The historical and current distribution of the Iberian population of the European mink (*Mustela lutreola*)

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Abstract: As most records of the European mink (*Mustela lutreola*) in the Iberian Peninsula have been published in local papers or remain as unpublished reports, it is difficult to determine its current distribution and to assess historical changes in its distribution. In this paper, we analyse data on the distribution of the European mink in the Iberian Peninsula. We conclude that the European mink most probably colonised the Iberian Peninsula in the late 1940's. Since it was first reported, the European mink has been slowly but steadily expanding its range across the northern Iberian Peninsula, mainly southwards but recently also eastwards and, possibly, westwards. Possible explanations for the assumed expansion are briefly discussed.

Keywords: European mink, *Mustela lutreola*, changes in distribution, Iberian Peninsula.

Introduction

The European mink (*Mustela lutreola*) is a riparian mustelid native to the European continent that once inhabited a large part of Europe (Youngman 1982). During the second half of the 20th century its distribution range shrank severely, and minks disappeared from most of their range (Youngman 1982, Maran & Henttonen 1985, Romanowsky 1990, Maran et al. 1998b, Sidorovich 2000). As a result of this decline, there are three major population nuclei nowadays: one in the north (Maran & Henttonen 1985, Tumanov 1992), one in the east (Kranz et al. 2003), and one in the west.

In the northern and eastern parts of their range minks have disappeared from most countries over the last decades, and populations continue to decline in areas where they are still present (Maran & Henttonen 1985, Maran et al. 1998b). Even if no single factor has been identified as responsible for the decline, recent studies point to competition from the American mink *(Mustela vison)* as responsible for the decline of its European counterpart, at least in some regions (Maran et al. 1998a, Maran et al. 1998b, Sidorovich 2000, Sidorovich et al. 2000).

The situation is quite different for the western population. Minks disappeared from Brittany and Pays de Loire (France) in the 20 years to 1997 (Lodé et al. 2001). Nowadays, the European mink still occupies the south of the country, approximately half of the area occupied previously. The underlying cause of the decline seems to be anthropic pressure upon the species (Maizeret et al. 1998, Lodé et al. 2001). The situation of the southwestern population is interesting, because the species seems to be expanding southwards, although data are inconclusive (Maran & Henttonen 1985, Palazón & Ruiz-Olmo 1992, Torres & Zuberogoitia 1997, Macdonald et al. 2002). Most studies on the status and distribution of the European mink in the Iberian Peninsula focus on small regions, are published in local journals or remain as unpublished reports. Therefore, the current distribution, status and trends are difficult to assess. This has led to confusion, and in some cases to misunderstandings

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both in local and international publications, with some papers presenting incorrect data.

In this paper we review the available information on the European mink in the Iberian Peninsula. The aim of the paper is to assess distributional changes, population trends, and the origin of the European mink in the Iberian Peninsula. Two alternative hypotheses are considered: 1. the European mink reached the Iberian Peninsula in the 20th century, and 2. it has always been part of the Iberian fauna, but went unnoticed until the last century, when increased interest among researchers prompted the collection of new records.

Materials and methods

This study draws on data from the northern Iberian Peninsula (figure 1). In the regions of Biscay, Gipuzkoa, Cantabria and northwestern Navarre, the climate is oceanic. Annual rainfall ranges between 1200 and 2200 mm, winters are mild and there is no aestival drought. In these regions streams are short, small and fast flowing, running into the Bay of Biscay (Flores 1989, Walter 1997).

The climate of the more southern regions (Soria, Rioja and Southern Navarre, and Burgos) is Mediterranean. Winters are rainy and summers dry, and there is a marked contrast between winter and summer temperatures. In this area streams run towards two majors rivers: the Ebro, which flows eastwards to the Mediterranean Sea, and the Duero, which flows westwards to the Atlantic Ocean. Some small streams may disappear due to the summer drought (Walter 1997).

