Chapitre 3

Evaluation of a technique to trap lemmings under the snow

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Résumé

Nous avons tenté de capturer des lemmings sous la neige dans leur habitat hivernal préféré en utilisant des boîtes en forme de cheminée à deux sites situés dans l'Arctique Canadien. Les boîtes ont été utilisées par les lemmings durant l'hiver mais nous avons eu un très faible succès de capture en avril et mai. Contrairement à la majorité de l'hiver, les températures sous-nivales étaient plus froides que les températures de l'air pendant que nous avons trappé au printemps. Nous émettons l'hypothèse que notre faible succès est dû au déplacement des lemmings des sites de fort enneigement, où nos boîtes étaient installées, vers ceux de faible enneigement ou vers la toundra exposée. Nous suggérons que les boîtes de trappage pourraient être plus utiles si le trappage se faisait plus tôt au courant de l'hiver.

Abstract

We attempted to live trap lemmings under the snow in their preferred winter habitat at two sites in the Canadian Arctic using chimney-like boxes. Boxes were used by lemmings during winter, but we had very low trapping success in April and May. In contrast to most of the winter, sub-nivean temperatures became colder than ambient air temperatures in spring when we trapped. We hypothesize that our low success resulted from lemmings leaving the deeper snow areas where our boxes were located and moving to shallower snow or exposed tundra. We suggest that the trapping boxes could be successful if trapping occurred earlier during winter.

Introduction

Our understanding of the winter ecology of Arctic lemmings (*Dicrostonyx* and *Lemmus* spp.) remains poor despite almost a hundred years of study (Elton 1924). In recent decades, new information has been acquired (MacLean et al. 1974, Sittler 1995, Korslund and Steen 2006, Kausrud et al. 2008, Gilg et al. 2009, Ims et al. 2011, Duchesne et al. 2011b, Reid et al. 2012), but much has been indirect. Lemmings live under the snow for up to eight months in the Arctic and build nests of vegetation as insulation from the cold. Much of our understanding of their winter ecology comes from sampling and analysing these nests at snow-melt (MacLean et al. 1974, Sittler, 1995).

Our understanding would increase dramatically if we could live-trap lemmings through the snow, and employ mark-recapture, radio-telemetry and repeated tissue sampling. Some early attempts to trap small rodents through the snow had some success. For instance, in Russia, Denisenko (1986) dug chimney-like shafts through the snow, installed snap traps near active sub-nivean lemming burrows, covered the traps and then added back the snow. Though successful, such methods are time-consuming and result in repeated disturbance of the snow pack and subnivean space, altering the habitat significantly (Fay 1960, Iverson and Turner 1969). Therefore, we tested a less disruptive technique using trapping boxes that necessitate very little or no digging to access traps and allowed repeated access, as required by live-trapping techniques. These boxes were based on the design of Pruitt (1959), and have been used by Korslund and Steen (2006) to trap voles through the snowpack. In this paper, we describe the use of trapping boxes, and a test of their effectiveness in trapping lemmings in winter at two sites in the Canadian High Arctic. Because the technique was not very effective during the time periods we tested it, so we provide some testable hypotheses to explain this failure and recommendations on potential improvements.

Methods

Study area

The study was conducted on the south plain of Bylot Island, Sirmilik National Park, Nunavut (73° 08 'N, 80°00' W) and on Herschel Island, Yukon (69° 34'N, 138° 55'W). On Bylot, the study area (70 km^2) was comprised of upland plateaus and rolling hills dominated by mesic tundra and wetter lowland areas with tundra polygons, thaw lakes and ponds. Small, intermittent streams running through upland areas supported riparian wetland vegetation (Duchesne et al. 2011b). On eastern Herschel Island (50 km^2), two types of drier upland plant community, - tussock tundra and prostrate-shrub heath, - were dominant, with infrequent small wetlands (Reid et al. 2012). Both study areas supported cyclic populations of collared lemming (*Dicrostonyx groenlandicus*) and brown lemming (*Lemmus trimucronatus*; Gruyer et al. 2008, Krebs et al. 2011). On Herschel Island, lemmings were in their low phase in spring 2009 (Krebs et al. 2011). On Bylot Island, both species were in their increase phase in spring 2010 and brown lemmings increased further to reach a peak in spring 2011 though collared lemming populations had crashed before spring (Gauthier, G. and Bilodeau, F. unpublished data).

