



RESEARCH ARTICLE

EXPERIMENTAL STUDY OF INTERSEXUAL INTERACTIONS IN THE AMERICAN MINK
(*NEOVISON VISON*) AND INTRAGUILD PREDATION

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ABSTRACT

In experimental conditions intersex interactions at the American mink involving captive-bred and feral minks were studied. During the breeding season, reaction of female American mink to familiar and unfamiliar males was studied and revealed a female preference for a familiar male and formation of a close relationship between a female and a male. American mink males show aggression to unfamiliar animals of own species, regardless of gender and age, as well as to other species of mustelids. The degree of aggression in males of the American mink is much depending on their origin and individual recognition. Aggression of wild males of the American mink is the reason for infanticide and intraguild predation.

INTRODUCTION

The American mink (*Neovison vison*) is a semiaquatic species of mustelids native to North America brought as furbearer to fur farms of Europe in the late 1920s of the XX century. Most of animals escaped from farms or were released into the wild. The first specimens of the American mink were recorded in the wild in various parts of Europe in 1930s-1960s. From 1930s, in Russia, the American minks were released to the wild to create populations in the wild. By the late 1990s this predator inhabited the shores of many water bodies from the western borders of Russia to the Far East. Wherever the American mink occurs, it impacts both on victims and competition causing decline their numbers (Macdonald and Harrington 2003). In Europe, minks predation resulted to the decline in seabird colonies, waterfowl birds (Craik 1997; Clode and Macdonald 2002; Bartoszewicz and Zalewski 2003), the number of water vole (*Arvicola terrestris*) (Woodroffe *et al.* 1990; Barreto and Macdonald 2000; Rushton *et al.* 2000; Macdonald *et al.* 2002) and some species of amphibians (Banks *et al.* 2008). The American mink affected the number of native carnivores, such as the European polecat (*Mustela putorius*) and the Spotted genet (*Genetta genetta*). In Catalonia the number of population of the European polecat drastically decreased in 1960s to 1970s (Melero *et al.* 2012).

American mink invasion decrease the number of polecat (*Mustela putorius*), erminea (*Mustela erminea*) and Siberian weasel (*Mustela sibirica*) in Western Siberia and northwestern Russia (Danilov and Tumanov 1976; Sinitsyn 1992; Sidorovich 1997; Sidorovich *et al.* 2001). The American mink negative impacted on the European mink (*Mustela lutreola*), which is now on the verge of extinction (Maran *et al.* 1995). There are several hypotheses trying to explain the decline of the European mink. The decline of the European mink is associated with habitat degradation (Tumanov 1996; Lodé 2002; Zabala *et al.* 2003), transfers from American mink diseases (Mañas *et al.* 2001), although this last assumption has no compelling evidence (Sidorovich 1997). Each of these hypotheses cannot explain the population decline of other mustelids after the introduction of the American mink. Studies in captivity and the wild have shown the existence aggressive interactions between American mink and European mink.

American minks are substantially larger and more aggressive than European minks, and American minks always dominate in fights. Many researchers believe that direct aggression, at least is a partial reason for extinction of the European mink following the invasion of the American mink (Maran *et al.* 1998; Sidorovich *et al.* 2000). Despite the description of aggressive behavior between these two species, there are still no published data on predation of the American mink towards the European mink and other mustelids (Podra *et al.* 2013). This article describes i) intersex and interspecific relations of the American mink involving feral minks ii) the predation of

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American mink as a possible mechanism of its impact on other species of the mustelids.

MATERIALS AND METHODS

Supervisions and experiments, and also accidental events in the animal nursery of the Ilmen Reserve formed the basis for this paper. In the Ilmen Reserve nursery, captive-bred and feral American minks, Siberian weasels, captive-bred European minks and domestic ferrets are kept. The research involved 5 wild-caught American minks (3 males and 2 females), 9 captive-bred American minks (6 males and 3 females), and 6 domestic ferrets. All minks were wild-type, two feral males and one American mink female were caught young and probably had the age of 10-11 months, one feral female was caught at the age of 3.5 to 4 months, and one feral male was caught adult at the age of two years or older. Captive-bred minks and domestic ferrets were born in the nursery. We had the opportunity to monitor the changes in behavior and the attitude to females of two captive-bred males, lived in the nursery to 8 years and a feral male, who has lived in a nursery up to 5 years. Animals were kept in wire mesh enclosures size of 3.0 x 2.0 x 1.7 m and standard cages with wooden nest boxes that are used at fur farms. The cages had the size which allows the animal to move freely, lie down fully stretched out, to climb up the mesh and to stand in the fully extended position on its hind legs (height of cage greater than width). Enclosures were placed in two lines opposed to each other, 8 enclosures in a line, the lines separated by the passage of 120 cm width. There was a hole in the bottom of each enclosure, i.e. a feeding slot to put a tray with food, which was locked with a light weight latch. A drinking bowl with fresh water was put into each enclosure and cage.

