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Seasonal availability of chemical nutrients on Signy Island

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This paper presents some preliminary results of an investigation into the seasonal variation of extractable nutrients in the soils of Signy Island.

In an examination of British soils Allen & Grimshaw (1962) found that extractable phosphorus and ammonium-nitrogen concentrations increased as a result of prolonged freezing. In view of the importance of such phenomena to the soils of subpolar regions experiments were carried out on Signy Island over a complete season. Signy Island is particularly suitable for such a study because of the prolonged freeze during the winter months, and the oscillation of the soil temperatures around 0 °C during the rest of the year.

Site and sampling details

Two soil types were studied, namely a semi-ombrogenous peat under a mixed population of *Polytrichum strictum* and *Dicranum aciphyllum*, and a brown loam-like mineral soil under the grass, *Deschampsia antarctica*. Both sites were within 100 m of the sea, the peat being at Factory Cove and the brown mineral soil on the north-facing slope of Observation Bluff.

Chemical analyses of the two soils gave the results shown in table 4 (dry weight basis).

Table 4

	pH	loss on ignition (%)	% N	% P	mg/100 g extractable Ca	Mg	K
peat	4·6	94	1·1	0·09	167	208	110
brown mineral	5·4	38	1·3	0·22	193	130	39

Both areas were sampled throughout the year, the peat site at approximately monthly intervals, but the brown mineral soil less frequently due to site and climatic difficulties. Ten 3 cm diameter cores were taken from the top 4 cm of peat or soil below the living vegetation. These were mixed and divided, to give two samples for treatment. All material was extracted in the moist field condition on the same day as collection, and the resulting solutions analysed the following day or stored in sealed containers. Although phosphate was the first ion to be analysed considerable loss from algal growth was noticed. Iodine-treated Polythene bottles were therefore used for brief storage prior to the extraction of phosphorus (Heron 1962).

The following extractants were used:

PO_4^{3-}–P	Truog's reagent
NH_4^+–N	6 % sodium chloride solution
NO_3^-–N	distilled water
Na, K, Ca, Mg	N ammonium acetate solution (pH 7·0)

Phosphorus

The results for the phosphate ion showed the greatest seasonal change. Figure 11 illustrates the variation found in the peat. The mineral soil showed the same basic trend. Concentrations increased over the winter months to a maximum just before the melt season. In spite of some summer freezing the concentrations remained relatively low, possibly because of continuous leaching.