Selecting trapping sites

Trapping occurred in springs 2010 and 2011 on Bylot Island and spring 2009 on Herschel Island. We selected trapping sites with a high probability of winter use by lemmings. Wintering lemmings prefer heterogeneous micro-topography and deep snow cover (≥60 cm), conditions that are typically found in hilly mesic tundra and along gullies bordering streams (Duchesne et al. 2011b). During early June 2009 on Bylot, we measured snow depth at 100 sites and pre-selected those with depth >60 cm. After snow-melt, we checked these sites for evidence of lemming use during winter, and then selected 40 sites with the highest density of sign to install the trapping boxes. Boxes were spread over 980 ha and the distance between boxes ranged from 42 to 155 m. On Herschel, we mapped lemming winter nests after snow-melt in June 2007 and June 2008. In September 2008 we chose trapping sites where there had been clusters of winter nests the previous two winters, and placed 27 trapping boxes on one 9 ha area, and four trapping boxes on another 2.5 ha area.

Trapping boxes

To allow placement of live traps at ground level and allow access to traps through the snow pack, we built chimney-like boxes (60 cm high, 40 cm long and 20 cm wide) of 1.3 cm plywood with a removable lid insulated with 5 cm of foam (Fig. 1). Once installed, trapping boxes were secured to the ground with two 2 m metal stakes to resist wind and disturbance by caribou. The interior floor of a box was large enough for a Longworth® live trap with extra space for lemmings to move around. Lemmings could enter the boxes through two 5 cm diameter, 20 cm long, plastic tubes located on opposite sides at ground level. At both study areas, a trap with cotton bedding was locked open and placed inside each box at the end of summer. At Herschel, just before snow-melt in April 2009, we opened the boxes, examined them for signs of lemming use, and baited the traps with apple. The traps were set for two days, checking every two hours. At Bylot Island, we opened the boxes in early May, and set traps with cotton bedding, and apples and peanut butter as bait. We visited traps every six hours for 10 days in May 2010 and 5 days in May 2011. We inferred lemming use of boxes during winter based on sign (faeces or nests) left in the boxes. We judged lemming species, and determined whether reproduction had occurred, based on faeces size, shape and colour according to Duchesne et al. (2011a).

Temperature loggers (i-buttons®) were installed on the floor of some boxes on Bylot in late August (16 in 2009 and four in 2010) and outside boxes at ground level (33 and 22 at sites under ≥ 60 cm of snow during winter, and 27 and 38 at random sites under < 60 cm of snow in 2009 and 2010, respectively) to compare temperatures inside the boxes with those in the surrounding sub-nivean space.

Snowmelt

We monitored snowmelt by measuring snow depth along two 250 m long transects every two days until all snow had disappeared. This started on 19 May each year on Bylot, and 21 May on Herschel.

Results

At Herschel Island, on the 2.5 ha area, all four boxes, when checked in late winter, contained winter nests built by brown lemmings but later taken over by weasels (likely *Mustela nivalis* judging by faeces size). Each box had remains of one or two lemmings. On the 9 ha area, only one box had a winter nest (built by a collared lemming) while 12/27 had sign (faeces) that the boxes had been visited at some time by collared lemmings. Winter nests were also found in the vicinity (< 5 m) of 4 boxes. Two days after baiting, the apple had disappeared from four boxes but only one juvenile male collared lemming (28.5g) was captured.

