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Behavioral studies on the use of open water basins by American mink (*Neovison vison*)

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ABSTRACT

The aims of this study were to investigate whether farmed mink use swimming basins as an environmental enrichment factor and to identify layouts suitable to allow mink to perform their characteristic behavior to a large extent. Furthermore, an assessment of the water quality was intended. In 2006, the German "Order on the Protection of Animals and the Keeping of Production Animals" (German designation: Tierschutz-Nutztierhaltungsverordnung) stated mandatory husbandry requirements for fur animals for the first time in Germany. For mink, these include a water basin which is suitable for swimming. Forty American mink (*Neovison vison*) from a commercial mink farm were housed in 2 identically constructed free-range enclosures at the age of 13 weeks. In each of the 2 enclosures, the mink were offered 3 different water basins, which differed in shape, depth, and surface area and included a rectangular "swimming pool" (surface area approximately 20.5 m^2, depth approximately 30 cm), a round "pond" (surface area 4.9 m^2, depth approximately 80 cm), and a flowing "creek" (surface area 4.0 m^2, length approximately 10.0 m, width 40 cm, depth 3-4 cm). Twenty nest boxes were placed in each enclosure (animal-to-nest box ratio: 1:1). The animal behavior in both groups was assessed by direct and video observations. Results showed that the mink generally accepted all 3 water basins and used them extensively from the beginning to the end of the study. Descriptive and negative binomial model analysis of water contact counts obtained from direct observations showed that mink preferred the swimming pool. However, in relation to the basin surface area, the preference effect is more pronounced for the pond. Overall, the animals spent a considerable amount of time at and in the water during their main activity time. On average, each mink could be observed 7 minutes per hour (12.0%) at and in the pool or 3 minutes per hour (5.5%) in the pond. The water quality was very good throughout the study. Although the mink used the water frequently, the total bacteria count and the level of Enterobacteriaceae were always very low. There were no traces of salmonella in any water sample.

Introduction

The behavioral needs of farmed mink, including access to "swimming water," have been the topic of debate and of several scientific investigations. In the wild, American mink (*Neovison vison*) are semi-aquatic mustelids whose living habits often are associated with various types of water supplies such as streams, riverbanks, and lake shores (Dunstone, 1993). The results of Zschille et al. (2004) confirmed that feral American mink prefer water bank habitats in eastern Germany. These mink are opportunistic predators which live mostly on fish, amphibians, and crustaceans but also hunt rabbits and other prey on land (Wiepkema and de Jonge, 1997). For example, Wolff et al. (2015) found that in Illinois, USA, the site occupancy by mink was related positively to the presence of local areas with high crayfish

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concentrations (hotspots), instead of local habitat characteristics that might indicate high prey densities.

Many studies have dealt with the question whether swimming is an essential behavior pattern for mink (Cooper and Mason, 1999; Hansen and Jeppesen, 2001a; Mason et al., 2001; Vinke et al., 2006; Ahola et al., 2011). A number of publications offer supporting evidence for this hypothesis: Several preference tests, in which mink had to work for resources, showed that swimming water was the most valued resource (other resources tested included an alternative nest site, toys, a raised platform, a tunnel, and an empty cage; Mason et al., 2001). Cooper and Mason (2001) show that there was no difference in the maximum "price" paid for the access to food and a swimming bath. In a comparison of the demand of farm mink for a swimming bath versus a running wheel revealed that mink accepted the running wheel and the swimming bath equally, even when one of the resources was offered for free, whereas the price for the other was increased (Hansen and Jensen, 2006a). The use of the running wheel may be associated primarily with locomotion, whereas the use of the swimming bath may be associated with exploration behavior (Hansen and Jensen, 2006a), possibly meeting different needs or desires (Hansen and Jensen, 2006b).

Farmed mink typically do not have the opportunity to swim or dive because their cages lack water pools. Standard wire cages for the accommodation of one breeding mink, or one female with litter, or one juvenile male plus one juvenile female in the growth period until pelting are approximately 85 cm long, 30 cm wide, and 45 cm high (total area: 2,550 cm^2) and connected to an additional wooden nest box (ZDP, 2015). The food is placed directly on the mesh wire on top of the cage, and drinking water is offered in nipple drinking troughs. The German Fur Animal Breeding Association (ZDP, 2015) currently is testing so-called "family cages" on commercial farms in Germany. Those are cage systems on multiple levels, enriched with "rest and play areas" (total area: 6,429 cm^2 without nest box), where the female remains with her kits until their sexual maturity (ZDP, 2015). However, these cages do not offer any swimming opportunities and do not meet the requirements of the German "Order on the Protection of Animals and the Keeping of Production Animals" (Tierschutz-Nutztierhaltungsverordnung, 2006).