We consulted a total of 22 works dealing with the distribution of European mink in the Iberian Peninsula, mostly international and local papers or books not widely available. Consulted works were: Rodríguez de Ondarra (1955), Puente (1956), Rodríguez de Ondarra (1963), Blas Aritio (1970), Senosiain & Donazar (1983), Castién & Mendiola (1985), Ruiz-Olmo & Palazón (1990), Palazón & Ruiz-Olmo (1992), Palazón

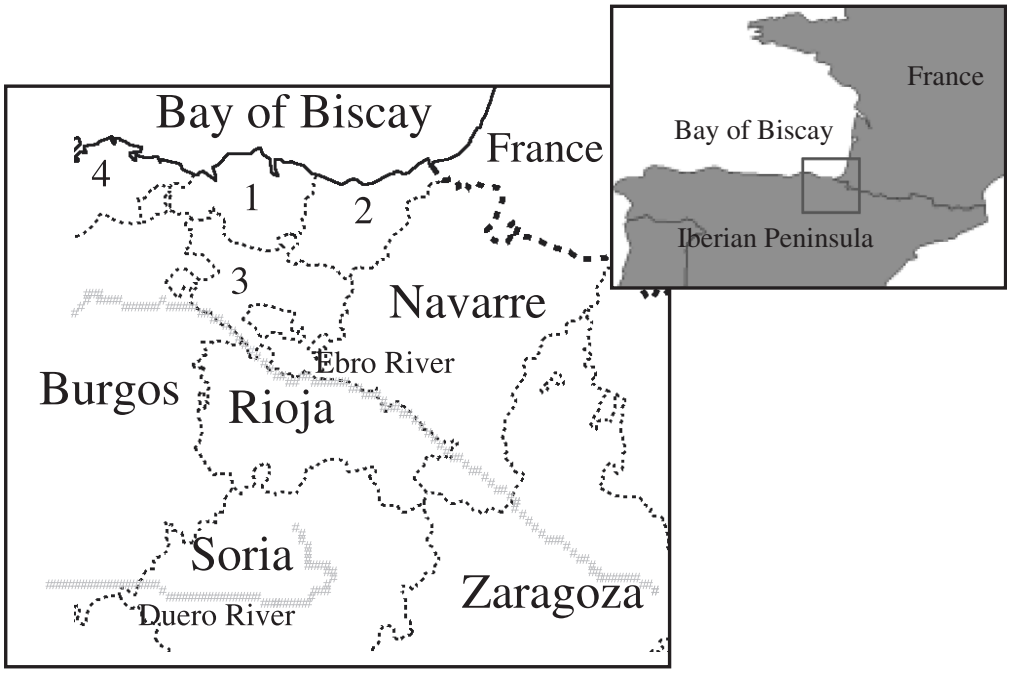

Figure 1. Map of the study area including the major rivers. 1 Biscay, 2 Gipuzkoa, 3 Araba and 4 Cantabria.

