Folia Zool. – 55(3): 257–263 (2006)

Evaluation of sign surveys and trappability of American mink: management consequences

Iñigo ZUBEROGOITIA[1], Jabi ZABALA[2] and Jose A. MARTÍNEZ[3]

[1] *Icarus E. M. S. L. Icarus, C/ Pintor Sorolla 6. 1º, E-26007 Logroño, Spain; e-mail: Zuberogoitia@icarus.es*

[2] *Sebero Otxoa 45, 5 B, 48480 Arrigorriaga, Biscay, Basque Country, Spain; e-mail: jzabalaalbizua@yahoo.com*

[3] *C/ Juan de la Cierva 43 (S.T. 100), El Campello, 03560 Alicante, Spain; e-mail: qvcocotiers@hotmail.com*

Received 22 September 2005; Accepted 7 September 2006

Abstract. We compared different methods of monitoring an American mink, *Mustela vison*, population in an European mink, *Mustela lutreola*, area. The study was carried out in the Butron basin, northern Spain. We compared sign surveys and trapping in the same non-continuous 500 m sections of river. We also radio-tagged 10 minks to evaluate the efficiency of the two methods. There was no significant association between the presence of tracks and trapping success. We noticed the presence of minks in sections where none was captured and vice versa. Furthermore, by monitoring the radio-collared minks, we found inter-sexual differences in spatial use that produced differences in the success of the trapping and sign surveys, with males using the main streams and females selecting little streams where tracks were difficult to survey. Moreover, we detected tracks in the sand of 17 minks that actively avoided the traps. Hence, 1) neither sign surveys nor trapping are reliable methods for estimating relative abundances because both are subjected to strong biases. 2) the spatial use of habitat by minks could severely affect management projects that consider only main streams and 3) projects aimed at extracting American minks need to consider those individuals that never trigger traps, females living in very small streams and the floating population living in other habitats.

Key words: American mink, field surveys, monitoring programs, relative abundance, trapping effort

Introduction

Estimates of animal abundance are among the most important requirements of wildlife managers and researchers. Developing methods for collecting distributional data is essential for several purposes: knowledge on geographical distribution, habitat-relation models, effects of land-use changes, effects of human density and disturbance on distribution, relationship between species occurrence and landscape physiognomy and composition, viability models, population-monitoring programs, which ultimately determine the convenience of protecting a species (Zielinski & Kucera 1996). Estimating the size of wildlife populations can be problematic, especially in mustelids as they are often elusive, nocturnal and may have large home ranges. The ideal method for obtaining reliable results is the capture-recapture method, although trapping carnivores at the intensity required to produce such estimates is not always possible, being difficult, labour-intensive and prohibitively expensive (Wilson & Delahay 2001). Therefore, most estimates of relative abundance, expressed as an index value, are often obtained employing alternative methodologies based on detection of field signs (Foresman & Pearson 1998, Sargeant et al. 1998, Wilson & Delahay 2001).

When a species is classed as a pest, or, as an alien species is regarded as a threat to endangered indigenous species, the management objective may be to reduce the population size. Such is the case of the American mink, *Mustela vison*, whose populations overlap the distribution range of the European mink, *Mustela lutreola* (Macdonald & Harrington 2003). This seems to be an irreversible event, presenting little hope of recovery for the native species in the wild (Maran 1996).

The critical situation of the native species has led to the development of several projects focused on the eradication of American minks. Therefore, in this study, we (1) compare the reliability of sign surveys and trapping as estimators of the American mink's abundance, and (2) assess the efficiency of trapping as an eradication measure.

Study Area

The study area was the Butron river system, Biscay, Northern Spain, a small catchment of 40 km long along its main axis, with an area of 174 km^2 (Fig. 1). We focused the study on 20 km of the medium part of the catchment. There, the largest stretch of the main river was 10 m width and 1.5 m deep under normal weather conditions, although most stretches are between 3 and 6 m width and between 30 and 50 cm deep. Riparian vegetation was patchy; usually present as a line on both sides of the streams, most times restricted to the riverbank. Alder, *Alnus glutinosa,* and willows, *Salix alba,* were the main species and they were associated with a dense undergrowth dominated by brambles, *Rubus* spp. Brambles, other bushes or rank grass also appeared in some areas with no tree-cover, and, in some areas natural riverbank vegetation had been completely removed and replaced by meadows.

