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Effect of weather and snow factors on the mobility of the Red Squirrel (*Sciurus vulgaris* Linnaeus, 1758) in the forest zone of Finnish Lapland

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Our previous research in the forest zone of Finnish Lappland (Pulliainen 1973) showed that the European red squirrel (*Sciurus vulgaris* Linnaeus, 1758) tends to reduce its mobility to a very low level in midwinter, when the days are shortest and temperatures generally the lowest. We have continued these gross activity surveys, and have also carried out a tracking study on the effects of weather and snow conditions on the mobility of these mammals for one winter. The present note reports our new findings.

The tracking was carried out in November-March 1991/92 in the Värriö Nature Reserve, eastern forest area of Finnish Lapland (67°44′ N, 29°37′ E). This is an area populated by conifers, birch and mixed forests of the taiga type, and can be characterized as being in a virgin state and uninhabited. The forests are old and mature, and the density of trees is generally very low. In some areas there are young spruce and pine saplings among the very old trees. When possible, squirrels were followed during their movement from one drey to the next, the tracking being carried out on skiis. Sometimes the observer was able to keep the animal in view the entire time, but sometimes it was only seen occasionally or not at all. If the squirrel appeared to be disturbed by the observer, it was left alone. The tracking was not continuous, and the animals were not marked. Only the trackings from one drey to another (13 in November, 12 in December and 7 in January) were included for statistical testing, covering the period 9 Nov–23 Jan, when daylight lasts for 0–6 hours (see Pulliainen 1973). The mean monthly temperatures were –3.5 °C in November, –7.5 °C in December and –8.2 °C in January, and the minimum temperature on the days concerned was –15.2 °C.

Line transects in the area showed that the local squirrel population reached its peak in 1989/90 (7.0 crossings/10 km in December–March). Although the population was decreasing, the number of squirrels in winter 1991/92 was still relatively high (5.2 crossings/10 km). The squirrels were tracked for 51 km, consisting of 75 trackings. The mean distance travelled from drey to drey was 670 m (max. 3030 m, min. 150 m, $n = 32$). The animals sank into the snow from 1 cm to 10 cm, and the more the squirrel sank the shorter was the day's journey (Spearman $r_s = -0.470$, $n = 32$, $p < 0.01$). Temperature, wind and cloudiness did not affect the activity of the squirrels.

The squirrels left the drey (83.3%, $n = 49$) and went into it (89.8%, $n = 30$) mainly by jumping from tree to tree. In 78.8% of the cases ($n = 33$), the squirrel returned to the same drey as it had left. Jumping from tree to tree was observed 0.8 times/100 m, the maximum continuous movement in the canopy being 80 m. The distance travelled in the canopy averaged 9.1% of the total day's journey. The more the squirrel sank into the snow

(Spearman $r_s = 0.531$, $n = 18$, $p < 0.05$) or the colder the weather ($r_s = -0.472$, $n = 32$, $p < 0.01$), the more the animals travelled in the canopy. Furthermore, the shorter the day's journey, the greater the part of it was performed in the canopy ($r_s = -0.766$, $n = 30$, $p < 0.001$).

The squirrel tracks were most often found in pine forest (71% of the tracking). According to direct observations, 70.6% of the feeding events were on Scots Pine, *Pinus sylvestris*, and 28.0% on Norwegian Spruce, *Picea abies*. Pine had a very good cone yield in the year concerned, but not the spruce, which produced only a few cones. The rest of the food consisted of mushrooms from caches at the bases of branches (0.8%) and berries (0.5%).

Two individuals in different colour phases were observed to live in the same 0.24 km^2 area of pine forest and to feed together at least in the interval 1 Dec 1991–6 March 1992, and were observed on nine occasions to share one of the four nests found in the area.

In summary, temperature, wind and cloudiness did not affect the activity of the squirrels, whereas sinking into the snow reduced the length of the daily journey and the squirrels moved from the surface of the snow into the canopy of the trees. This latter change was also prompted by low ambient temperatures.

Tonkin (1983), reviewing earlier research of effects of weather on squirrel activity, showed that contradictory conclusions can be drawn from the effect of a particular weather factor. Thus, it is easy to find support for the present results. This emphasizes the complexity of the background of the response, which comprises at least the condition of the individual in question, the availability of food and the structure of the microhabitat, together with the various weather factors.

Our earlier studies (Pulliainen 1973) showed that winter dreys are very important for thermoregulation in the European red squirrel, as it is able to keep its drey temperature 20–30 °C degrees above the ambient air temperature. When food is scarce, it may be more reasonable to stay in the drey at very low temperatures instead of attempting to find something to eat (Pulliainen 1973). During the present survey, when pine seeds were plentiful and the temperature was not very low, energy was conserved by avoiding moving about on the surface of the very soft snow. Probably greater speed was also attained when jumping from tree to tree than when trying to move in the soft snow.

One detail also worth noting here is the case in which two individuals shared the same nest. Wauters and Dhondt (1990) reported that nest sharing is rare and usually occurs only between partners in the mating season, most nests being used by only one squirrel. The present case was recorded outside the mating season, in a situation in which empty dreys were available in the vicinity.

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