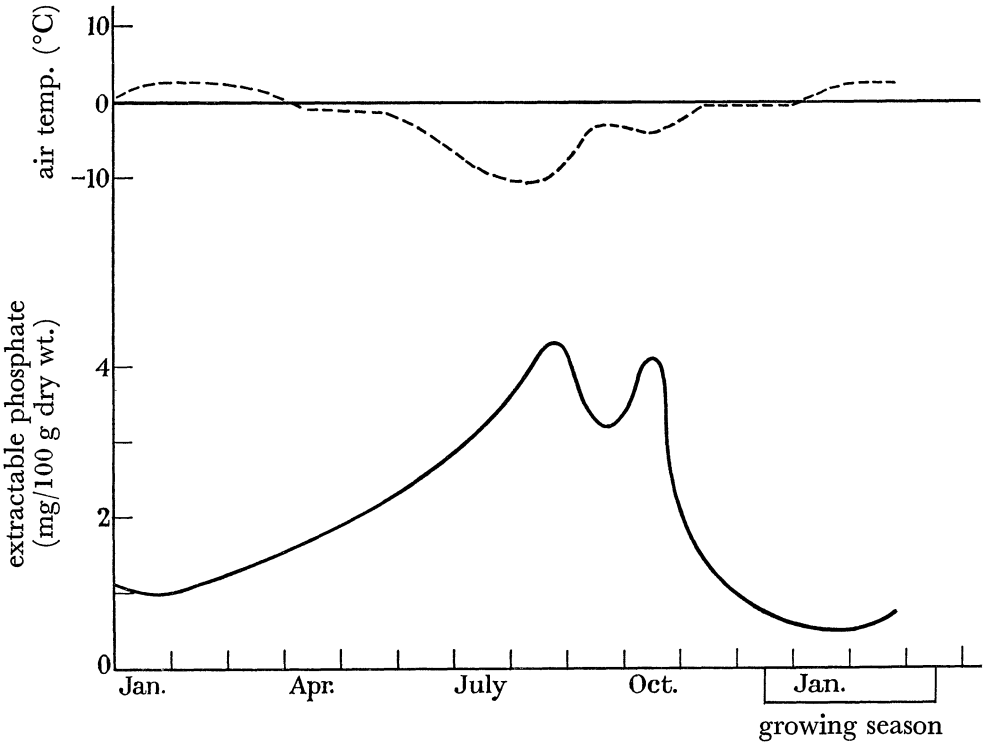

Figure 11. The variation in the extractable phosphorus content of *Polytrichum–Dicranum* peat and the mean monthly air temperature on Signy Island from Janaury 1965 to March 1966.

Nitrogen

The concentration of ammonium ion also increased during the winter months. In addition, a sharp rise occurred during September and October. The increase was probably due to the supply of ammonia from bird droppings, since cape pigeons and snow petrels returned to their nest sites adjacent to the sampling areas at this time, and the start of the melt would immediately distribute this soluble ammonia. This fact may also explain the secondary peak in the phosphate curve during October.

Nitrate concentrations showed no clear-cut seasonal variation. However, the amount present in the horizon studied approached the lower limit of the analytical procedure which could be practised on the Island.

Mineral ions

The marine influence on the Island was obvious from the sodium variations. Figure 12 shows the results for the peat site. Concentrations increased from the end of one melt season to the beginning of the next. During the melt sodium concentrations dropped rapidly

as the peat or soil was leached by the relatively sodium-free water derived from the winter snow accumulation.

Potassium showed some variation, but this may be due to spatial variations within the site caused by the influence of a nearby nesting colony.

No change was detected in the concentrations of calcium or magnesium.

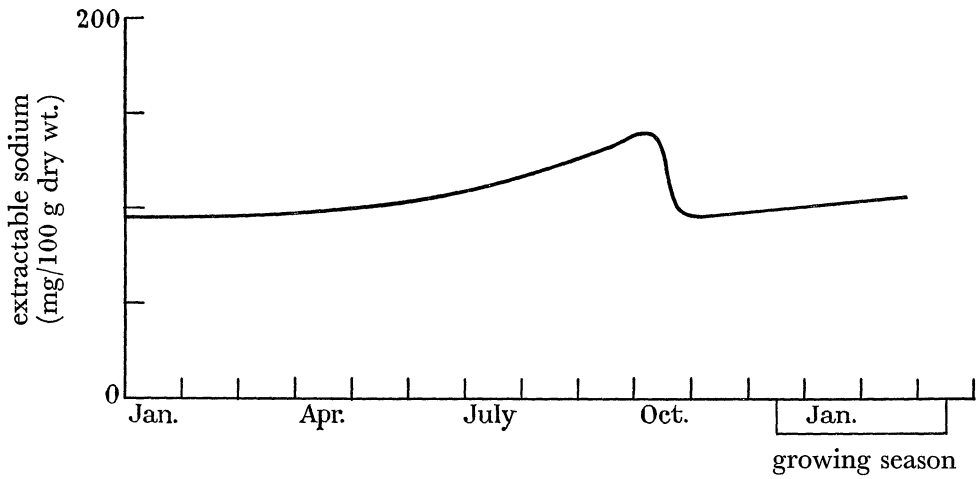

FIGURE 12. The variation in the extractable sodium content of *Polytrichum–Dicranum* peat on Signy Island from January 1965 to March 1966.

DISCUSSION

The seasonal release of phosphate and ammonia is probably not important for plant growth on Signy Island because of the large supply of these nutrients from breeding colonies of seal, penguins and other seabirds as stated in the preceding paper. However, this increase in availability of essential nutrients may be of importance in subpolar regions not subject to supply from animals, providing it is not washed away during the excessive drainage in the melt season. Further experiments are in progress to examine the intensity of the duration of freezing necessary for this release, and also into the mechanism of the process.

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