SNOW FENCE EXPERIMENT PROTOCOL

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PURPOSE

Lemming population growth in winter is positively associated with earlier onset of autumn snow, a lack of winter thawing events, and deeper winter snow depths. The insulative capacity of snow, especially deeper than the hiemal threshold (c. 20-30 cm), is necessary to provide a habitable tundra environment for lemmings in winter. Given that many tundra regions receive low snowfall, and most of this snow is redistributed by wind leaving large areas with little cover, then it seems likely that suitable winter habitat may be limiting in some areas. This limitation may have various effects including forcing a spatial shift in habitat use in the autumn, to influencing winter reproductive output in years and areas with more snow cover.

This protocol outlines an experimental manipulation of snow depth aimed at testing: (i) whether lemmings are more likely to remain in summer habitat for the subsequent winter if snow depth is enhanced, and (ii) whether lemming population growth in winter is higher on areas with deeper snow.

FOCAL SPECIES

Collared lemming (*Dicrostonyx* spp.)
Brown lemming (*Lemmus sibiricus*)

PROCEDURES

The snow depth enhancement experiment will be established in association with live-trapping grids on which we are measuring absolute abundance of lemmings, at Herschel and Bylot Islands. Snow depth will be enhanced by placing snow fencing on one grid at each study site. Results from these treatment grids will be compared to at least one control grid at each site. I believe grids should be 9 ha in order to encompass sufficient animals for a measurable effect.

<u>Grid Placement</u>

We should place the snow fence treatment and control grids in areas that are (i) definitely quite productive summer habitat for at least one lemming species, and (ii) receive relatively little snow deposition in most years (likely because they are more wind-exposed). It would not be so informative to use areas that already receive relatively large amounts of snow deposition (e.g., topographic complex with many concavities), so require no fencing to enhance depths to the hiemal threshold. It is also not very informative to use areas that are so windswept and barren that lemmings would find them food-limiting in winter. Mesic dwarf shrub heath and upland tussock-grass tundras will most likely satisfy these conditions. Control and treatment grids should occupy similar habitat types, and general topographies.

<u>Hypotheses</u>

Here I outline a couple of hypotheses regarding winter habitat and lemmings, mainly to set the context for the logistics of field work (what and when has to be established and measured) as part of the snow fence experiment. There are other hypotheses that can be tested regarding lemming winter habitat use, but the logistics of those have to do with other equipment and techniques.

Hyp. 1: Lemmings are more likely to use tundra that has enhanced snow depth.

Tests:
1a (Her, Byl). Estimate winter occupancy with winter nest counts on control and treatment grids before applying the treatment. This means choosing, establishing, and counting winter nests on these grids in spring 2007 for an estimate of winter use prior to establishing the snow fencing in late summer 2007.

1b (Her, Byl). Estimate winter occupancy with winter nest counts on control and treatment grids for all winters the treatment is applied.

1c. (Her). Use radiotelemetry on lemmings to track what proportion of the population shifts habitat use in autumn at the onset of freezing temperatures and early snow.

Hyp 2: Lemming winter population growth is higher on areas with enhanced snow depths and consequently a more suitable sub-nivean thermal regime.

Tests:
1a (Her, Byl). Set up snow fencing on treatment grids in late summer to take advantage of all snow events. Live trap lemmings in late summer and early the next spring.

1b (Her, Byl). Establish some temperature loggers to record temperatures at ground level, at the height above ground where snow is generally deep enough to reach the hiemal threshold (20 and 30 cm), and in the ambient air (c. 1 m above ground).

<u>Snow Fence Establishment</u>

The best combination of resilience, weight and cost for snow fencing is a Tensar fencing product (Tensar SB Value Plus) available from Agriflex Incorporated in Oakville, Ontario (905-847-5367). We will probably have to use orange colour (UX4250), though it may be available in black (UX4200). It comes in 420 foot rolls which can be cut into shorter lengths in the field. The fencing rolls are 4 feet wide.