At Bylot Island, lemmings left sign indicating use or visitation at 13 of 40 boxes in 2010 and 31 of 40 boxes in 2011. They had built nests in some boxes (0/40 in 2010 and 10/40 in 2011). In 2010, boxes were used by collared lemmings (7/40), brown lemmings (2/40), or by both species (4/40), but only brown lemmings used the boxes in 2011. Signs of reproduction were found in one box in 2011 and none in 2010. Winter nests were also found in the vicinity of 15 boxes in 2010 and 19 in 2011. Stoats (*Mustela erminea*) used some boxes (1/40 in 2010 and 4/40 in 2011) to store lemmings they had killed in the surrounding area or, in one case, the lemmings occupying a nest built inside a box. No lemmings were caught in the boxes in spring, despite all the sign of winter use and even though lemmings were at high densities during both winters (Gauthier, G. and Bilodeau, F. unpublished data).

Snow depth at the end of winter on Bylot Island was near average in 2011 but much deeper in 2010 (Fig. 2). Our trapping occurred during early snowmelt in both years. Snowmelt was faster during trapping in 2011 (6.2 cm loss in five days) compared with 2010 (3.5 cm loss in ten days). Tunnels leading into the boxes were not blocked by hard snow or ice, suggesting that our traps could have been accessed easily by lemmings during the trapping period.

From early December to late April on Bylot, sub-nivean temperatures were higher than ambient air temperatures, whereas temperatures inside boxes were slightly higher than those at random sub-nivean sites with <60 cm of snow but lower than those at sites with ≥60 cm of snow (Fig. 3). However, the situation was reversed during May, when trapping occurred. In 2010 and 2011, respectively, average temperatures in boxes were 6.6 °C and 6.3 °C lower than ambient, 0.4 °C and 1.4 °C lower than random sites, but 1.0 °C higher than sites with ≥60 cm of snow in 2010 and 1.1°C lower in 2011.

Discussion

Contrary to previous studies that used boxes similar to ours to trap voles under the snow (Sullivan et al. 2004, Korslund and Steen 2006), we had poor success trapping lemmings under the snow during late winter in the Canadian Arctic. Yet, lemmings used our trapping boxes extensively sometime during winter. On Herschel Island, where we were able to trap before snow melt, we caught one lemming and bait was eaten from several boxes. Lemming population density on Herschel was relatively low by spring that year (Krebs et al. 2011) and would have contributed to our low trapping success.

Snow is a good insulating material, as shown by the higher sub-nivean compared to ambient air temperatures we recorded during winter. Temperatures were also higher inside our boxes than at random sub-nivean sites in winter, so the boxes provided a suitable temperature regime for lemmings. Lemmings are attracted to warmer sub-nivean sites in winter (Duchesne et al. 2011b, Reid et al. 2012), so we presume that lemmings mostly used the boxes in winter However, in late winter or early spring, the temperature profile in the snow pack changes such that ambient air is generally warmer than the sub-nivean space. In May of both years, temperatures inside our trapping boxes were actually colder than those at all other sites available to lemmings. Therefore, lemmings had a clear thermal advantage in moving to exposed tundra without snow or sites with shallow snow, after this thermal inversion. We hypothesize that the colder temperatures inside boxes in May explain why we caught no lemmings on Bylot in that month.

When we were trapping on Bylot Island, snow had started to melt and snow depth was continually decreasing (Fig. 2). During melt, ice can form in the subnivean space potentially restricting access to food plants, and melt-water may flood low-lying areas. Lemmings may have moved out of areas with deeper snow pack in anticipation of these spring events and to gain better access to early growing plants on exposed tundra.

There is a concern that use of the boxes by weasels and stoats may have deterred lemmings from using the same boxes. However, brown lemmings readily go into live traps, even those baited to catch stoats (F. Bilodeau personal observations), so the past use of boxes and their traps by stoats is unlikely to be a factor reducing lemming trappability.

Conclusion

We hypothesize that trapping with our boxes would be more successful if conducted during winter and before the spring overturn of the temperature gradient in the snow pack. This could be tested at field sites with easier winter access than ours. To improve the insulative capacity of the boxes, especially before snow depth accumulates to 40 or 50 cm, we recommend increasing the thickness of foam insulation in the lid. Based on prior studies which successfully trapped small mammals during winter (Schweiger and Boutin 1995, Sullivan et al. 2004, Korslund and Steen 2006), trappability could also be improved by (i) deploying the boxes with baited traps prior to snow-fall so that the traps become an established feature of the environment for the target animals, and (ii) maintaining a fairly frequent live-trapping regime, including pre-baiting, within the boxes so that the bait provides fairly consistent and frequent positive reinforcement for rodents during the source of the winter. Differences in capture rates between boxes submitted to such trapping protocols compared to boxes without them should be tested to determine if the protocols improve capture success.

