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Birch consumption by reindeer (Rangifer tarandus) in Finnish Lapland

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Abstract

HAUKIOJA, ERKKI & HEINO, JUHANI. (Zoology Dept., Univ., 20500 Turku 50, Finland) Birch consumption by reindeer (Rangifer tarandus) in Finnish Lapland. REP KEVO SUBARCTIC RES STAT 11. 22—25. Illus. 1974. — A method for estimating the consumption of birch leaves by browsing herbivores is presented. In 170 study plots in northern Lapland, the mean consumption was 1150 g dry leaves per hectare up to the middle of the summer. The consumption per plot was dependent on the forest type, amount of root shoots and altitude. The grazing on birch continued in late summer. The annual birch consumption by an individual reindeer is of the order of 25 kg dry matter. As a consumer of the birch, the reindeer is less important than invertebrates.

1. Introduction

The mountain birch, *Betula tortuosa,* is the most important primary producer in northernmost Finnish Lapland. In the tundra IBP (International Biological Programme) work at Kevo, Finnish Lapland, the main task in herbivore studies has been to determine how much different herbivore groups take materials from the birch (HAUKIOJA et al. 1971).

The semi-domesticated reindeer is perhaps the most important of these herbivores, but in general only few quantitative studies concerning the grazing of reindeer have been made (e.g. GAARE 1968).

In the present paper the magnitude of herbivore action by the reindeer upon the birch is under study. How important a part the birch plays as food for the reindeer is not known precisely, but during the summer period it is one of the most important plant species in the diet of the reindeer.

2. Materials and methods

2.1. Study area

Field work for the present paper was done in the Utsjoki commune, in northernmost Finland, with the Kevo Subarctic Research Station (69° 45'N, 27°E) as the central location. The dominant vegetation type consists of subalpine birch forests, which form the timber line at the height of 300—500 m a. s. l (HÄMET-AHTI 1963). About one third of the area consists of treeless tundra-like vegetation. The reindeer population of the Utsjoki commune is of the orded of 20'000 individuals.

2.2. Methodological procedure

The method used for estimating biomass removal from the birch due to grazing by the reindeer is with some modifications the same as used by HAUKIOJA et al. (1971) in estimating herbivore damage to the birch by voles.. The principle is to measure the diameter of the shoot at that point from which onwards the reindeer has eaten the leaves. When the relationship between the leaf-

biomass and the diameter of the shoot is known, an estimate of the amount of plant biomass removed from each shoot can be obtained.

During field work the study plots were examined shoot by shoot to find out twigs on which reindeer had browsed. Only the feeding marks of the present season were taken into account. The shoots, from which leaves had been eaten, were pruned and the measurement of shoot diameters was made later in the laboratory with an accuracy of 0.1 mm. As the browsed shoots were removed, it was possible to check the areas later for new signs of feeding.

170 study plots of the size 10 × 10 m were established in Utsjoki so that their distribution roughly corresponded with the distribution of local habitat types. A rough location of the plots was determined on a map and the precise location by randomly selecting a birch for a corner of the plot. The plots were marked in the terrain so that it was possible to check the same area later. All plots were inspected in June — mid July, 1973, and 48 of them again in August — beginning of September, 1973.

Regression equations for shoot diameter against leaf biomass were calculated for three types of birch forests. The types were 1) birch forests in river valleys, 2) »typical» birch forests on the slopes of fells and 3) areas near the timber line. In the first type the twigs are thin, leaves narrow and the field layer vegetation not well developed. In the second type the trees are polycormic, there are plenty of twigs near the ground, root shoots are numerous, especially on areas partly destroyed by a geometrid larva, *Oporinia autumnata* (KALLIO & LEHTONEN 1973). In the third type trees are short, twigs and leaves are thick and xeromorphic.

For each type and each diameter class (1—5 mm), a sample of twigs was cut, their leaves were picked and dried at 105° to a constant temperature. Fig. 1 gives the results. For each study plot the type best characterizing the birch type of the area was coded with the measured shoot diameter distribution. A computer programme was written to calculate the total consumption of birch leaves in each plot.

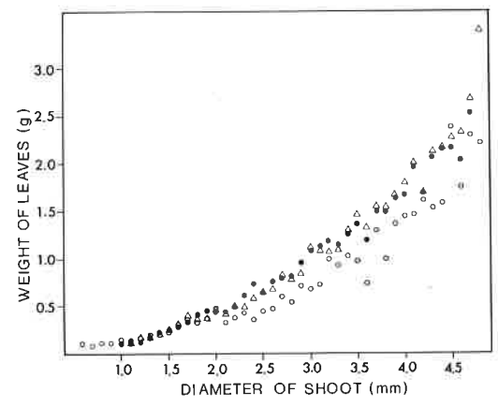

Fig. 1. Relationship between the diameter of *Betula* tortuosa shoots and the dry weight of its leaves. Open circle = type 1 forest, triangel = type 2 forest and solid circle = type 3 forest; for further information see text.

The measurements for the above regressions were made in late July. They therefore give the dry matter situation at the time when leaves are heaviest. This is a possible source of error, as the reindeer consume some of the leaves at a phase when they are not yet full-grown. On the other hand, the regressions do not take into account the amonut of material other than leaves removed in the feeding process, i.e. bark and the tips of soft shoots. It is assumed that these sources of error counterbalance each other; at least their effects run counter to each other.