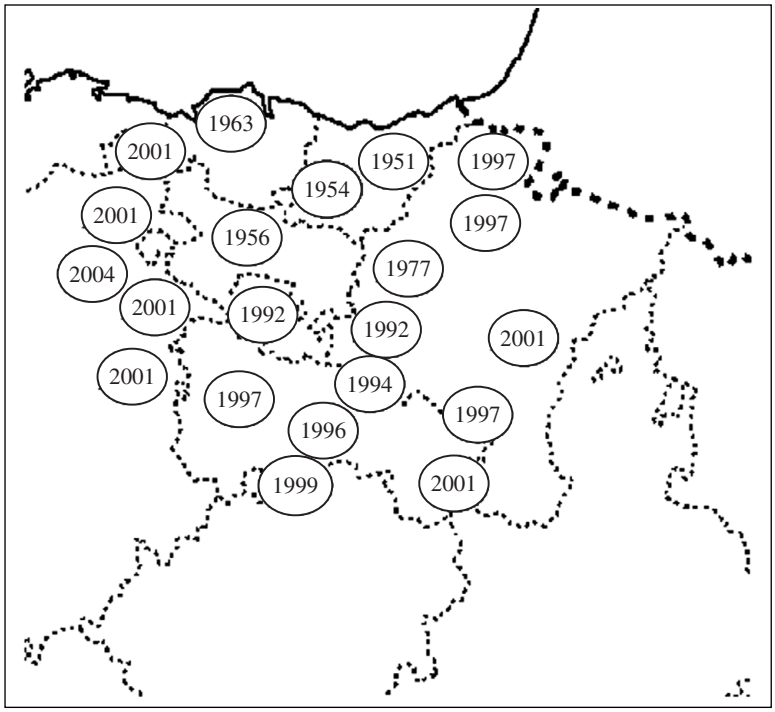

Figure 2. First record dates of European mink in different areas of the northern Iberian Peninsula.

(1993), Illana (1994), Torres & Zuberogoitia (1996), Arambarri et al. (1997), Palazón & Ruiz-Olmo (1997), Torres & Zuberogoitia (1997), Ahiartza et al. (1999), Belamendia (2001), Ceña et al. (2001), Gonzalez-Estaeban et al. (2001), Zabala et al. (2001), Zuberogoitia et al. (2001), Palazón et al. (2002), Zabala & Zuberogoitia (2003a).

These papers deal with different areas, focus at different scales, and often use different methods. Therefore, the discussion is coarse-grained in order to provide a general overview. We evaluated the reliability of each paper in relation to the methods used and the effort made to detect the species (table 1). Works were thoroughly reviewed and only those based on live-trapping data, road kills, triggered cameras or techniques that involve the handling of the animal, or provide secure proof of its presence were considered. Works based on observations were only considered when made by professional researchers or well known naturalists. A few other works not considered reliable, are discussed separately.

Results

The first data on European minks in the Iberian Peninsula date back to 1951 (Rodríguez de Ondarra 1955). The author provides data about three European minks captured in 1951 and 1952 at two locations in Gipuzkoa (figure 2). Puente (1956) subsequently reports on the presence of the species in the nearby region of Araba. In

Table 1. Reliability of different types of data.

Data source	Reliability
Trapping data	Reliable
Photographic data	Reliable
Road kills, hunted or stuffed animals	Reliable
Observations and presence reports	Depending on source: Scientists / renowned naturalists: reliable Others: not reliable
Inquests	Not reliable
Indirect reports (not from the author)	Not reliable

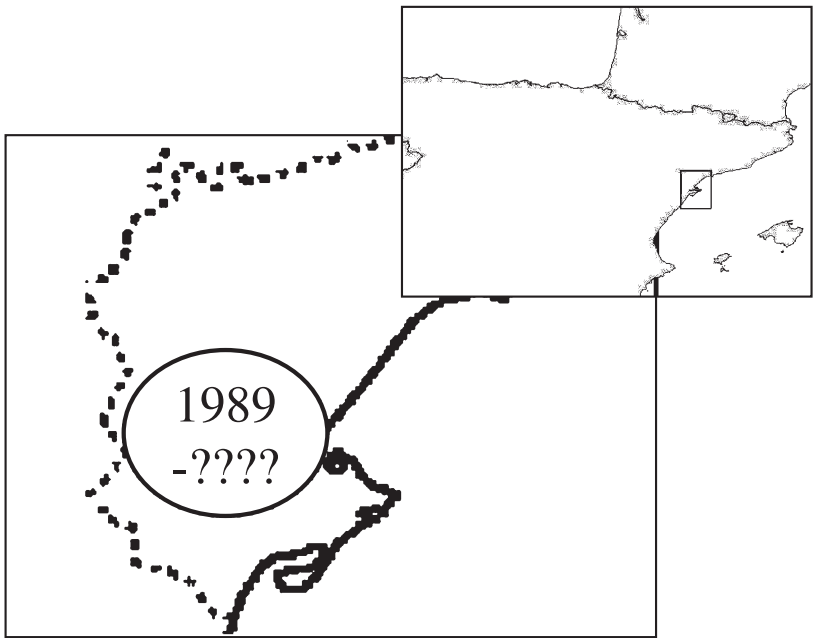

Figure 3. Location of the data provided by Ruiz-Olmo & Palazón (1990) and Palazón & Ruiz-Olmo (1992) for Catalonia.

