Ann. Zool. Fennici 45: 317–322 ISSN 0003-455X (print), ISSN 1797-2450 (online)
Helsinki 27 August 2008

Do otters and mink compete for access to foraging sites? A winter case study in the Mazurian Lakeland, Poland

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Received 16 Mar. 2007, revised version received 15 Nov. 2007, accepted 22 Nov. 2007

Brzeziński, M., Święcicka-Mazan, A. & Romanowski, J. 2008: Do otters and mink compete for access to foraging sites? A winter case study in the Mazurian Lakeland, Poland. — *Ann. Zool. Fennici* 45: 317–322.

The distribution of otter and American mink tracks in the Mazurian Lakeland during winter, characterised by low temperatures and thick ice cover, was used to analyse competition between the two species for access to the limited area of foraging sites. The study was carried out in February and March, 2006 and comprised 12 lakes and sections of three rivers and two canals. Tracking was conducted along a total of 98.25 km of the shoreline, which was divided into 393 study sections, 250-m-long each. Otter tracks were recorded at all the lakes and canals under study and at two rivers. Mink tracks were recorded along all the watercourses and on eleven lakes. The otter was recorded in 25.9% of the sections, whereas American mink in 28.8% of the sections. Co-occurrence of the otter and mink was observed in 8.8% of the sections. In sections with unfrozen stretches (12.3% of all the study sections), the frequency of otter and mink tracks was significantly higher than in totally frozen sections. Co-occurrence of the otter and mink was found in 28.3% of the sections with access to open water. In unfrozen sections the frequency of co-occurrence of the two species was four times higher than in totally frozen sections. Only 20% of the sections with air holes were not visited by any of the two species. The study showed that during periods of low temperatures, when accessibility to open water and aquatic prey was limited, both species clearly preferred those parts of the water bodies where unfrozen places remained. A high rate of co-occurrence of the two species in such places indicates mutual tolerance between the otter and mink in the sections offering aquatic food resources.

Introduction

Coexistence of the otter and American mink in many riparian habitats in which they overlap in their use of resources, provides one of the essential prerequisites for interspecific competition between the two mustelids. Competition is expected to be asymmetrical in favour of the larger otter, that better exploits aquatic food (Bonesi *et al*. 2004). A number of studies have demonstrated varying overlap of diet of these species in different habitats and seasons (Erlinge

1972, Chanin 1981, Wise *et al*. 1981, Kyne *et al*. 1989, Clode & Macdonald 1995, Jędrzejewska *et al*. 2001). Exploitation competition and food niche overlap between otters and mink is expected to increase in periods with limited food resources (Erlinge 1972) but probably only in habitats that do not offer alternative food for the mink. Otherwise, competition may decrease (Jędrzejewska *et al*. 2001) because mink, being a more generalist carnivore, can easily adapt to local environmental conditions, move to sub-optimal habitats and/or minimize competition with otters by a shift in their food niche (Clode & Macdonald 1995, Bonesi *et al*. 2004). In a recent study on the river Teign (Devon, UK) it was shown that American mink shifted its diet to mostly terrestrial as otter density increased, thus suggesting that mink habitat use is affected by the dominant competitor, the otter (Bonesi *et al*. 2004). It was also shown that re-establishment of the otter population led to a rapid reduction in the density of mink in England due to interference competition (Bonesi & Macdonald 2004a). The authors observed that mink coexisted with otters for longer periods in areas with abundant alternative mammalian prey (Bonesi & Macdonald 2004b).

The Mazurian Lakeland in northeastern Poland is inhabited by thriving otter and mink populations. Due to the abundance of good quality habitats otters were present even during periods of a serious population decline in the 1970s. In the early 1990s, signs of otters were recorded in all the 10 × 10-km UTM squares searched during the national otter survey (Brzeziński *et al*. 1996). American mink started to colonize the region in the mid-1980s and very quickly reached high densities (Brzeziński & Marzec 2003). Thus, populations of both species have coexisted in the Mazurian Lakeland for 20 years, inhabiting lakes, rivers, canals and other water bodies.

The aim of this study was to investigate whether there is evidence for the suppression of mink habitat use by otters in the aquatic habitats of the Mazurian Lakeland in winter. We tested the hypothesis that under interference competition, during periods of reduced availability of food, the sub-ordinate American mink should segregate from the habitats used by otters. To test the hypothesis, we compared the distribution of otter and mink tracks during periods of very low temperatures when access to aquatic food resources at almost completely frozen lakes and rivers is limited for both species.

