



Short Note

Resting and denning sites of European mink in the northern Iberian Peninsula (Western Europe)

Francisco PALOMARES^{1,*}, José Vicente LÓPEZ-BAO², Garbiñe TELLETXE³, Juan Carlos CEÑA⁴, Pascal FOURNIER⁵,
Gloria GIRALDA⁶, Fermín URRÁ⁷

¹Estación Biológica de Doñana, CSIC, Avda. Américo Vespucio s/n, 41092, Seville, Spain

²Research Unit of Biodiversity (UO/CSIC/PA), Oviedo University, 33600-Mieres, Spain

³URTZEL Estudios Ambientales, Elizaga 18, 31638, Eugi, Spain

⁴C/ Estambreira 13-3 B, 36006 Logroño, Spain

⁵GREGE, Route de Préchac, 33730 Villandraut, France

⁶Gobierno de Navarra. C/ González Tablas, 9, 31005 Pamplona, Spain

⁷Gestión Ambiental de Navarra, Padre Adoain, 219-Bajo, 31015 Pamplona, Spain

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Abstract

We recorded resting and breeding sites used by the endangered European mink (*Mustela lutreola*) inhabiting Western Europe (Foral Community of Navarre). Over a sample size of 22 radio-tracked mink (10 adult females, 7 adult males, 2 young females, and 3 young males) between March 2007 and February 2009, we found that European mink mainly rested within brambles and reeds (39.7% for each type, $n=156$), regardless of seasons and age-sex classes. On average, the resting site re-use rate was 1.3 (range=1–4.3). Nine out of 10 breeding dens were located in lagoons or tributaries. The only one located along a main river course lost the litter due to flooding. Eight out of 10 breeding dens were in bramble patches. Thick and helophytic vegetation should be prioritised in management plans aimed at improving the conservation status of this species. Promoting this vegetation would favour adequate resting and breeding sites for European mink. A focus on improving vegetation around lagoons or tributaries can help to minimise flooding during the breeding period.

Resting and denning sites provide animals and their offspring with protection from weather conditions and predation during inactive periods and breeding. This is particularly important in small species that often suffer from thermoregulation problems or that can be killed by several predators (Weber, 1989; Genovesi and Boitani, 1997; Palomares and Caro, 1999; Tannerfeldt et al., 2003). The study of the characteristics of resting and breeding sites is of paramount importance for conservation and management, as interventions oriented to improve their availability and quality are common (e.g., Mcgee et al., 2006; Aubry et al., 2013).

The European mink (*Mustela lutreola*) is a small, critically endangered European mustelid (Maran et al., 2011), with only a few populations located in Eastern and Western Europe (Sidorovich, 2000; Palomares, 1991; Ruíz-Olmo and Palazón, 1991; Maizeret et al., 2002). Mink populations in both regions are in decline (Lodé et al., 2001; Maran et al., 2011), and general concern has emerged focused on improving their status (Palazón, 2010). Suitable refuges for mink to rest and establish their dens may be a limiting factor in some areas (Lodé et al., 2001; Zabala et al., 2003). Therefore, knowledge about the resting and breeding sites used by minks is important to inform recovery plans and delineate effective conservation interventions to preserve and restore refuge areas for the species. In this study, we studied characteristics of resting and breeding sites used by free-ranging European mink in a western population of the species. We expected that mink use con-

cealed sites such as thick vegetation patches and underground dens for resting and similar structures far from flood risk areas for breeding.

The study was conducted in the Arga and Aragón Rivers in the Foral Community of Navarre (northern Spain; Fig. 1) from March 2007 to February 2009. The lower reaches of the Aragón (42°29'–42°39' N, 1°78'–1°47' W) and Arga (42°29'–42°44' N, 1°81'–1°78' W) rivers are included in the Natura 2000 network due to a strong representation of Mediterranean river forests with poplars, *Populus* sp., and willow, *Salix* sp., as the dominant tree species. Patches of brambles, *Rubus* sp., are common around water courses, and in some places there are small lakes with abundant reedbeds, *Phragmites australis*. Most of the floodplains surrounding rivers have been occupied by agricultural lands or poplar plantations in recent decades. Dikes and breakwater defences were built in the past to defend agricultural and forestry plantations from flooding. The Arga River was canalized to protect downstream towns from floods, which are common in both rivers (Ollero-Ojeda, 2000). Such flooding sometimes coincides with the breeding season of mink, which occurs from April to June (Palazón, 2010).