1963, new locations in Gipuzkoa and Araba are identified, as well as the first data from two other locations in Biscay and one in Navarre, near the border with Gipuzkoa (Rodríguez de Ondarra 1963). Senosiain and Donazar (1983) confirm the southerly spread of the species into Navarre, based on road-kills between 1977 and 1982. Castién and Mendiola (1985) report the presence of the populations in Gipuzkoa, eastern Biscay and central Araba. The presence of European minks in these areas has been subsequently confirmed by several authors (Palazón & Ruiz-Olmo 1992, Palazón 1993, Illana 1994, Arambarri et al. 1997, Aihartza et al. 1999, Ceña et al. 2001, González-Esteban et al. 2001, Zabala et al. 2001, Zuberogoitia et al. 2001, Zabala & Zuberogoitia 2003a). Blas Aritio (1970) reports European minks in western Cantabria, based on indirect data from trappers.

In the 1990s, Palazón and Ruiz-Olmo (1992) report new European mink locations in Navarre, indicating a southerly range expansion, towards the Ebro River. Palazón (1993) shows similar results for the mink population in central Araba. By 1997, the presence of European mink in large areas of the Ebro River and La Rioja is documented (Torres & Zuberogoitia 1996, Arambarri et al. 1997, Palazón & Ruiz-Olmo 1997). Before 1994 the species was unknown in La Rioja, but during this year a trapping study revealed the presence of the species in the area (Torres & Zuberogoitia 1996). A few years later, road kills and illegally shot individuals were also reported (Torres & Zuberogoitia 1996). The latest results show higher densities at those sites where the minks were first trapped (Ceña 2003).

At the same time, in 1990 there is a single record of minks in Catalonia in the Ebro Delta (Ruiz-Olmo & Palazón 1990) (figure 3), and in 1992 there were another two possible records from that area, one of which is doubtful (Palazón & Ruiz-Olmo 1992). This record is located far from the European mink's distribution area and has not been explained or subsequently confirmed. The authors speculate about a possible long distance migration of a single mink or of

some individuals (Ruiz-Olmo & Palazón 1990).

Finally, by 1999 the presence of the European mink in Burgos and northern Soria as well as the first data from the catchment of the Duero river were reported (Palazón et al. 2002).

Discussion

Did European mink colonise the Iberian Peninsula?

Although there is no scientific basis to reject either of our hypotheses on the historical distribution of European mink in the Iberian Peninsula, the information available suggests that the species first reached the Iberian Peninsula around 1950.

There are no records of European minks in the area before 1951, even though commercially valuable furbearers are among the first species to be recognised by local hunters, trappers and naturalists (Youngman 1982). Although there are no statistics available on the intensity of trapping in the past, it is known that it was quite common, practised not only by trappers but also by farmers, who regard most mustelids as pests. Indeed, the first European mink found in the study area was captured by a fur trapper who, not recognising the species, submitted it to naturalists for identification. It turned out to be unknown to naturalists as well (J. Elosegi, personal communication). Subsequent reports of European minks are based on trapped and hunted individuals (Rodríguez de Ondarra 1955, Rodríguez de Ondarra 1963, Puente 1956, Blas Aritio 1970, Senosiain & Donazar 1983). In this way, Rodríguez de Ondarra (1963) gathered data on more than 35 minks captured between 1951 and 1958 in the Basque Country, although this probably accounts for only a small part of the total number of animals caught.