The slow waters of the study area produced sandy riverbanks. This, in combination with the usual changes of water level as a consequence of the rainy climate, created a strip of

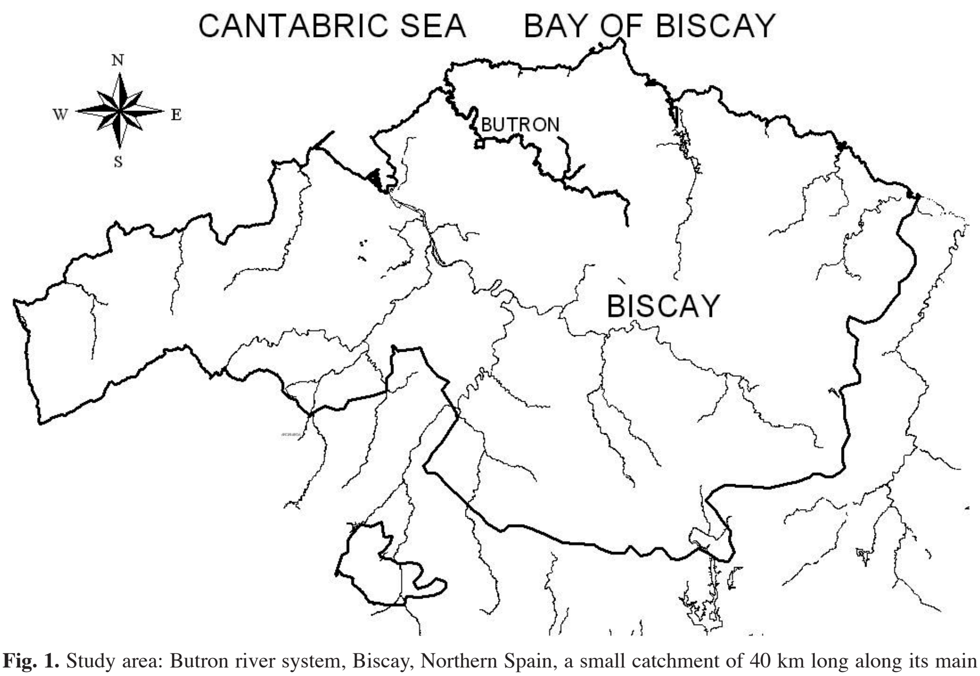

Fig. 1. Study area: Butron river system, Biscay, Northern Spain, a small catchment of 40 km long along its main axis, with an area of 174 km^2.

sandy flat substratum on both sides of 1 m width between water and vegetation, which was often washed. There, animals left clear tracks, making species identification easy. Otters, *Lutra lutra,* and pine martens, *Martes martes,* were absent and polecats, *Mustela putorius,* and stone martens, *Martes foina,* were very rare in the study area, European and American minks being the only medium-sized mustelids present (Zuberogoitia et al. 2001, Zabala et al. 2005). It is almost impossible to distinguish the tracks of both mink species, so we considered the presence of tracks as an undistinguished "mink presence". Mink tracks are easy to distinguish from those of common genet, *Genetta genetta*, feral cats, *Felis catus,* and foxes, *Vulpes vulpes*, all abundant in the area, and with little experience it is easy to differentiate between mink tracks and stone marten's.

Materials and Methods

Sign surveys

We divided the main stream into non-continuous 500 m sections (Bonessi & Macdonald 2004). The banks were surveyed up to one or two metres from the river's edge where there was no vegetation and the sand made it easy to find tracks. All surveys were conducted by the same two trained surveyors, walking in the river, when the depth allowed, or walking along the shore, one of the surveyors upstream and the other downstream. The river was surveyed firstly in two areas holding 11 and 14 sections on 15 November 2004 and on 22 November 2004 respectively, secondly in 18 sections which had been surveyed previously, on 10 January 2005, and finally in 11 repeated sections on 4 April 2005.

Trapping

Trapping was carried out to evaluate estimates of relative mink abundance obtained with sign surveys and to fit radio-tags in order to monitor all the trapped minks. During each season, 37–40 live-traps were located regularly at intervals of 100 m along the river in every section surveyed for signs, regardless of the survey results. Traps were baited with sardines in vegetable oil and kept active for four days. Traps were surveyed every morning, during the first hours after dawn. Trapping was conducted by a single team with experience in mink trapping and handling to avoid biases due to different trappers. We set 304 trap/nights from 15 November to 26 November 2004. Then, we conducted 148 trap/nights from 10 to 15 January 2005, in sections in which we had evidence of mink presence. Finally, we conducted another short trapping excursion in spring in order to recapture all tagged minks and to capture others known to occupy other areas (i.e. areas with mink signs between radio-tagged mink territories). From 4 to 9 April 2005 we performed 138 trap/nights, 32 of which where set close to mink after locating them using radio-tracking.