Ethical Note

Conditions of keeping animals during the experiments did not differ from the usual. Although minks put together for mating were aggressive, but they were all under our control, and prevented the animals from serious injuries and damage excluding some accidents events when the American mink males escaped from their enclosures at night. Observations and experiments were carried out for a few years when the animals were kept in good condition.

Experiments and accidental events

The first type of experiments

Stage 1 : At the end of February, the captive-bred male American mink "A" was put to the enclosure to feral female American mink "C" which was at the age of 2 years (caught at the age of 3.5 to 4 months) and did not participate in reproduction in the previous season. The male was put to the female's enclosure in a standard cage. Through the mesh floor of the cage, the animals could communicate but were not able to injure each other. After 10 days male "A" began to release in an enclosure for "C" female. The male cooed, grabbed the female by the neck and held her. After 1.5 hours the male returned to the cage. The male was released from the cage since the beginning of March every day for 1 – 2 hours for 14 days. Sometimes the male runs to the female "C" in the nest box, took away her food, the female "C" squeaked and tried to expel the male, but severe fights was not.

Stage 2 : After another placing of the male "A" to female was released the young (age 10 months) captive-bred male "B", who lived in the enclosure opposite the "C" female. The male "B" explored the enclosure of the female "C", moving slowly and sniffing, not marked and cooed. The female "C" at first watched him from the nesting box, then slowly followed him, sniffing, and after some time attacked him, she chased him across the enclosure and attacked him. The female chased the male round the enclosure and attacked him. It was succeeded to separate them with great difficulty.

Stage 3 : 60 minutes after the "B" male, the "A" male was put to the "C" female's enclosure again. The "C" female made some aggressive attempts to attacks on the male, but the fight did not happen. After that, the "A" male messed around the female's nesting box for a long time trying to enter the box. There was a little skirmish between "A" male and "C" female, after which "A" male lay down on top of the female's box, cleaned himself, curled up and fell asleep. The "C" female stayed in her box for a long time. Unlike the male "B", the "A" male heavily marked all items in the female's enclosure, chafed with his back and sides against the floor and walls of the female's box.

Stage 4 : Two hours after the end of the 3rd stage, another young (age 10 months) captive-bred male "V" was released to the female "C". In the enclosure of the female "C", the male "V" began to explore the territory, slowly walked around the enclosure, cooing the territory. The male "V" slowly walks, explores and marks the enclosure, trying to coo. The "C" female stayed in her box for a long time, looked out and sniffed. As the result, the female attacked the male "V" and there was severe fight. The female was driven into her box with a great difficulty, as she tried to attack and bite the male "V".

The second type of experiments

In late February young (age about 10 months) wild female "Z" was captured. In the breeding season, during March, two captive-bred American mink males were placed alternately to the enclosure of the feral female "Z" without prior acquaintance and adaptation to each other as in the case of female "C" (first type of experiments). The female "Z" hasn't accepted any of the introduced young males and female "Z" attacked them. Then, a large experienced captive-bred male was released to feral female "Z", which has managed to overcome her aggression and to mate with her, but offspring haven't been received possibly because of stress of feral female "Z".

The third type of experiments and accidental events

A. The captive-bred female American mink "FF" (3 years old) and wild adult male "DD" (2 years old or older) captured in the autumn of the previous year, the winter were kept in neighboring enclosures separated by a common solid metal wall upstairs passing into the net. At appearance of people the male of "DD" fell into a state of shock, fell on the floor, pretending to be dead. During the day he never came out from its nesting box. It created great difficulties in the breeding season so in March the manhole in the mesh for free access of animals to each other was done. After that there were repeatedly mutual transitions of minks to each other, as a rule, at night. In late April, shortly before the female "FF's" whelping, the hole between the enclosures was blocked. It was

a very stressful for the male. Striving to get to the female "FF", he did underminings, tore wire mesh resulting in hurt his feet and we have restored the passage between the enclosures. At the end of June, the male "DD" and the female "FF" managed to escape through the feeding slot from their enclosures and enter the next enclosure, where the female of domestic ferret dwelt with 6 puppies, whose age was 1.5 months. The male "DD" killed five ferret cubs taking their bodies to his box. Only the female ferret and one juvenile ferret male survived.

B. Accidental events related to escapes and aggressive fights between the animals occur on any farm. In August, an adult captive-bred male American mink escaped from its enclosure and get through the feeding slot to two juveniles (3-months-old) captive-bred American minks (female and male) were kept. The adult male killed the young male and tried to mate with young female.