Nowadays, road kills are a major source of information (see Belamendia 2001, Maizeret et al. 2002, Zabala & Zuberogoitia 2003a). There are, however, no records on road kills from the study area before 1951, nor are there any known fur or cranial samples of European mink from that period. Moreover, during the late 19th and the early 20th centuries the Iberian fauna attracted the attention of several naturalists who described many subspecies for the Iberian Peninsula, including subspecies of stoats *(Mustela erminea)* (two), weasels *(Mustela nivalis)* (two), polecat *(Mustela putorius)* (one), stone marten *(Martes foina)* (one), and several small mammals (see Garcia-Perea & Gisbert 1997). Thus, it is unlikely that the European mink went unnoticed. Besides, changes in the knowledge of the distribution of the species show a consistent pattern of south-westerly expansion accompanied by an extinction front to the east and north (see figure 4). Therefore, we support the contention of most authors that the European mink reached the Iberian Peninsula in the late 1940s (Rodríguez de Ondarra 1955, Youngman 1982, Senosiain & Donazar 1983, Aihartza et al. 1999, Zabala & Zuberogoitia 2003b). In addition, based on the same reasons and given the increased fieldwork effort from the 1990s onwards, we assume that the first records of the species, approximately, coincide with the colonisation of new areas.

Indications of an expanding population

The European mink has been slowly but steadily expanding southwards from the time that it was first identified in Spain in 1951 (Rodríguez de Ondarra 1955) (figure 2). There is also evidence of an eastward expansion through the colonisation of the Ebro River tributaries (Senosiain & Donazar 1983, Palazón & Ruiz-Olmo 1992, Palazón & Ruiz-Olmo 1997). The European mink initially seemed to have reached its western distribution limit by 1963 (Rodríguez de Ondarra 1963), but more recently there are indications of a further westward expansion (Zuberogoitia et al. 2001, Zabala & Zuberogoitia 2003a). Despite the introgression of some American mink populations (Ceña et al. 2001, Zuberogoitia et al. 2001, Palazón et al. 2002), the presence of European minks has been confirmed at large spatial scales. Interestingly, the authors found a road killed European mink at Burgos in the summer