Radio tagging and parallel sign surveys

We live-trapped and fitted two European minks (one male and one female) and 11 American minks (five males and five females, another female was not tagged) with TW-4 and TW-5 radio tags (Biotrack Ltd, Wareham, Dorset, U. K.). Radio-collars weighed approximately 15 g, <3% of the lightest adult female caught in our study area (520 g). We located animals twice every week mainly at daylight but also during the first hours of night (between 10:00 a.m. and 20:00 p.m). Fixes were taken within 1–20 metres of the animal using the homing technique

(White & Garrot 1990) with an accuracy of 2 m^2, which was tested by watching them in active periods (Zuberogoitia et al. 2006). Every location was recorded with an accuracy of 3 m^2 on georeferenced high-resolution aerial photographs and implemented in a GIS. In addition, we surveyed areas occupied by radio-tagged minks, looking for tracks and faeces in order to detect the presence of other mink.

The tracking period was five months (16 November – 7 April), although three minks (one female and two males) were poached before the end and two minks (one female and one male) removed the collar during the first weeks.

Results

Sign surveys and trapping results

During the autumn fieldwork, we surveyed 24 river stretches and found tracks of minks in 17 of them (70.83%; "positive stretches" hereafter). We captured minks in six of the positive stretches and in one of the negative stretches. There was no significant association between the presence of tracks and trapping success ($X^2_1 = 1.48$, $P = 0.224$). In January, we surveyed 18 stretches and found tracks in 11 of them (61.11%). We captured minks in one of the positive and in three of the negative stretches. There was no significant association between the presence of tracks and trapping success ($X^2_1 = 2.91$, $P = 0.087$). Finally, in April we set the traps in 11 stretches in which presence of minks had been ascertained (by radio-tracking and recent tracks) and in one where there were no recent tracks. Only one tagged mink was captured.

Considering the three periods, we set the traps in 30 areas where the presence of minks had been confirmed and in another 15 where we could not ascertain the presence by means of sign surveys (at the first time). We captured nine minks in eight positive stretches (30% of the stretches) and four more in the negative stretches (26.7%). There was no significant association between the presence of tracks and trapping success ($X^2_1 = 0.28$, $P = 0.595$).

During the first season, we trapped seven American minks (2.3 individuals per 100 trap/nights) and two European minks (0.66 individuals per 100 trap/nights) and we noticed, by examination of the sand around the cage, that at least in nine different sites there were minks which visited traps but had not been captured. In the winter period, we captured five more American minks (3.38 individuals per 100 trap/nights) and noticed that there were eight more different sites where minks visited the traps but did not enter. Moreover, during the trapping period of April, we tried to capture four tagged American minks, one tagged European mink, and nine non-tagged minks monitored by their tracks. Only one of the 14 minks was captured (0.72 individuals per trap/nights).

During the whole trapping period, we detected minks that would trigger the traps actively without getting caught, three during the first sample, four more during the second sample and six during the last sample. In fact, one tagged mink visited 11 traps and triggered six without capture.

Monitoring results

The average home range of male American minks was 7.09 km (SD = 6.76) and of females 4.92 km (SD = 3.79; we have not considered those animals monitored partially, Table 1). However, the use of the space changed between sexes, since females used little streams more intensively (59.78% of the home range, SD = 18.7) than males (17.3%, SD = 26.47, X^2_1 = 38.11, P = 0.001; Table 1). The average width of the streams used by males was 5.1 m (SD = 3.46) and by females 3.03 m (SD = 3.13), the difference being significant (U Mann-Whitney test, U = 2873, P = 0.001). Moreover, the average depth of the streams used by males was 63 cm (SD = 55.61), and by females 49 cm (SD = 55.56; U Mann-Whitney test, U = 3108, P = 0.002).

Table 1. Summary of the radio-tracking records of American minks. The distance (in metres) of both main streams and small streams used is included. Percentage is the percentage of home range composed by little streams.

	Capture date	Last location	Locations	Home range (m)	Principal streams (m)	Little streams (m)	Percentage (%)
Female	24/11/2004	07/12/2004	3	332	55	277	83.4
Female	18/11/2004	28/02/2005	28	10486	5325	5161	49.2
Female	15/01/2005	07/04/2005	27	3051	1940	1111	36.4
Female	14/01/2005	07/04/2005	26	4063	1763	2300	56.6
Female	13/01/2005	07/04/2005	30	2099	560	1539	73.3
Male	26/11/2004	24/01/2004	19	1316	1193	123	9.3
Male	26/11/2004	01/12/2004	4	1017	981	36	3.5
Male	16/11/2004	23/02/2005	32	4085	3694	391	9.6
Male	16/11/2004	13/12/2004	6	2237	2237	0	0
Male	13/01/2005	07/04/2005	26	15874	5707	10167	64.1

The average distance from males to the main stream was 149.2 m (SD = 437.8), while it reached 523.2 m for females (SD = 763.3), the differences between sexes being significant (U Mann-Whitney test, U = 1566.5, P = 0.001).