Based on the biology of wild mink, European animal welfare recommendations suggest that swimming is an essential behavior pattern for mink, and therefore, a swimming basin should be provided for farmed mink (Council Directive 98/58/EC; Council of the European Union, 1998). In 2006, the German "Order on the Protection of Animals and the Keeping of Production Animals" (Tierschutz-Nutztierhaltungsverordnung, 2006) amended and published on August 22, 2006, last changed on February 5, 2014, stated mandatory husbandry requirements for mink for the first time in Germany. These requirements (with a transition period until 2016) include a water basin for swimming, a platform, and a nest box. Therefore, the purpose of this basic pilot study was not to prove whether swimming is a behavioral need or not. It was the aim to investigate if and to what extent farmed mink use swimming water as environmental enrichment, and to analyze which kind of water basin is suitable to allow mink to perform swimming and diving behavior to a large extent. An assessment of water quality and temperature was also conducted.

Animals, materials, and methods

Subjects and experimental design

The study was carried out at a research center of the Ludwig-Maximilians-University Munich, Germany, from the end of July through the beginning of December 2007. Forty American mink (*N. vison*) were housed in 2 identically constructed free-range enclosures, with a size of approximately 300 m^2 each (Figure 1). Every enclosure housed 20 mink (groups A and B). This double approach was deliberately chosen, to have a simultaneous replication of the experimental set up. The animals were bought from a commercial mink farm at 9 weeks of age after weaning and put into a quarantine facility (which met the criteria of the German "Order on the Protection of Animals and the Keeping of Production Animals" of 2006 but had no swimming bath) for 3 weeks. At the age of 13 weeks, they were moved to one of the 2 free-range enclosures. Both groups were formed randomly, but a balanced gender ratio was considered (group A: six demibuff and 5 silverblue females, 5 demibuff and 4 pearl males; group B: 6 demibuff and 4 pearl females, 6 demibuff and 4 silverblue males). Although this type of social housing in large groups is not typical for wild mink after weaning, or mink housing on commercial farms, it was chosen to be able to observe the behavior of a great number of individual animals at the same time in semi-natural surroundings as a starting point for further studies. To be able to identify the individual animals for health inspections and the use of the different nest boxes (see the following paragraphs), all mink were microchipped with a transponder (HDX—Half Duplex Datenübertragungstechnik RFID-System, Texas Instruments, Thief River Falls, Minnesota, USA) in general anesthesia (animal experimentation permit: see Ethical consideration).

In each of the 2 identical enclosures, the mink were offered 3 different water basins, which differed in shape, depth, and surface area. The following water basins were available to the mink: a rectangular "swimming pool" (surface area approximately 20.5 m^2, depth approximately 30 cm), a round "pond" (surface area 4.9 m^2, depth approximately 80 cm), and a running "creek" (length approximately 10.0 m, width 40 cm, depth 3-4 cm [surface area 4.0 m^2], with 2 pools/hollows along its length). The "creek" established a connection between the "swimming pool" and the "pond." All 3 water basins were linked by a pump, which allowed the flowing of the "creek" (Figure 1).

Twenty nest boxes with litter material were provided in each enclosure. This represented an animal-to-nest box ratio of 1:1. Each nest box was equipped with 1 entrance/exit tunnel with 1 antenna on each end of the tunnel that read the mink's transponders and allowed to register individually each mink's entering and exiting a nest box (Thurner et al., 2008). These data were used to establish diurnal and seasonal activity patterns (data not shown in this article). Each nest box measured 35 × 35 cm and was 30 cm high (area approximately 0.12 m^2). The mink were fed twice daily in the group with commercial mink feed, between 9 and 10 AM and 3 and 4

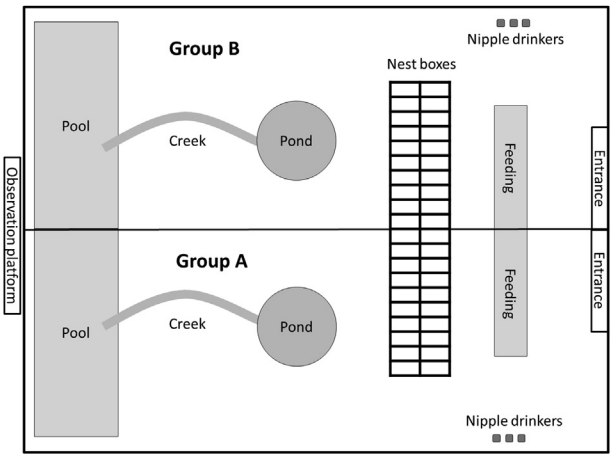

Figure 1. Schematic depiction of the free-range enclosures (not true to scale).