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Leaf-eating insects on willows in tundra biocenoses of the Southern Jamal

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The work on leaf-eating insects was carried out in July-August 1970 and 1971. Many species were observed, among them about ten species of butterfly, more than ten species of sawfly and two species of leaf beetle. The commonest species are two sawflies of the genus Nematus and the leaf beetle Phytodecta pallida L.

The principal aims of our work were to study the seasonal dynamics of leaf-eating insects, quantity and biomass, and to estimate the energy flow through energy levels. Four plots were chosen from which to collect samples. Two of them were situated in typical tundra and two others in river-bank willow thicket.

Leaf beetles are practically unknown on tundra plots, and sawflies make up nearly the whole biomass of leaf-eating insects. Sawfly larvae appear simultaneously with leaf opening in the first ten days of July, and in a week they achieve their highest number, viz. 5-7 specimens/m^2. However, the highest biomass (up to 30 mg in 1970) was recorded only on 20-25 July, representing no more than 1 larva per m^2. Sawflies were found throughout August. Samples were obtained from these plots by harvesting all willow plants from ten square metres, once every fourth day.

On bank willows, both sawflies and leaf beetles are found. Sawflies here attain their highest number (35 larvae per m^2) and biomass 200 mg/m^2 . However, the greater part of the insect biomass consists of leaf beetles. Their larvae also appear nearly simultaneously with leaf opening, and achieve their largest quantity - 130 specimens/m^2 - on 20 July. The biomass reaches its peak (850 mg/m^2) a week later. From 5-10 August, leaf beetle larvae leave the willow shrubs for the soil. The samples from these plots were also collected every fourth day, but because of the dense and uniform shrub cover, the sample size was only 0.25 m^2.

The biomass at the first trophic level was estimated in the second half of August. Three species of willow, in different proportions on various plots, represent in our case the first trophic level. On the first tundra plot the net biomass of willows (leaves) averaged 14 g (dry weight 4.6 g) in 1970, and 17.5 g (5.8 g) per m^2 in 1971. The biomass on the second tundra plot was somewhat greater than that on the first plot, and reached 22 g (7.3 g) and 29 g (9.4 g), respectively. In the bank thicket, the figures for willow biomass were far above those on tundra plots. For low willows (to 70 cm) they were 85 g (28 g) in 1970 and 130 g (43 g) in 1971. For tall willows (to 200 cm) they were 330 g (110 g) in 1971.

In typical tundra leaf-eating insects consume from 1.3 per cent to 2.5 per cent of willow biomass developed in summer; the average is 0.3-0.4 g/m^2 (dry weight 0.11-0.12 g). In the course of the summer, the insect production is 0.030-0.045 g/m^2. The biomass produced at the second trophic level (leaf-eating insects) ranged from 0.15 to 0.30 per cent of the biomass at the first trophic level (willows). In the bank thicket, the insects consumed from 5 per cent to 9 per cent of the willow leaf biomass; this amounts to 7.5-30.0 g/m^2 (dry weight 2.5-10.0 g). The biomass increase during summer at the second trophic level here ranges between 1.2 and 2.7 g/m^2 (0.25-0.65 g), and goes as high as 0.8 per cent of the biomass of the first trophic level.

If we compare willow biomass consumed and the biomass increase of leaf-eating insects, it may be seen that for 1 g of body weight, larvae need 8-10 g of leaves (or on the basis of 1 g of dry body weight, 10-12 g of dry leaf weight). A special series of experiments on larval energetics was performed in cages, in which the daily increase in larval weight and daily food consumption were recorded. These experiments gave figures less than half of the above; the great restriction of larval activity is probably responsible for this result.