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Providing 'get-away bunks' and other enrichments to primiparous adult female mink improves their reproductive productivity

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ABSTRACT

This study investigated whether simple, cheap enrichments – 'get-away bunks' (a wire mesh semi-cylinder attached to the cage ceiling) and small manipulable objects (balls and suspended chewing items) – could improve welfare and productivity in nursing mink dams (*Neovison vison*) in commercial farm conditions in southern Ontario (Canada). Experiment 1 replicated a study conducted the previous whelping season on the same farm. It evaluated whether providing bunks to multiparous dams ($n = 164$) could decrease their morbidity and mortality or boost kit weaning weight, and assessed dams' overnight use of these structures to compare day and night utilization. Overnight bunk-use proved to be no different from daytime use, and night- and day-use co-varied; bunk use recorded in daylight is thus a good proxy for overall use. Bunk use did not, however, influence kit weights at weaning, nor reduce dam deaths from nursing sickness (replicating the previous year's findings), nor significantly improve subjectively scored teat health (unlike the previous year's findings). Experiment 2 reassessed bunk effects using larger sample sizes, and investigated their interaction with enrichment objects. Focusing on primiparous dams ($n = 318$), it evaluated whether providing balls and items to chew, along with bunks in a cross-factored design, could decrease stereotypic behaviour, glucocorticoid output (assessed via faecal cortisol metabolites: FCM), kit losses, and, again dam mortality. Objects were provided *c.* 10 months earlier (since the previous July) for approximately 60% of the object-enriched dams, and *c.* 5 months earlier (since January) for the remaining 40%. Analyses showed that effects of bunks and enrichment-objects did not significantly interact for any variable. Bunks significantly reduced kit mortality: kit losses/litter were reduced by *c.* 0.3 infants, resulting in negligible levels of mortality, and bunks tended to reduce dam stereotypy levels by about half (from approximately 12.5% to 6% of time spent active). However, bunks had no significant effects on FCM or dam mortality rates. Bunk-use also significantly co-varied with litter size, being greatest in dams with bigger litters. Enrichment objects tended to increase weaning litter size, an effect caused by dams provided with these objects for 5 months weaning 0.9 more kits per litter than females without these items. However, this type of enrichment again had no significant effects on FCM or dam mortality. Instead, which farm animals lived on appeared to be the major determinant of FCM and dam mortality: both significantly varied between

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farms, with one farm showing notably higher levels of both. Also, even controlling for farm, females who died tended to have had elevated glucocorticoids when sampled 2–3 weeks prior to death. In conclusion, bunks and manipulable enrichment objects seem ineffective against nursing sickness, but had independent, additive effects on the productivity of young adult females, possibly acting by improving primiparous dams' welfare.

1. Introduction

Mink on North American farms typically live in small wire mesh cages, each with a nest box: environments providing limited stimulation or opportunities to exert control. Several European studies demonstrate welfare and productivity benefits from giving farmed mink environmental enrichments, including structural changes to cages (e.g. shelves), manipulable objects, and improved nesting materials (e.g. Hansen et al., 2007; Jeppesen, 2004; Malmkvist and Palme, 2008; Vinke et al., 2004). Our aims in this and related studies (Dawson et al., 2013; Mason et al., 2012) are to evaluate similar housing changes on commercial Canadian farms, with their different genetics, cage designs, climates and feeding regimes. One such manipulation involves providing items that can be chased and/or chewed, such as balls and hanging plastic chains. A Danish study found that objects of this type reduce cortisol levels, tail-chewing and stereotypic behaviour (Hansen et al., 2007). Another is structural, involving semi-cylindrical wire mesh 'bunks' attached to the cage ceiling. In some European countries, e.g. Denmark, bunks, shelves or suspended cylinders allowing mink an elevated area to climb into and rest may be incorporated into all cages for year-round use (e.g. Hansen et al., 2011). However, North American cages for paired juveniles and single adults typically have a 'drop-in' nest box that fills part of the cage, greatly limiting the space available for such additions. Only whelping cages (for nursing families) here have the nest box attached outside the cage, so leaving room for additional structures: fortunate since, as reviewed below, such furnishings seem particularly beneficial for nursing dam welfare.

Mink are polytocous, raising a litter of altricial offspring annually. After *c.* 90 generations of artificial selection for large litters, farmed females produce more infants ('kits') than their wild counterparts (Dunstone, 1993; Malmkvist et al., 2007), and by 30 days the mass of the litter is typically heavier than the dam (Jøergensen, 1985). Furthermore, kits are typically not separated from the dam until more than 2 weeks after they are mobile enough to pursue her into all parts of the cage (Brink et al., 2004; Brink and Jeppesen, 2005); and during the last 2 weeks of the whelping period kits do not just suckle (albeit it at reduced levels), but also drink their mother's saliva (Brink et al., 2004; Brink and Jeppesen, 2005). This situation may cause the dam health problems, especially mastitis and nursing sickness (e.g. Clausen et al., 1992; Rouvinen-Watt and Hynes, 2004; Schneider, 1996). It may also elevate stress, because dams cannot remove themselves from kits as they would in the wild (Hansen, 1990; Pedersen and Jeppesen, 2001). Cage furnishings can help mitigate some of these problems. Danish research shows that dams provided with shelves or similar structures that they can climb into but their kits cannot, perform less stereotypic behaviour than controls (Hansen, 1990). Furthermore, dams use such elevated structures increasingly over lactation, although abandoning them once kits can climb up to them (Hansen, 1990; Jeppesen, 2004). One Canadian study (Dobson and Rouvinen-Watt, 2008) further found that amongst dams stressed by research procedures (e.g. blood sampling), those given suspended plastic bunks were better able to wean larger litters, in terms of kit number and total litter mass; while mortality rates in 'high weight loss' females (losing more than 20% body weight over lactation) also appeared reduced. Recently, we confirmed that elevated bunks on commercial Canadian farms are increasingly used by dams as their litters mature (Dawson et al., 2013); the bunks also reduced stereotypies, and in multiparous females, visually scored teat health problems.

Our first aims were to build on this last study, using animals on the same farm in the following whelping season (Experiment 1). Teat health was not previously scored blind to treatment (Dawson et al., 2013); this therefore needed replication with blinding. Bunk use had only been assessed between *c.* 09:00 and 17:00 h, leaving nocturnal and 24 h use unknown. Dawson et al. (2013) also found no apparent benefits for nursing sickness: to investigate this further, we now focused on multiparous dams with large litters, *a priori* likely to be more at risk of this disease (Clausen et al., 1992; Rouvinen-Watt and Hynes, 2004). In Experiment 2, we compared the relative effects of bunks and manipulable enrichment objects on stereotypic behaviour, kit losses, weaning litter sizes, dam mortality rates, and levels of faecal cortisol metabolites (FCM). We also investigated whether they are synergistic if used together, since ecological and human health studies reveal that combining stressors can cause non-additively heightened negative effects (e.g. Dragano et al., 2005; Sih et al., 2004), while rodent-based neuroscience research shows that combining diverse enrichments can be disproportionately beneficial, compared to supplying enrichments separately (Sozda et al., 2010). This experiment capitalized on an ongoing, large-scale study (Mason et al., 2012) in which thousands of animals were provided with objects to chase and chew, on the farm used in Dawson et al. (2013) and Experiment 1 plus an additional two farms.

1.1. Ethical approval

The University of Guelph Animal Care Committee, complying with the University of Guelph Animal Care Policy and Canadian Council on Animal Care, approved both experiments.