Material and methods

The study was undertaken in the Mazurian Lakeland (53°30´–53°50´N, 21°10´–22°25´E), northeastern Poland, in February–March 2006. The Mazurian Lakeland is the post-glacial region covered by about 2700 lakes (> 1 ha), numerous rivers and man-made canals. The landscape is very diverse, with large areas covered by pine and mixed forests, as well as by fields, meadows and pastures. Wetlands, peatbogs and alderwoods, often adjoining lakes, can be found in the entire region. During the cold season (late November–early April) mean monthly temperatures vary from –6.7 °C to –2.7 °C. The lowest temperatures are recorded in January. Lakes are usually frozen from December until March and do not thaw during winter. Ice cover on streams, rivers and canals is less stable and is formed only during periods of very low temperatures. Snow cover is recorded for about 75–92 days, but in some years even for 130 days. During this period the mean depth of snow cover varies between 10 and 15 cm.

Twelve lakes, and sections of three rivers and two canals, located in the Mazurian Landscape Park and its vicinity, were selected for the study (Fig. 1). The size of the lakes ranged from 41.9 ha to 680 ha and the length of their shoreline varied between 4100 m and 14 170 m. The surroundings of selected lakes differed significantly, however, all lakes except one were characterized by the presence of tributaries and outlets. The survey was undertaken between 10 February and 12 March 2006. During this period the mean daily temperature was –5.6 °C and ranged from –10.9 °C to 0.6 °C. Therefore, all lakes, rivers and canals were ice-covered, and unfrozen sections and air-holes were scarce.

We studied the distribution of the otter and mink along entire banks of lakes, and along sections of rivers and canals with the method of snow tracking. The lakes, rivers and canals

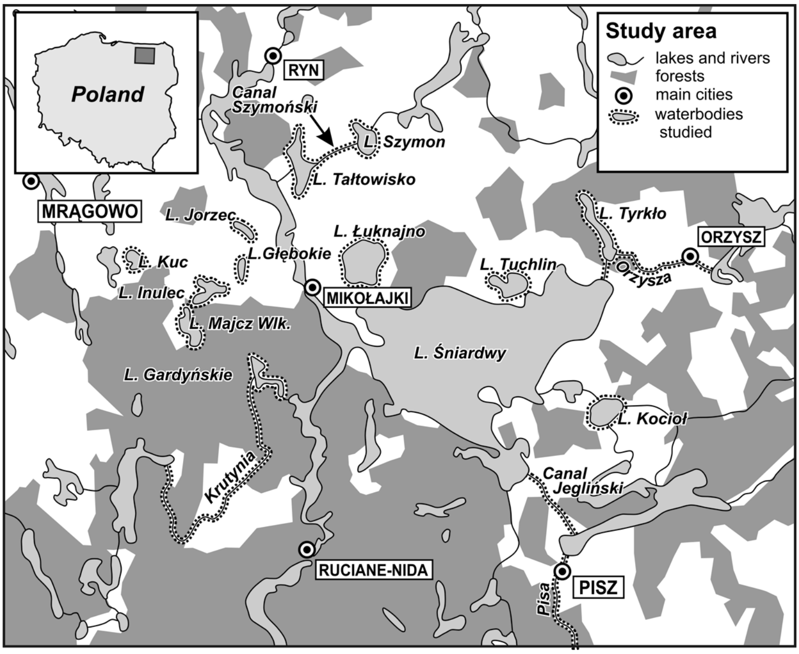

Fig. 1. Distribution of study sites in the Mazurian Lakeland.

studied were divided into 250-m-long sections and each section was searched for mink and otter tracks. Altogether 393 sections were distinguished (98.25 km), however, due to very dense riparian vegetation and wide reedbeds, 18 sections (4.5%) were omitted. Each section was searched for tracks only once during a total of 12 days of field surveys and the presence or absence of otter and mink tracks was recorded for each section. We conducted snow-tracking on the second and third days after snowfall. All tracks, as well as unfrozen stretches and natural (beaver- and otter-made) air-holes were mapped. Very small air-holes made by anglers, which freeze very quickly were not recorded.