Fencing must be set up perpendicular to the prevailing wind(s) in rows traversing the lemming trapping grid. Details on the effective snow accumulation zone downwind of the fence can be calculated from formulae in Tabler (1991). Much of this depends on wind fetch, and snow fall amount, which we have to estimate for our individual study areas. We estimate that to cover 9 ha we will need 5 parallel rows of fencing. The exact placement of fence rows on the grid, and the distances between rows, depend on whether the winds are strongly dominant from one direction, or can also be expected to blow from two opposite directions during the winter. In general, the further downwind on the grid the closer together the fencing rows should be, because the volume of available snow for drifting will decrease downwind. In the Figure below we provide one plan view of a potential fence layout.

For fence posts we will use 1" T-bar metal posts, each a minimum 7 feet long. These have to be driven into the ground with a heavy sledge hammer (at least 10 lb head), and a short stool or set of steps is very useful to get high enough to do the hammering. We do not know the optimum distance between successive posts, but estimate one post every 3 m (range 2 to 4 m depending on ability to penetrate the permafrost when hammering). At least 4 feet of the post should remain above ground. The fencing is attached to the post with approximately 6 individual strands of baling wire, each looped through the holes in the fencing, around the post, and around a 120 cm long surveyor's wooden lathe on the other side of the fencing from the metal post (The lathe prevents the wire from rubbing directly against the fencing material). When hammering, the post is best oriented such that the straight-line of the fencing itself will form the hypotenuse of a triangle for which the trunk and one tip of the “T” post form the other two sides. This facilitates two necessary steps: (i) being able to take advantage of the knobs on the outside of the top of the “T” to hold baling wire in place so it does not slide down the post, and (ii) using the surveyors’ lathe to effectively sandwich the fencing between the lathe and the post, with maximum fiction. A challenge to efficient fencing is to get enough tension on the fencing to make it tight between successive posts

The T-posts at the end of each fencing section, and intermittently along the fencing (c. every 30 m), need to be supported with guy lines (c. ¼" nylon rope) anchored with strong metal (e.g., rebar) or wooden stakes (two or three sections of surveyors lathe together will form a sufficiently strong anchor). The end posts require 3 anchor lines; the others just one or two depending on the relative strength of the wind from various directions.

One suitable sequence of tasks is: (a) layout the line for the fencing with a 100 m tape and compass; (b) place the T-posts and surveyor’s lathe in place along the line; (c) hammer the T-posts into the ground (depending on how easy this is, the exact spacing of these posts down the line may have to change); (d) anchor the post where the fencing will first be attached; (d) roll out the length of fencing along one side of the line; (e) wire the starting end of the fence section to the end post; (f) attach the top edge of the fencing loosely to the top of each post down the line so that the fencing is off the ground; (g) use a small hand winch (“come-along”) to hold the fencing section tight to the next fence post and wire that post; (h) repeat step (g) post-by-post down the line. A special note is that leaving a gap of c. 15 cm between the bottom of the 4 foot fencing and the ground is recommended by Tabler (1991). In undulating terrain this will be difficult to accomplish exactly (the gap will vary considerably, and this is not a big problem). On a concave slope it is probably more useful to pay attention to making sure the straight-line of the bottom of the fencing is not forced into the ground; the gap may be larger than 15 cm for some length.