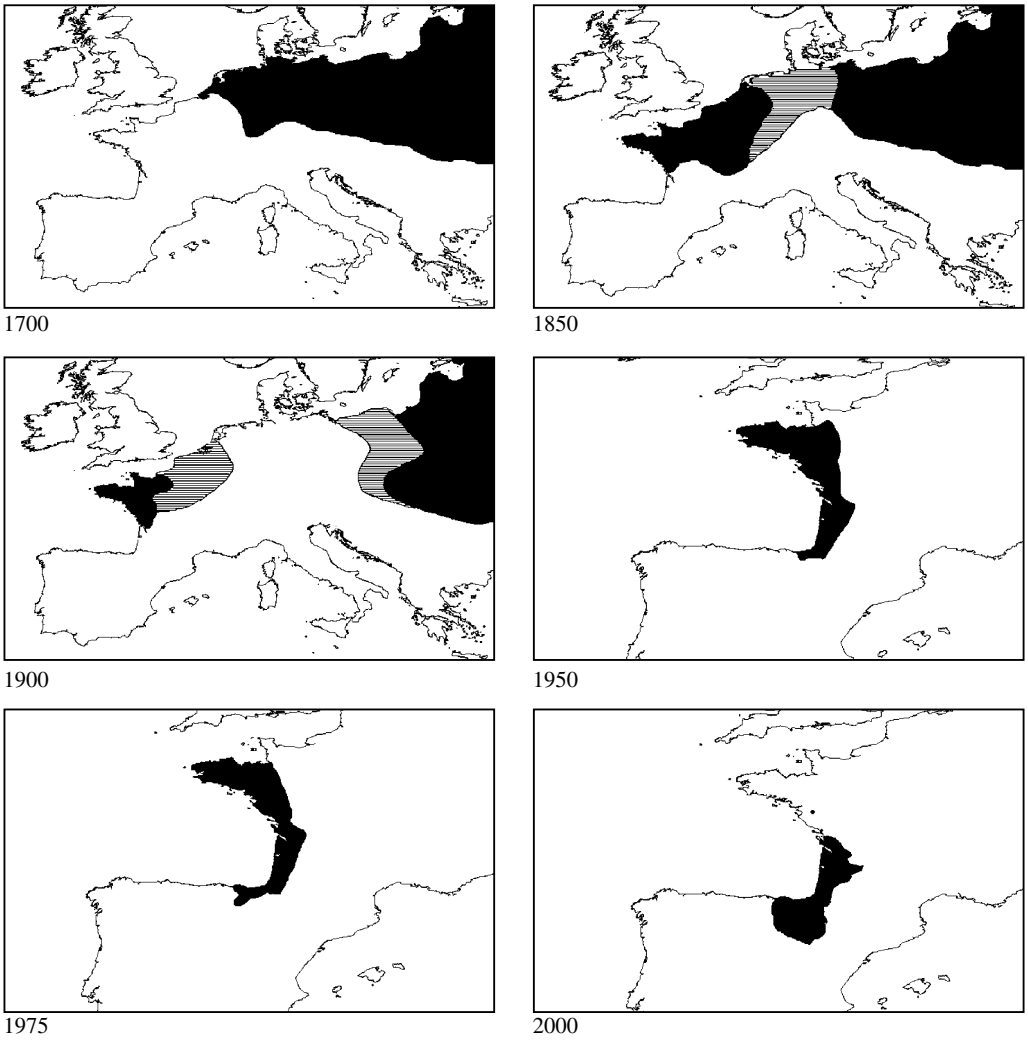

Figure 4. Distributional changes of European mink. Black areas indicate the known European mink presence, shaded areas indicate where mink was recorded as rare or disappearing at that time. Maps have been built after Youngman (1982), Saint-Girons (1994), Lodé et al. (2001), Maizeret et al. (2002), Palazón et al. (2002), and Zabala & Zuberogoitia (2003a).

of 2004 (figure 2), in an area where the species had not been previously detected, despite trapping having been conducted there (for the latest map on the species' distribution see Palazón et al. 2002).

The only outlier in this distributional pattern is the record from Catalonia reported by Ruiz-Olmo & Palazón (1990), which is some 400 km away from the current known distribution area. Bowman et al. (2002) suggest that the dispersal distance of mammals is isometric to the linear dimension of their home range multiplied by a constant that ranges from 7 to 40. The home ranges of male European minks in the study area are about 13 km long (Garin et al. 2002), which would, according to the model of Bowman et al. (2002), enable dispersion distances of 91–520 km. This model does provide an explanation of

the seemingly large gap between the main areas and the Catalonian observation, a possibility that is noted by Ruiz-Olmo and Palazón (1990) and Palazón and Ruiz-Olmo (1997).

Another problem regarding the distribution is the presence of European minks in Cantabria reported by Blas Aritio (1970). Trappers from that area recorded two types of polecat. One of these, was considered by Blas Aritio (1970) to be a European mink, had a darker coat. However, since the presence of minks there has not been confirmed by captures, road kills or examination of old material, and since the author based his conclusions on indirect reports of trappers, we do not consider these records as reliable. Polecats are known to have a dark phenotype, that is often confused with that of the European mink (Lodé et al. 2001) and which seems to be common in the north of the Iberian Peninsula (Zuberogoitia et al. 2001).

Recent genetic research, which included populations from Southwestern Europe, found very low intra-specific genetic variability in mtDNA for European minks, which is consistent with the hypothesis of an expanding population (Michaux et al. 2004). Moreover, there is hardly any genetic variation between European minks from France and Spain, suggesting that the population was established by a few individuals, and possibly even by a single female (Michaux et al. 2004). However, an early Holocene origin is also possible, with some long distance migrants from a refugium establishing the population (Michaux et al. 2004). Studies based on mtDNA and microsatellites also show that the genetic variability between the European mink populations from France and Spain is negligible, the most probable explanation being a severe bottleneck, or the consequence of a founder effect. This is consistent with the probable absence of minks in the area before the 19th century (Cabria et al. 2003, Gómez-Moliner et al. 2003).

The colonisation of the Iberian Peninsula in the late 1940s would also coincide with, and possibly be a consequence of, a period of high population density in neighbouring France, judging from the large number of specimens deposited in museums in France during that time (Youngman 1982).