European mink were captured in two sections of 25 and 35 km of fluvial courses and wetlands of the Arga and Aragón Rivers, respectively, including the riverbed and the wide network of lagoons, channels and irrigation ditches located along its borders, in areas with previous knowledge of the presence of the species (Fournier-Chambrillon et al. *in press*). Within each area, 180 box-traps (60 × 15 × 15 cm) baited with fish were set at intervals of 100 m along the border of rivers and the associated lagoons and tributaries. Trapping sessions took place from 2007 to 2008 in the Arga River and in 2007 in the Aragón River, and

*Corresponding author

Email address: ffpaloma@ebd.csic.es (Francisco PALOMARES)

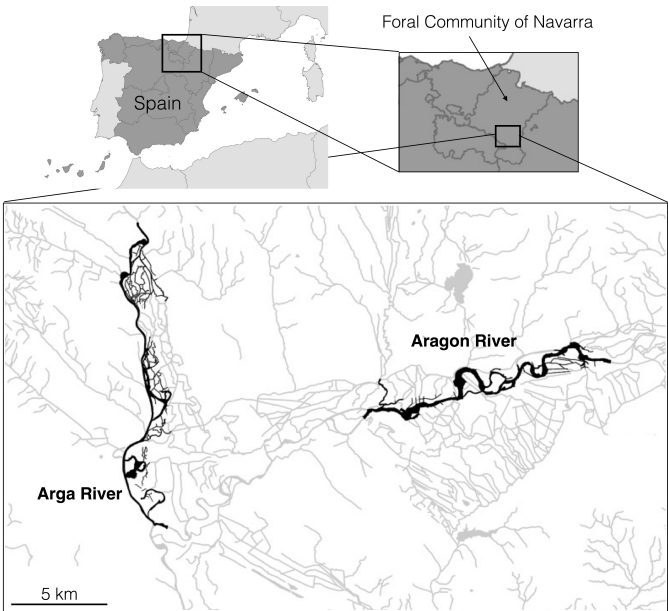


Figure 1 – Map of the study area showing the situation of the Arga and Aragón Rivers in the Foral Community of Navarra and Spain where resting sites of 22 radio-tracked European mink were studied between March 2007 and February 2009.

were carried out during two periods per year, pre-breeding (March) and post-breeding (October–November) periods of species (Palazón, 2010). Each trapping session spanned a total of 10 days.

Capture, tagging and manipulation were performed following the Guidelines of the American Society of Mammalogists (Sikes and Gannon, 2011) and the Directive 2010/63/UE of European Union for animals used in research and under the permission of the Service of Biodiversity Conservation of Navarra Government. Once captured, animals were transported to a veterinarian clinic located in the centre of the study area to implant a sterilized intraperitoneal radio-transmitter. Animals were immobilized, either with an intramuscular injection of ketamine (Imalgene® 1000, Merial SAS) combined with xylazine (Rompun® 2%, Bayer), or with an intramuscular injection of medetomidine (Domitor®, Pfizer) combined with ketamine (Kétamine 500®, Virbac), and reversed with atipamezole (Antisedan®, Pfizer; Fournier-Chambrillon et al. *in press*). Radio-transmitters were designed for mink and were provided with movement and mortality sensors (Biotrack®, ATSC®, TELONICS®, models 150-STP and 130-HP; Fournier et al., 2001; Fournier-Chambrillon et al., 2003a). The size and weight of the transmitters were 66×17 mm and 18 g (1.4–2.6% of body mass) for males, and 59×11 mm and 9 g (1.3–2.5% of body mass) for females. Animals received anti-inflammatory and long-acting antibiotic to prevent infections, and were released on their capture site 24 to 48 hours after manipulation. Procedures were performed by a trained veterinary with strong experience on European mink manipulation. No animal was lost due to the manipulation process.

Animals were sexed and aged according the following classes: adults (>1 years old; individuals with adult body measurements captured in spring or autumn, and with teeth partly abraded and with tartar, and individuals with adult body measurements captured in spring, with new teeth without abrasion or tartar) and young (<1 year old; individuals captured in autumn, with new teeth without abrasion or tartar). All mink were radio-located one and two times daily, or for six hour periods with locations every two hours, four days every week during the breeding seasons of 2007 and 2008. Locations of resting mink were obtained by homing-in. We considered a resting place to be locations where mink were inactive during daylight, and a breeding den locations where an adult female was repeatedly located during the breeding period (April–May; Palazón, 2010).

Study rivers often present heavy flooding episodes in winter and spring (Ollero-Ojeda, 2000), which might affect litter survival. We determined the probability of the den being flooded in a period of 2.3, 5, 10 and 25 years (i.e., to be located in an area where a flooding episode is likely in these time intervals), using the available maps about flooding risk generated by the Navarra Government.

Twenty-eight individuals were captured and radio-tagged between 2007 and 2009, although information on resting sites was obtained for 22 mink (10 adult females, 7 adult males, 2 young females, and 3 young males). A total of 158 locations in resting sites were obtained during the study period, with an average of 7.1 locations per individual (SE=1.46, range=1–22), and a total number of different resting sites of 111 (mean=5.05, SE=0.90, range=1–16, n=22 mink). These 111 resting sites were normally used only once (96 cases), although two resting sites were used two times, six were used three times, four were used four times, and one was used five, six and eight times. On average, resting site re-use rate was 1.3 (SE=0.16, range=1–4.3, n=22 individuals), and no differences between age-sex classes were detected (Kruskal-Wallis test, H=0.51, df=2, p=0.78; young males and females grouped for analysis). In no cases were different individuals located at the same resting sites.