Figure 1. Picture of a trapping box at Herschel Island.

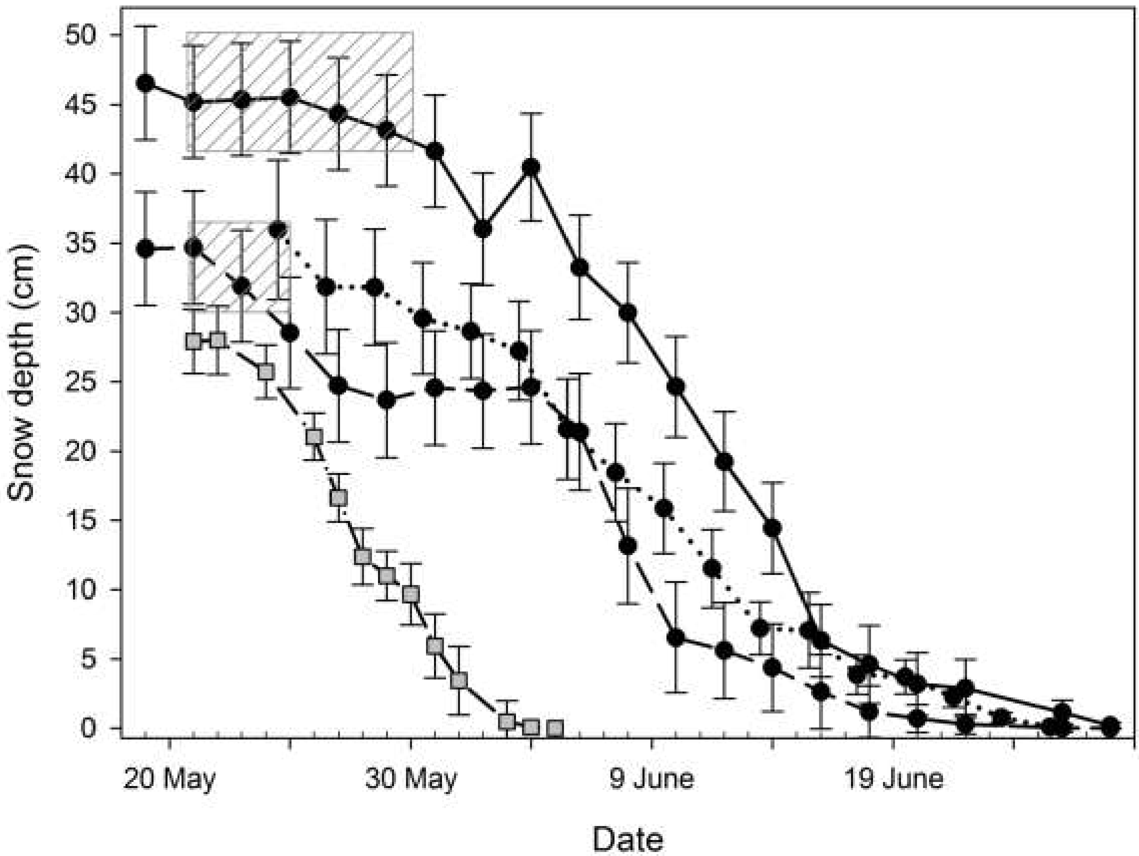

Figure 2. Change in snow depth along transects during snowmelt in spring 2009 on Herschel Island (gray boxes, dash-dot line) and in spring 2010 (solid line), 2011 (dashed line) and long-term average (dotted line) on Bylot Island (black circles). Error bars represent SE. Hatched areas represent when trapping occurred on Bylot each year.