Possible explanations

How can we explain the recorded population expansion in the Iberian Peninsula? Factors limiting a species' distribution may be abiotic or biotic. It is difficult to identify one single abiotic factor responsible for the distribution, current or past, or for any changes in distribution. Indeed, the European mink is currently distributed across the Eurosiberian and Mediterranean biogeographical areas of Europe, areas with very different climate conditions (Walter 1997, Palazón et al. 2002).

Biotic factors also vary. Competition with the American mink is suggested as the cause for the decline in Eastern Europe (Macdonald et al. 2002), yet the most likely underlying cause in France seems to be anthropic pressure upon the species, specifically, the conjunction of intensive trapping, alteration of water quality, and habitat modification (Lodé et al. 2001, Lodé 2002). In addition interspecific relationships with polecat have been proposed, based on experiments conducted in captivity (Schröpfer et al. 2001). We will discuss the possible role of these factors for the distributional changes in our study area here.

Water quality. Data on water quality are scarce in the study area. It seems that there has been a slight improvement over the last few years, at least in some areas, and there are some policies favouring the use of natural fertilisers and regulating the use of pesticides, which could favour the presence of minks in some rivers. Since these have only been implemented just recently, it is unlikely that they could had a significant bearing in explaining the apparent recent expansion of minks (Anonymous 2000, Anonymous 2001, Arluziaga 2002, Anonymous 2003).

Habitat modification due to land use changes. Changes in landscape and land use are known to influence the distribution of predators, especially of habitat specialists like the European mink, and intensification of agricultural practices is supposed to be one of the reasons for its historic and current decline (Lodé et al. 2001, Macdonald et

al 2002, Robinson & Sutherland 2002, Schadt et al. 2002). In the Basque Country, agricultural practices have experienced a severe regression, especially during the 1980s and 1990s, in favour of forest cultures that currently occupy 54% of the area (Anonymous 2001). However, in a study on the habitat selection of the European mink conducted in the Basque Country, minks were found to avoid forests and forest cultures, preferring meadows and small orchards (Zabala et al. 2003). In La Rioja, trends in land use changes over the past decade are less clear-cut. There has been an expansion of agricultural lands and forest cultures since 1996 (by 2% and 16% respectively), while meadows have declined by 23% of their previous area (Anonymous 2000). In Navarre, only minor changes took place. From 1991 to 2000, agricultural areas have been reduced by 4%, meadows and pastures experienced a decline of 9%, and forest cultures expanded by 1% (Anonymous 2003). The overall pattern in land use varies among areas (table 2), and its possible influence in the assumed expansion of minks is difficult to assess. However, in areas where expansion seems to have occurred over the last decade, like Navarre and La Rioja, changes in land use are relatively insignificant. The only exception could be the reduction of pastures and meadows in La Rioja area (Anonymous 2000), but no study has pointed out possible benefits of the reduction of this habitat for the European mink. The few studies conducted hitherto on the habitat selection of the European mink stress the importance of riverbank structures such as bramble thickets (Zabala et al. 2003, Zabala & Zuberogoitia 2003c). Some changes in agricultural practices and intensity as a result of the abandonment of rural areas over the last decades, may be an important factor favouring the expansion of the European minks in the Iberian Peninsula. Moreover, riverbank protection policies have been developed, with different intensity in different areas, which could also affect the expansion of European minks. Another practice the importance of which is difficult to assess, but which undoubtedly has had an effect, is a reduction in the indiscriminate use of poisons, which was also common in the past. This has also been pointed out as an important factor influencing the current distribution of some carnivores in the area (Aihartza et al. 1999). The law 4/1989 of the 27th of March of 1989 forbade these practices, and it is noticeable that, for instance in Araba, since 1988 there are no records of kill-trapped individuals (Arambarri et al. 1997). Even if this last factor is not sufficient to explain an expansion, it is likely, to have had some beneficial effects for the species.