Discussion

Indirect methods for monitoring populations are used to record three features of the status of animals: distribution, relative abundance and absolute abundance. The first feature is reasonable easy to achieve, although it requires time and money to obtain reliable results (see B a g h i l i & V e r h a g e n 2003, G ó m e z - M o l i n e r et al. 2004) and sometimes incorrect results appear related to short-term projects or inadequate methodologies. In our study area, for example, the presence of American minks was ascertained and published some time ago (A h i a r t z a et al. 1999, Z u b e r o g o i t i a et al. 2001, Z u b e r o g o i t i a & Z a b a l a 2003a). However, paradoxically, a later and extensive study detected no individuals, so the species was concluded to be absent (G o n z á l e z et al. 2001). The second feature, relative abundance, seems to be related to densities, species and habitats. In the present study, we estimated the distribution using sign surveys, but we did not detect minks in all the surveyed areas, although they were present, as shown by the trapping and radio-tracking methods. Thus, estimates of the relative abundance obtained through different methods were notably different. Similarly, otter surveys produced an estimate of the relative abundance at low densities but not at high densities (R u i z - O l m o et al. 2001). Finally, regarding absolute abundance, it is almost impossible to determine it with indirect methods for elusive species.

Direct methods are required then in order to improve the estimates. However, live-trapping, although the most reliable method, is not cost-effective for the sole purpose of determining the relative abundance of mink on a regional basis. Moreover, B o n e s i &

Macdonald (2004) found this method to be worse than sign surveys in estimating relative abundances at low densities. Nevertheless, they concluded that only trapping can be used at present to achieve the absolute abundance. However, in agreement with Yamaguchi & Macdonald (2003) our results show that even at high densities the live-trapping method yields worse returns than sign surveys, since trapping is likely to underestimate population densities because several individuals evade traps. Seasonal changes in the probability of being trapped, as we have found in this study, may cause fatal errors in estimating relative abundance (Zabala et al. 2001).

The results obtained by trapping show that the relative abundance of American minks in the study area, between 29.6 and 43.5 trap-nights for each capture, is close to that obtained by Yamaguchi & Macdonald (2003) in a high density area of the United Kingdom. Thus, we suggest that the the Butron catchment may have reached its carrying capacity for American minks.

The sex-ratio found in the study area is 1:1, quite similar to that obtained for other unharvested populations (Gerrell 1971, Yamaguchi & Macdonald 2003). Nevertheless, our results show a sex bias in the probability of being trapped. There were also considerable differences in the use of space, with males using almost exclusively main streams (82.7% of the locations; females 40.22%). Females were found mostly in small streams, often less than 1 m width and 15 cm deep, usually for more than three weeks consecutively. These small streams formed a wide network throughout the study area, and were covered by dense brambles. This type of habitat did not seem adequate for minks, since there was little water or occasionally no water at all. Moreover, due to the structure and density of the vegetation it was very costly to look for tracks, and mink went unnoticed during sign surveys. So, it seems certain that a large proportion of the population, mainly females, went unnoticed in places where normally they are not trapped. Hence, sex differences in habitat preferences and spatial segregation, known also for other semi-aquatic mustelids (Lodé 1996), may swamp the reliability of trapping studies. This in turn would bias population estimates and, of course, strongly influence those programs aimed at extracting American minks from the wild in order to reduce the pressure on the European mink and other wildlife.

In conclusion, projects focused on estimates and extraction of American mink populations relying on trapping in the main streams are bound to fail because a large amount of extra hours of work per person is needed where small streams join main streams. Moreover, the floating population could be away from rivers (Zuberogoitia & Zabala 2003b). Therefore, re-colonization of the rivers is likely to take place quickly.

The American mink now occupies almost all of the range of European mink, with some free catchments only in southwest Europe. It is likely to be impossible to eradicate completely this invasive species. Therefore, we recommend firstly developing special "conservation" measures in the best preserved areas where healthy populations of European minks are present; secondly, making a big and continuous effort in the adjacent areas in order to maintain them free of American minks, and finally, developing periodical trapping schemes in areas occupied by American minks in order to reduce their density and delay expansion subsequent to high density conditions.