DISCUSSION

During our experiments we observed the entire possible range of relationships between males and females of American mink. It is considered that females of American mink are relatively passive in the choice of males for mating and exhibit promiscuous mating system (Thom *et al.* 2004; Yamaguchi *et al.* 2004). In our experiments (first type of experiments) female preferred familiar males, aggressive rejected two young males, although at least one of them was familiar to her, as he lived in an enclosure located in front of the female's enclosure. Thus, the choice of femalee was based on individual recognition and preference of the male. In the wild American minks have home ranges, which are located linearly along the shores of water basins and intrasexual territoriality is typical for them as for other mustelids (Powell 1979; Yamaguchi and Macdonald 2003; Melero *et al.* 2012) and the female can be familiar with any, at least with two males whose sites may adjoin to its area or to overlap partially. The abundance the various watercourses increases the possibility of more dense settlement areas and during a reproduction season at hyperactivity of males, conditions for "mixing" of the existing neighbor's relationship between animals are created and the female has an opportunity to copulate with not one male. The origin of animals is of great importance at research relations between males and females of American mink. The difficulties of working with wild animals are related to their fear of people and stress, constant desire to escape, and impossibility to use enough number of feral animals in experiments, forcing researchers to use captive-bred minks, whose behavior modified by selection considerably (Thom *et al.* 2004). It is known that the behavior patterns of wild and domesticated rodents belonging to same species, there are many differences (Dewsbury 1978).

According to our observations feral males of American mink are more aggressive than captive-bred males. In the wild, aggression is useful for mink, but not convenient in captivity, so aggression was one of the main directions of selection in domestication history of American mink (Trapezov 2000; Malmkvist and Hansen 2002). The aggression of captive-bred minks varies considerably. Males used in breeding for several years become less aggressive towards females with age. In our experiments, the males of American mink, which we used for breeding for 5 years, did not show extreme aggression towards females which were resisted actively, and left them alone if female was not ready to mate, in contrast to feral males that

could put significant wounds. In our experiments (the third type, A), feral male American mink contacted actively with a female before the mating, after mating and during cubs feeding, though we didn't observe that the male came into female's box after the birth of cubs. Together and purposefully they attacked a family of ferrets (opened the latch, locking feed capacity in feed slit cages ferrets).

The aggression of American minks and killing of domestic ferret cubs is one of the examples of interspecific predation that is common in mammalian carnivores (Palomares and Caro 1999; Sommer 2000). Aggressive interactions between adult American minks and other mustelids were observed repeatedly in experimental conditions and in the wild (Maran *et al.* 1998; Sidorovich *et al.* 1999; 2000), but infanticide difficult to observe in the wild and hence very little evidence of its registration and description (García-Díaz *et al.* 2013). American minks could attack any other mustelidae species in the nursery, for example, such as European minks, if their enclosure would be available for penetration. In the wild, both mink species inhabit in the same habitats, and thus the European mink is primarily exposed to intraguild aggression of American mink males. In my opinion, the American mink male infanticide is the main mechanism that led to the catastrophic extinction of the European mink and reduction of other mustelids after American mink invasion, and the aggressive behavior patterns of the American minks is adaptive species sign. In wild populations of the American mink the individual recognition may be much more important than we think. In our nursery, two big captive-bred American mink males lived in adjacent enclosures separated by wire mesh wall for 8 years, and were never aggressive confrontations between them, each of them actively interested in life of another.

Another example could be the case that a hunter trapped two males of American mink in the one den by winter (per. com.). Data on the movements of the American minks, obtained mainly by telemetry techniques (Gerell 1970; Yamaguchi *et al.* 2003; Melero *et al.* 2008) indicated that yearling animals were not recorded at home range of adult males, as a rule (Wolff and Macdonald 2004), it's most likely due to the aggressive behavior of American mink males and possibility of death of young animals in case of their meeting with adult males. The incident of death of a young American mink male due to aggression of the adult male in our nursery confirms this possibility. It is believed that mating with several males helps females to avoid potential male aggression and killing of cubs (Wolff *et al.* 2004; García-Díaz *et al.* 2013). A small number of observations don't allow us to unambiguously assert that in wild populations of American mink events occur that way, as we observed in the experimental conditions of the nursery however the participation in researches of feral animals allows to exclude the influence of artificial selection taking place at captive-bred animals. Our observations show that the aggression of the American mink is the most important behavioral patterns and individual recognition is a necessary opposite of the aggression. Further researches of intraspecific and behavior at wild American minks, undoubtedly, will bring more understanding in this problem.

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