Another potential source of error is in the ability of the observer to find browsed shoots. This was tested by pulling leaves from about one hundred shoots in the same manner as the reindeer does when feeding and the site with these simulated feeding marks was checked after three weeks. 95 % of the artificially browsed shoots were found using as normal a field procedure as possible. Thus the finding effciency for an experienced person is very high.

In the same experiment the diameters were measured on both occasions and the results in mean diameter agree rather well (2.23 and 2.17 mm). The shrinkage of a browsed shoot does not therefore affect the result particularly.

A normal searching procedure for browsed shoots was also made in a fenced area, where there were no reindeer. No feeding signs were found which indicates that there is probably no severe misinterpretations of the materials.

3. Results

Using the symbols recommended by PETRUSEWICZ (1967), the relationships in the food intake are as follows:

MR = C + NU

where MR = materials removed in the feeding process,

C = the amount of materials actually eaten, and

NU = the amonut of materials wasted in the feeding process. What the proportion NU is in the case of birch herbivory by reindeer is not known, but evidently C is much larger than NU. In the following the term consumption is synonymous with materials removed.

The values presented later are dry weights of *Betula* leaves and are expressed as grams per hectare; the word consumption means only the consumption of birch leaves.

3.1. June — July

Signs of grazing were found in 77 (45 %) of the 170 study plots. The mean biomass removed was 1150 g/ha. If only those plots which had been visited by reindeer are taken into account, consumption was 2539 g/ha.

Table 1. Birch consumption by reindeer in different forest types in Utsjoki 1973. For further explanation see text (p. 23).

Forest type	N	consumption (g dry weight/ha)
1	86	448
2	45	2950
3	39	531

The mean consumption differs in the three birch wood types (Table 1). The high value for type 2 was a result of the fact that this is the favourite summer biotope for reindeer and therefore the freqency of non-grazed plots was low (Table 2). That the reindeer

Table 2. Birch consumption by reindeer in different forest types in Utsjoki 1973. Only grazed study plots are included. For further explanation see text (p. 23).

Forest type	N	consumption (g dry weight/ha)
1	30	1403
2	38	3493
3	9	2299

favour this type is probably because of the large amount of soft shoots available. As the mean consumptions are nearer each other in Table 2 than in Table 1, the availability of food seems to affect habitat selection more than to the actual removal of food from an area.

When consumption per shoot is studied (Table 3) the highest values are found in type 3 woods. This probably depends on the lower number of shoots for browsing and

Table 3. Consumption per shoot in different forest types in Utsjoki in 1973. Only browsed shoots are included. For further explanation see text (p. 23).

Forest type	N	consumption (g dry weight/shoot)
1	1206	0.35
2	3111	0.43
3	403	0.51

the xeromorphic nature and high weight of leaves.

The plots which were destroyed by a mass outbreak of *Oporinia* in 1965—66 had a lot of root shoots and these plots seem to have been especially favoured by reindeer (Table 4). Browsing marks of the reindeer were

Table 4. Birch consumption by reindeer in *Oporinia* damaged and undamaged areas in Utsjoki 1973.

Area	N	consumption (g dry weight/ha)
Damaged	24	2414
Undamaged	146	934

found in all *Oporinia* plots studied, but the consumption of plant materials (due to the small number of living birches per plot) was not high in all cases.

A study of consumption in relation to altitude (Table 5) revealed that the altitude class of 250 m a.s.l. had the highest mean consumption. This is the same altitude where *Oporinia* damage was most frequent. Consumption is less at lower and probably at higher altitudes, too.

Table 5. Birch consumption by reindeer in relation to altitude.

Altitude	N total	N grazed	consumption (g dry weigh/ha)	*Oporinia* plots
76—125	40	15	771	0
126—175	29	14	913	0
176—225	38	18	1219	6
226—275	26	15	1807	11
276—325	36	14	1177	7
326—	1	1	(2549)	0

3.2. August — September

22 plots out of the 48 studied again in August — September had new browsing marks. Somewhat less than half of the areas, therefore, were grazed during the mid-summer period. This is about the same as during early summer. A detailed description of this mid-summer grazing is premature at the present state of the study.

4. Discussion

The importance of the birch for reindeer as a summer diet is not well documented. On

the other hand, there is considerable field-observation showing that the birch is regularly used by the reindeer (YLI-PIETILÄ 1973). The protein content of the buds and leaves of the birch is high (Kallio, unpubl.) so that the importance of browsing can be easily understood especially during the summer period when body-growth of the reindeer occurs.

In the following a calculation is presented which, in spite of many uncertainties, indicates that the importance of the birch for the reindeer is considerable.

The facts in the calculation are that the area of Utsjoki is 4300 sq. km., of which about 2500 consists of birch forest (P. Kallio, oral. inform.) and above we have shown that the consumption of birch leaves up to mid-summer is about 1.15 kg/ha. Assuming total consumption during a year is 2 kg/ha (a guess) and the reindeer population 20,000 individuals (a guess), the amount of birch material consumed by a reindeer during a year is 25 kg dry weight of *Betula* leaves. The energy content of this is of the order of 130,000 kcal which must be an appreciable amount in the energy budget of reindeer during a summer.

On the other hand, the herbivorous action of the reindeer upon the birch also has considerable effects. Although the mean consumption is much less than the total invertebrate consumption of the birch (unpublished) only a few invertebrate species (as *Dineura viridorsata,* a Hymenoptera species, and *Massalongia,* Cecidomyidae, Diptera) are probably more important than the reindeer as consumers of the birch. However, the indirect effects of reindeer browsing, e.g. in preventing the renewal of *Oporinia* areas are probably more important than can be determined from the average consumption figures.

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