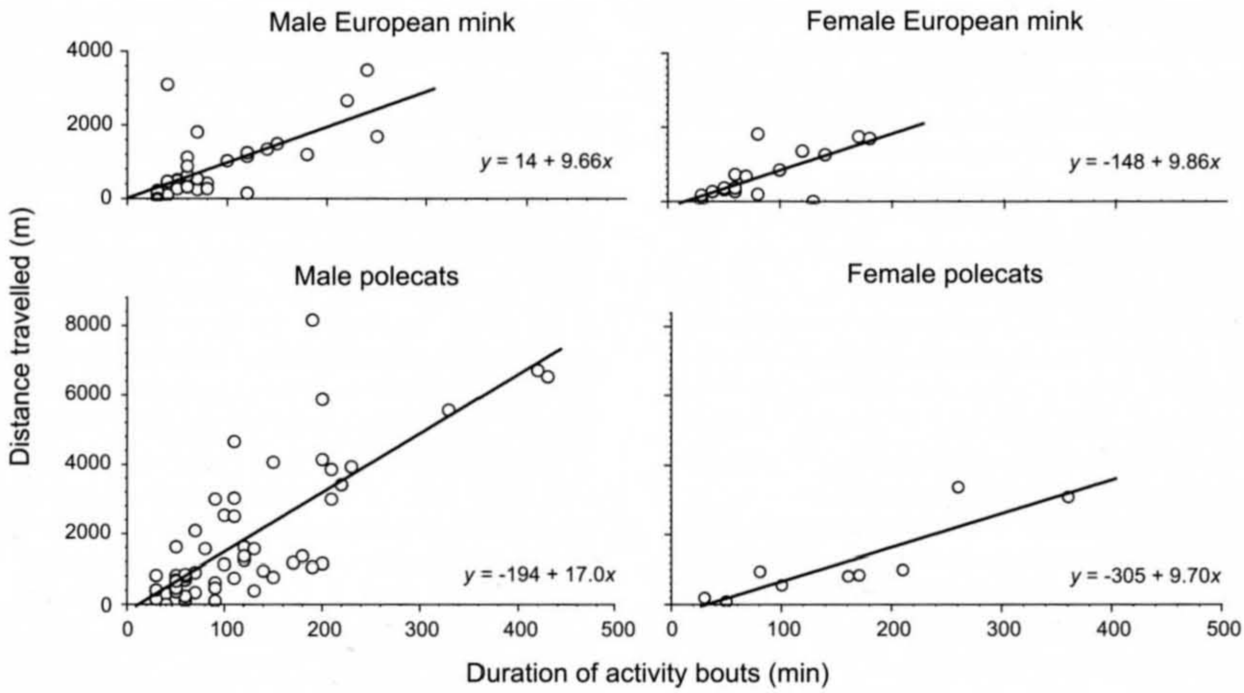

Fig. 6. Relation between the duration of activity bouts and the distance travelled in 3 male and 3 female European mink *Mustela lutreola* and 9 male and 2 female polecats *Mustela putorius*.

polecat home ranges were in agreement with this model, as Baghli and Verhagen's (2004) found in Luxembourg. The large size of European mink home ranges is probably related both to the distribution of suitable habitats for food (MacDonald 1983) and shelter, and to the foraging strategy of the species. Our previous study showed that preferred habitats of mink (open marshes and flooded woodlands, highly productive areas and valuable shelters) were very restricted along the rivers and covered only 2% of the study area (Fournier *et al.* 2007). Conversely, polecats used a wider variety of habitats, including the most widely distributed: pine forest, meadows, oak woodland and bushes in summer, pine forest, moorlands and willow-alder stands in winter.

Inter-day distances for European mink in Spain were reported by Palazón (1998). The mean (± SD) results, 1.3 ± 1.5 km for males (n = 9) and 0.7 ± 0.8 km for females (n = 3) are close to ours. Unfortunately, there are no literature data available for polecats.

Polecat "sedentarity" was supported in our study by a high number of inter-day distances lower than 800 m, particularly in females, and by a high fidelity to diurnal locations in both sexes. On the other hand, polecats visited larger areas than mink during their activity bouts. Male polecats also displayed longer activity bouts and covered longer distances than mink of both sexes, as well as than female polecats. Similar differences between polecat sexes were reported in Luxembourg by Baghli and Verhagen (2004 and 2005) both for the average distance covered per night (3.1 km for males and 0.8 km for females) and for the duration of activity bouts (66.9 minutes for males and 48.7 minutes for females). In both cases data are similar to ours.

Thus, the two semi-aquatic mustelids display very different patterns of space use. European mink have larger home ranges, they make frequent long-distance movements from one core area to another and make only short stays inside these core areas. They also display short activity bouts which are probably related to food resources concentrated in small areas. Lodé (1999) similarly showed that polecat activity duration was shorter when animals exploited prey with an aggregative distribution and Zalewski *et al.* (2004) also showed a reduction of activity in pine martens *Martes martes* when the density of prey increased. The spatial behaviour of the European mink is clearly an adaptation to restricted habitats, scattered over large linear areas. Polecats occupy small home ranges which males cover actively during long activity bouts while females are more sedentary and less active. In conclusion, European mink display restricted activity over large ranges whereas polecats have an intense activity inside smaller ranges.

In addition to the spatial behaviour of individuals inside their home range, very long-distance movements were observed in two male mink. Such behaviour is mentioned for example by Weber (1989a) in European polecats, Gerell (1970), Birks (1989) and Niemimaa (1995) in American mink and by Arthur *et al.* (1989) in fishers *Martes pennanti*. These authors suppose that these movements outside the home ranges are often related to the mating behaviour.

Implications for European mink conservation

Male European mink have home range areas over four times larger than male polecats and five time larger than female polecats. For home range lengths, differences are of the same order (four times longer in males and twice as long in females). The conservation strategy for this mustelid should take into account this extensive use of space. First, it should aim to maintain high habitat quality (swampy areas with permanent water and dense vegetation) over entire river networks, on very large areas. For the European mink, the minimum viable population size (able to maintain 90% of the original heterozygosity and to fulfil the demographic stochasticity) was evaluated to be from 364 to 693 individuals participating in breeding, which should be divided into 10 sub-populations containing at least 30–40 breeding individuals (Maran 2003a, b). Assuming an average home range length of 13 km for males and 6 km for females, such a population would stretch over 1492–2841 km of watercourse and each of the subpopulations would cover 123–164 km of watercourse. European mink are unlikely to survive in the confinement of Europe's small restricted natural reserves. The conservation strategy should also aim at ensuring safer movement for the animals, and particularly at limiting the risks of collisions with vehicles. Traffic collisions are one of the main causes of European mink mortality in France (Fournier-Chambrillon *et al.* 2003b) and in Spain (Arambarri *et al.* 1997) and, for a threatened species like the European mink, even a slight increase of mortality can lead to a no-return situation. Collisions with vehicles can be avoided by creating underway passes and erecting special fences to prevent road crossings at high-risk spots.

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