Interspecific relations. Last, but not least, intragild effects should be considered. There are some American mink populations in the Iberian Peninsula, the oldest of them dating back to the late 1950s or the early 1960s. By the 1990s American minks were present in several areas of the Iberian Peninsula, especially in the north, including areas already occupied by the European mink (Bravo & Bueno 1999, Zuberogoitia et al. 2001). The expansion of both species is therefore synchronic and, since there are relatively well preserved areas where both species are absent, the observed pattern can not be a consequence of the presence or absence of the American mink. Moreover, the westernmost distribution area of the European mink in Biscay lies besides the well preserved streams of Cantabria were both species of mink are unknown, whilst both species are present in the less well preserved rivers of Biscay (Bravo 2002, Zabala & Zuberogoitia 2003a, Zuberogoitia & Zabala 2003). On the other hand, it is important to recognise that in

Table 2. Land of use (in %) in the Basque Country, Navarre, and la Rioja (adapted from Anonymous 2000, Anonymous 2001, Anonymous 2003.

Land use	Agriculture	Pastures & meadows	Forests & forest cultures	Other
Basque Country	14	19	54	13
Navarre	34	25	30	11
La Rioja	32	22	27	19

some areas occupied by both mink species, local extinctions of European mink have occurred (Ceña et al. 2001, Zuberogoitia et al. 2001, Palazón et al. 2002).

Little is known about the ecology of polecats in the Iberian Peninsula. However, they are distributed across most of the European mink area and may locally reach fair densities (Virgós 2002). Some studies point out that this mustelid may not show semi-aquatic behaviour in the area (Zuberogoitia et al. 2000, Virgós 2002). Moreover, the polecat is common in the neighbouring French area, where it is regarded as a pest, but not as a cause for the decline of the European mink (Lodé et al. 2001).

Conclusions

In conclusion, even if we cannot definitively reject the hypothesis that the European mink is an old part of the Iberian fauna, there are strong indications that the species is a recent arrival to the Iberian Peninsula. We can not currently present a conclusive explanation for this phenomenon as none of the proposed causes for the decline of European mink in its neighbouring distribution area in France has changed significantly among the areas where it is present or absent. Furthermore, the influence of American mink on its European counterpart in the area, is as yet unclear. Zabala & Zuberogoitia (2003a) state that the European mink recently extended its distribution westwards in Biscay, therefore the expansion could still be an ongoing process and this could be one reason for the absence of explanatory variables.

Future research

Further research is needed in order to check for a possible expansion of European mink into nearby areas and to determine those causes that may have favoured changes in its distribution. Genetic research might play an important role by determining the origin of the western population in space and time, and by confirming or rejecting the model of expansion proposed in this paper. Research on those land uses and policies that influence the presence of European minks at landscape scale would also help increase understanding of distributional changes. It would also be interesting to determine the potential distribution area of the species, by identifying areas suitable for colonization, and then periodically checking these, especially at the borders of known distribution areas, in order to find out if expansion is still happening. Finally, studies on mink pathologies could help understand the decline or the absence of European mink in some historically occupied areas in Europe, which are nowadays apparently suitable but remain unoccupied.

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Samenvatting

De historische en huidige verspreiding van de Europese nerts (*Mustela lutreola*) op het Iberisch Schiereiland.

De meeste meldingen van de Europese nerts (*Mustela lutreola*) op het Iberisch Schiereiland zijn niet vastgelegd in internationale of nationale literatuur. De verspreiding van de soort is daarom niet precies bekend en ook moeilijk te bepalen. In dit artikel wordt aan de hand van onder meer ongepubliceerde rapporten en moeilijk toegankelijke artikels met een lokale verspreiding, een beeld gegeven van de historische en huidige verspreiding van de Europese nerts op het Iberisch Schiereiland. Geconcludeerd wordt dat de soort het noorden van Iberië waarschijnlijk aan het eind van de jaren ‘40 van de vorige eeuw heeft bereikt. Sindsdien lijkt de soort zich langzaam maar gestaag uit te breiden, vooral in zuidelijke richting, maar meer recentelijk ook oostwaarts en, waarschijnlijk, westwaarts. Mogelijke verklaringen voor deze vermoedelijke uitbreiding worden kort besproken.

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