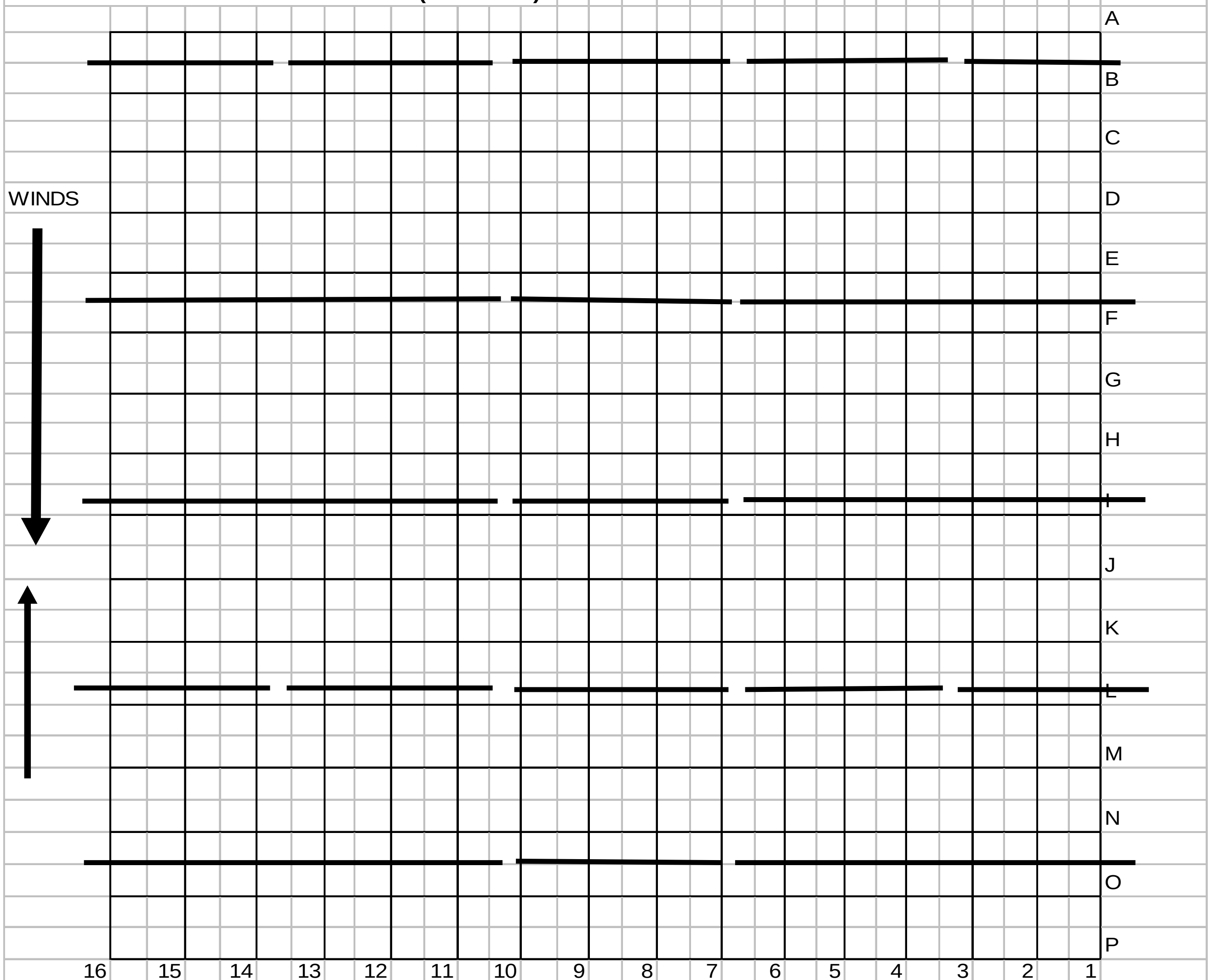
Equipment

- Snow fencing, T-posts, anchor posts, rope
- Tape measure
- Compass
- Sledge Hammer (2)
- Short step ladder
- Baling wire
- Pliers (broad-nosed) with wire cutters
- Hand-winch (“Come-along”)

Reference

Tabler, R.D. 1991. Snow fence guide. Strategic Highway Research Program. Report SHRP-W/FR-91-106. National Research Council, Washington, DC.

SNOW FENCE LAYOUT - 420 foot rolls (Plan View)



Key: Trapping grid of 9 ha: 300 m x 300 m Narrow lines outline grid cells of 20 m x 20 m

Thick lines are snow fencing: 5 rows in total, parallel to one of the grid axes, & perpendicular to prevailing winds

Rows are 55 to 80 m apart. Each row has 5 x210 ft (64 m segments) or 2 x 420 ft & 1 x 210 ft segments

Segments separated by 2 m gaps to allow researchers passage on the grid. Segments extend >10 m beyond g

This is Tensar Value Plus Product: 13 rolls (420 ft ea) @ $260/roll = $3,380 plus $203 GST = $3,583