Acknowledgements

This work was financially supported and the licences to work with this species issued by Servicio de Conservación y Espacios Naturales Protegidos, Diputación Foral de Bizkaia. The paper was improved by helpful comments from an anonymous referee. We thank Prof. C. Mason for linguistic revision.

LITERATURE

Aihartza J., Zuberogoitia I., Camacho E. & Torres J.J. 1999: Status of carnivores in Biscay (N Iberian Peninsula). *Misc. Zool. 22: 41–52.*

Baghli A. & Verhagen R. 2003: The distribution and statusof the polecat *Mustela putorius* in Luxembourg. *Mammal Rev. 33 (1): 57–68.*

Bonesi L. & Macdonald D.W. 2004: Evaluation of sign surveys as a way to estimate the relative abundance of American mink (*Mustela vison*). *J. Zool. Lond. 262: 65–72.*

Foresman K.R. & Pearson D.E. 1998: Comparison of proposed survey procedures for detection of forest carnivores. *J. Wildlife Manage. 62: 1217–1226.*

Gerell R. 1971: Population studies on mink *Mustela vison* in southern Sweeden. *Oikos 8: 83–109.*

González J., Villate I. & Irizar I. 2001: Área de distribución y valoración del estado de las poblaciones de visón europeo en la Comunidad Autónoma del País Vasco. *Unpublished report, Dpto Biodiversidad, Gobierno Vasco.*

Gómez-Moliner B., Cabria M.T., Rubines J., Garin I., Madeira M.J., Elejalde A., Aihartza J., Fournier P. & Palazón S. 2004: PCR-RFLP identification of mustelids species: European mink (*Mustela lutreola*), American mink (*M. vison*) and polecat (*M. putorius*) by analysis of excrement DNA. *J. Zool. 262: 311–316.*

Lodé T. 1996: Conspecific tolerance and sexual segregation in the use of space and habitats in the European polecat. *Acta Theriol. 41: 171–178.*

Macdonald D.W. & Harrington L.A. 2003: The American mink: the triumph and tragedy of adaptation out of context. *New Zealand J. Zool. 30: 421–441.*

Maran T. 1996: Ex situ and in situ conservation of the European mink. *International Zoo News 43: 399–407.*

Ruiz-Olmo J., Saavedra D. & Jimenez J. 2001: Testing the surveys and visual and track censuses of Eurasian otters (*Lutra lutra*). *J. Zool. Lond. 253: 359–369.*

Sargeant G.A., Johnson D.H. & Berg W.E. 1998: Interpreting carnivore scent-station surveys. *J. Wildlife Manage. 62: 1235–1245.*

White G.C. & Garrot R.A. 1990: Analysis of wildlife radio-tracking data. *Academic Press, New York.*

Wilson G.J. & Delahay R.J. 2001. A review of methods to estimate the abundance of terrestrial carnivores using field signs and observation. *Wildlife Res. 28: 151–164.*

Yamaguchi N. & Macdonald D.W. 2003: The burden of co-occupancy: intraspecific resource competition and spacing patterns in American mink, *Mustela vison*. *J. Mammal. 84: 1341–1355.*

Zabala J., Zuberogoitia I., Garin I. & Aihartza J.R. 2001: Small carnivore trappability: seasonal changes and mortality. A case study on European mink *Mustela lutreola* and Spotted genet *Genetta genetta*. *Small Carnivore Conservation 25: 9–11.*

Zabala J., Zuberogoitia I. & Martínez J.A. 2005: Habitat and landscape features ruling the habitat selection and occupancy of the polecat (*Mustela putorius*) in a low density area: a multiescale approach. *Eur. J. Wildl. Manage. 51:157–162.*

Zielinski W.J. & Kucera T.E. 1996: American marten, fisher, lynx and wolverine: surveys methods for their detection. *Pacific Southwestern Research Station, Forest Service, U.S. Department of Agriculture, Albany, California.*

Zuberogoitia I., Torres J.J., Zabala J. & Campos M.A. 2001: Carnívoros de Bizkaia. *Bilbao Bizkaia Kutxa, Bilbao (in Spanish).*

Zuberogoitia I. & Zabala J. 2003a: Aproximación a la distribución del Visón Americano en Bizkaia. *Galemys 15: 29–35.*

Zuberogoitia I. & Zabala J. 2003b: Does European Mink use only rivers or do they also use other habitats? *Small Carnivore Conservation 28: 7–8.*

Zuberogoitia I. Zabala J. & Martínez J.A. 2006: Diurnal activity and observations of the hunting and ranging behaviour of American mink (*Mustela vison*). *Mammalia (in press).*