European mink were recorded resting in burrows, breakwaters, between woods or roots, within reeds and within brambles, although the last two were the most common sites used (39.7% for each type, n=156 resting sites; Tab. 1). In some cases, there were other types of vegetation intermixed with brambles and reeds. In a few cases, it was possible to confirm that mink used natural burrows or burrows between breakwaters (7.1 and 9.0%, respectively; Tab. 1). The origin of natural burrows included the common rat, *Rattus norvegicus* on one occasion, and water vole, *Arvicola amphibius* on another (trails around dens were built by pushing away and cutting grass, typical signs of common rat and water vole, respectively; Román, 2010). Some doubt remained about whether or not animals using thick vegetation were indeed using burrows. On the few occasions where the use of burrows could be checked, they were considered as burrows in the data presented in Tab. 1. On the other hand, on other occasions, it could be confirmed that there were no burrows at the sites where mink were resting. Grouping data between colder (December–March) and warmer (April–November) months, no differences in resting sites used were detected ($\chi^2=0.22$, df=2, p=0.90; data grouped as brambles, reeds and others,

Table 1 – Resting sites used by radio-tracked European mink in the Arga and Aragón Rivers (Foral Community of Navarra; northern Spain) between March 2007 and February 2009.

Type of resting site	Number of cases				Number of individuals		
	Overall	Adult females	Adult males	Young	Overall	Females	Males
Burrow	11	8	3	0	6	3	3
Breakwater	14	5	6	3	5	2	3
Reed	62 ^a	28	19	15	13	8	5
Between woods	5	1	1	3	3	1	2
Between roots	2	1	1	0	2	1	1
Brambles	62 ^b	29	18	15	18	10	8
Total	156	72	48	36	22	12	10

^a in three cases reeds were intermixed with vegetation types other than brambles.
^b in 21 cases brambles were intermixed with other vegetation types.

for analysis). All the age-sex classes considered mainly used brambles and reeds as resting sites in similar proportions (Tab. 1).

Ten breeding dens were located during the study period (five in 2007 and five in 2008), one for each of ten different females. All dens were located in lagoons or tributaries except one that was located along a main river course. The female that established the breeding den along the main river course lost her litter after a flooding event. This den was located in an area with a high probability of flooding over a period of 2.3 years. However, the rest of the breeding dens were located in sections where flooding events were likely to happen every 25 years.

Eight den sites were within brambles (7 on slopes in lagoons and tributaries, 1 on the edge of an irrigation ditch) and one between reeds in a riverbank. In most cases, it was not possible to determine if there were associated burrows, although in two cases burrows were clearly observed. The 10th breeding den was in a burrow in a riverbank, covered by one artificial stone.

Hence, most resting places in all age-sex classes of European mink were under or within thick and helophytic vegetation (brambles and reeds). In only a few cases could associated burrows be confirmed. The use of dense cover of bramble bushes or reedbeds might be related to some type of anti-predator behaviour. For instance, Fournier-Chambrillon et al. (2003b) found that 20% of European mink found dead in French populations had been killed by medium-sized carnivores.

Similar sites (with similar frequencies) to those described in this study have been reported as resting places in other Spanish and French populations (Palazón and Ruíz-Olmo, 1997; Garin et al., 2002; Zabala et al., 2003; Fournier et al., 2007; Palazón, 2010). Therefore, our results appear to be generalizable to the western population of European mink. These types of vegetation should be favoured in all management plans for the species, where underground dens and burrows do not seem to be as important for resting as in other small mustelid living at latitudes where thermoregulation costs may be high (e.g. Weber, 1989; Baghli and Verhagen, 2005; Fournier et al., 2007). Planting brambles near riverbanks or favouring small shallow lakes (e.g. in old river meanders) where reedbeds can extend and develop, are simple conservation measures to improve the habitat of areas with scarce or non-existent populations of European mink.

It is interesting to note that the low degree of resting site fidelity found in this study is similar to that reported for other Spanish European mink populations (Garin et al., 2002; Zabala et al., 2003). This coincidence in results suggests that European mink may be making sequential use of their home ranges to maximize foraging opportunities and to save energy in movements among foraging patches, and that brambles are so abundant that mink do not need to re-use sites. We do not have information about bramble availability for our study area, but Zabala et al. (2003), also for an area in northern Spain, found that 185 polygons out of 409 had >50% bramble coverage of shores.

On the other hand, den sites were mainly located in thick vegetation composed of brambles in tributaries and lagoons, which suggests that this type of vegetation might be important for breeding female European mink. One important issue was that the only litter lost by a breeding female was in a den situated in a high risk flooding zone. Therefore, areas targeted for improving breeding suitability should have thick bramble patches in tributaries and lagoons that are situated well above the flood risk zone, but close to their borders (Zabala et al., 2003).

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