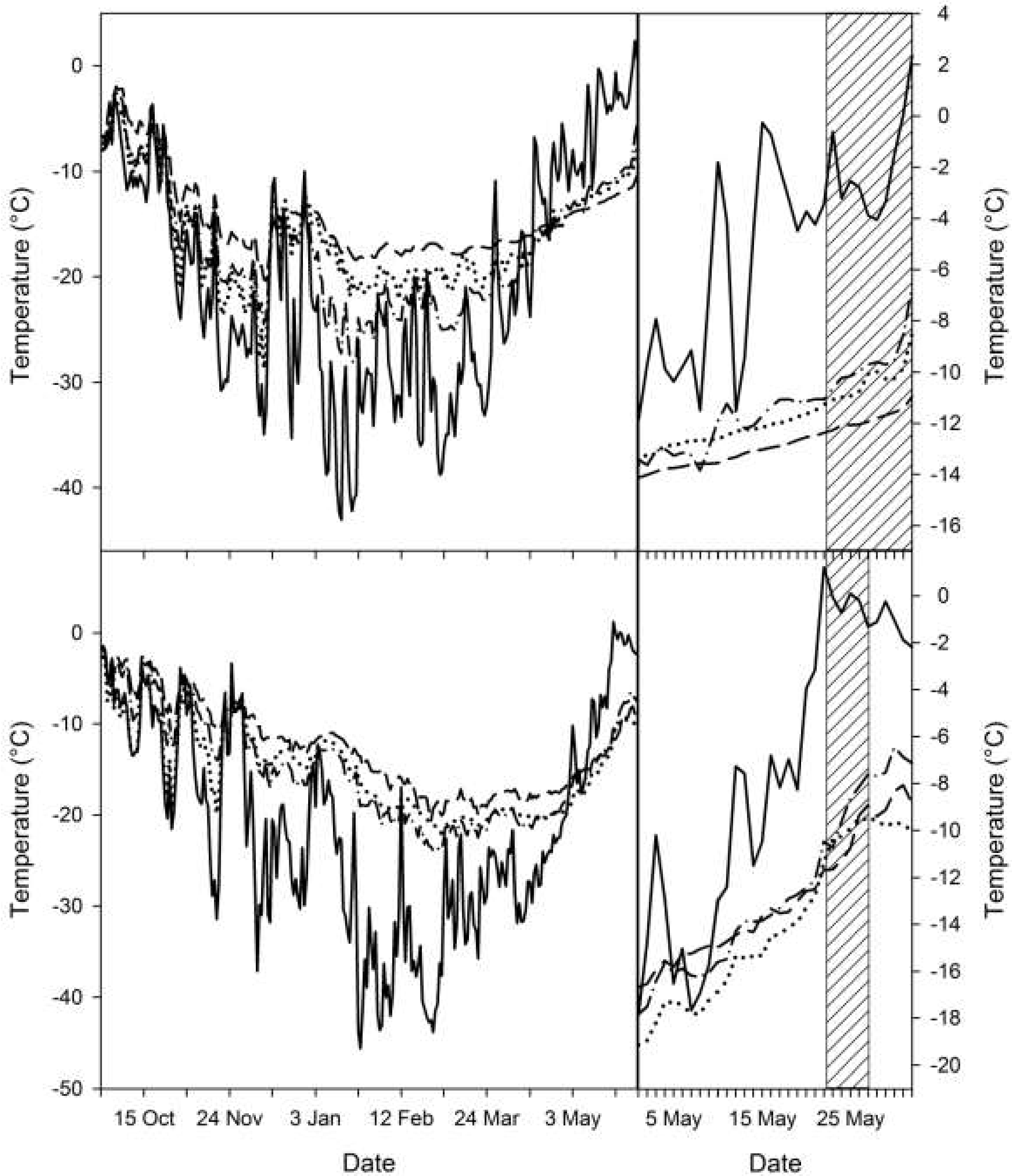

Figure 3. Daily temperature of ambient air (solid line), sub-nivean space under ≥60 cm of snow (dashed lines), subnivean space under <60 cm of snow (dashed-dotted lines) and trapping boxes (dotted lines) on Bylot Island during winters 2009-2010 (upper panel) and 2010-2011 (lower panel). Hatched area represents when trapping occurred.

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