Results

Otter tracks were recorded on all the lakes, two of three rivers and on both canals surveyed. Mink tracks were recorded on eleven lakes and along all surveyed rivers and canals. The tracks of both mustelids were recorded with similar frequency ($\chi^2 = 0.81$, df = 1, $p > 0.05$). Otter tracks were found on 25.9% of the surveyed sections, whereas tracks of mink were found on 28.8% of the sections. The coexistence of otter and mink tracks was recorded on 8.8% of all surveyed sections. Thus, the sections with otter tracks only made up 17.1%, and the sections with mink tracks only comprised 20% of all surveyed sections. Over 50% of the total length of the surveyed shoreline were not visited by any of the two carnivores. The distribution of the tracks of both species was random and did not indicate any coexistence or avoidance of otter and mink ($\chi^2 = 1.74$, df = 1, $p > 0.05$). However, the distribution of otter and mink tracks differed when analysed separately for sections with unfrozen stretches and totally ice-covered. A total of 46 unfrozen sections (67% on rivers, canals and small tributaries and 33% on the lakes) were found, which made up 12.3% of all the surveyed sections. Otter and mink tracks were significantly more often found on unfrozen sections than on sections with no access to open water ($\chi^2 = 11.81$, df = 1, $p < 0.001$ for otter; $\chi^2 = 18.72$, df = 1, $p < 0.001$ for mink) (Fig. 2). Moreover, frequency of co-occurrence of otter and mink tracks was over four-fold higher on sections with open water than on ice-covered sections ($\chi^2 = 24.74$, df = 1, $p < 0.001$). The tracks of both species were recorded in 28.3% of sections with unfrozen stretches and air-holes (Fig. 3), and on 6.1% of the ice-covered sections. Less than 20%

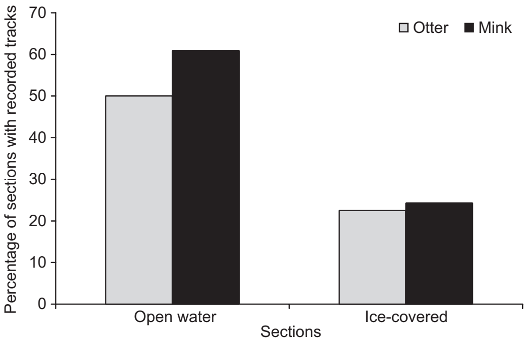

Fig. 2. Occurrence of otter and mink tracks in relation to the presence or absence of unfrozen sections of lakes, rivers and canals.

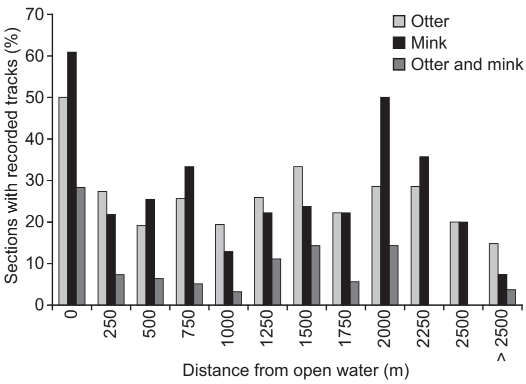

Fig. 4. Occurrence and coexistence of otter and mink tracks in relation to distance from the nearest sections with open water.

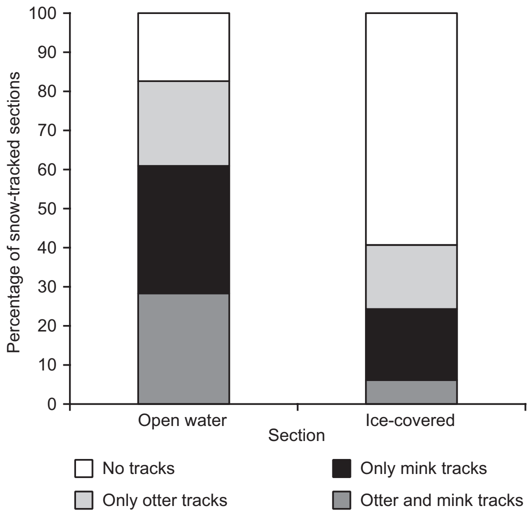

Fig. 3. Coexistence of otter and mink tracks in sections with open water and totally ice-covered.

of all unfrozen sections were not visited by any of the two mustelids during the study period. The frequency of occurrence of both species' tracks in the sections with open water was random (χ^2 = 0.37, df = 1, $p > 0.05$).

The abundance of otter and mink tracks did not decline significantly with distance from sections with unfrozen stretches and air-holes (χ^2 = 4.12, df = 10, $p > 0.05$) (Fig. 4). The co-occurrence of otter and mink tracks on sections with no access to open water was not related to distance from unfrozen stretches and air-holes (χ^2 = 7.09, df = 10, $p > 0.05$) (Fig. 4).

Discussion

The study in the Mazurian Lakeland does not support the prediction that otters force American mink to change their habitat use in winter. Random distribution of the tracks of both species in the sections with open water did not indicate avoidance of otter and mink. Otters and mink concentrated their activity in sections of lakes and rivers with open water as compared with sections with no access to air-holes. The probability of encountering both species in unfrozen sections was four-fold higher than in sections completely ice-covered, indicating that mink do not tend to avoid areas where otters search for aquatic prey. Based on a single survey conducted we could not detect whether mink and otters used the surveyed sections in the same or different periods, however, snow tracking revealed not a single case of a mink persecution by an otter. Such aggressive interactions were noted in other studies on competition of those species: Kruuk (1995) and Bonesi and Macdonald (2004a) suggested that mink possibly avoided the hunting grounds of otters at times when food resources for these species were particularly restricted.

Studies in northeastern Poland showed similar winter diets of otters and mink. On medium-sized and large rivers otters prey predominantly on fish (Brzeziński *et al.* 2006), whereas on small rivers the otter diet is strongly supplemented by amphibians (Brzeziński *et al.* 1993, Jędrzejewska *et al.* 2001). American mink in the study area also feed almost exclusively on fish and amphibians, and do not shift to an alternative terrestrial prey in winter (Brzeziński 2008). This result is in accordance with observation that the percentage of amphibians and small mammals in the mink diet is often negatively correlated (Jędrzejewska *et al.* 2001). The high dietary content composed of amphibians and fish in the Mazurian Lakeland arises from the high quality of lake and lakeside habitats (Brzeziński 2008). Increased abundance of amphibians in the winter diet of mink and otter in north-eastern Poland (Jędrzejewska *et al.* 2001, Brzeziński *et al.* 2006) suggest that both species efficiently find and dig out hibernating frogs. This indicates that, despite reduced availability of aquatic prey in the Mazurian Lakeland in winter, the generalist mink is not forced to change its diet and habitat use towards more terrestrial in the presence of a potentially dominant competitor, the otter.

These results are in contrast to earlier evidence on the effects of interference competition between the otter and mink in England (Bonesi & Macdonald 2004a). Taking into account two essential prerequisites for the existence of interspecific competition: (i) the overlap of ecological niches; and (ii) a reduction in resource availability caused by exploitation or interference (Keddy 2001), we assume that otters do not significantly reduce resource availability to American mink in the habitats studied in the Mazurian Lakeland. There are two possible explanations of this phenomenon: low density of otters and/or high availability of aquatic prey in the study area. Bonesi *et al.* (2006) observed that in England mink always declined when more than 40% of sites in the 50 × 50-km square were occupied by otters. Although precise data on the density of the otter population in the Mazurian Lakeland are lacking, we assume that it is higher than in England [100% of 10 × 10-km UTM squares with otter signs recorded (Brzeziński *et al.* 1996), and the presence of otters on each lake surveyed in the present study]. Thus, a lack of evidence of competition between the otter and mink in the study area can not be explained by a low density of the otter, moreover, American mink densities are relatively high as compared with those in other regions of Poland (Brzeziński & Marzec 2003).

The most probable explanation of the difference relation between the otter and mink in England and the Mazurian Lakeland is the availability of food. The river Teign in the study area in England is an oligotrophic river with a narrow strip of riparian habitat and salmonids predominate in the diet of the otter and mink (Bonesi *et al.* 2004). All the lakes surveyed in the Mazurian Lakeland are eutrophic, with high stocks of cyprinids, whereas riparian habitats support high densities of amphibians, reaching density of up to 1000 adult common frogs/ha in summer in lakeside alder woods (M. Brzeziński unpubl. data).

Otters and American mink coexist at relatively high densities over large areas of eastern Europe and Scandinavia and their habitats overlap to a higher extent as compared to other pairs of mustelids inhabiting river valleys (Sidorovich *et al.* 1996). In good quality habitats even recovering otter populations in areas previously colonized by mink do not have negative impacts on mink populations (Skarén & Kumpulainen 1986), contrasting earlier suggestion that the otter may successfully eliminate the mink (Jenkins & Harper 1980) or at least reduce mink densities (Bonesi & Macdonald 2004a). While Bonesi and Macdonald (2004b) showed that otter and mink coexisted for longer in habitats where mink could find alternative terrestrial prey, this study demonstrates that in habitats with large supply of aquatic prey even during periods of reduced availability of foraging sites, competition between these two mustelids may not have a particularly strong influence on the distribution and densities of the American mink.

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