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Dissolved coloured substances were a minor source of light extinction in Loch Leven; this situation contrasts with that found in many of the Shetland lochs examined during the ITE survey. These waters were often strongly coloured by dissolved humic material.

The rapid extinction of light in Loch Leven was reflected in the shape of the photosynthesis/depth profiles; these showed a narrow zone of optimum light and a sharp decrease of photosynthetic rate with depth. Productivity per unit area was shown to be related to the logarithm of the ratio between incident irradiance (I_0) and the irradiance (I_k) defining the onset of light-saturation of photosynthesis. I_k increased with increase in water temperature, which in turn increased with increase in I_0. A spring maximum in the ratio I_0/I_k is interpreted as due to a lag in the increase in water temperature with increase in I_0.

It seems that the highest crop densities found in Loch Leven may be light-limited due to self-shading by the phytoplankton themselves. Poor light penetration may also explain the scarcity of submerged macrophytes in the loch during the study period (Jupp, Spence and Britton 1974).

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PLANKTON IN LOCH LEVEN

Since 1972 when changing methods of waste disposal decreased the phosphorus input into Loch Leven, there has been a conspicuous decrease in the biomass of microalgae. During the four years before 1972 seasonal maxima ranged from 190 to 259 mg chlorophyll *a* m^{-3}; thereafter they have been fluctuating between 70 and 163. There have been accompanying differences in the species present. Thus, before 1972, the relatively small *Cyclotella pseudostelligera, Oscillatoria redekei* and *Synechococcus* and *Stėniella* species predominated giving peaks, singly or in combination, in March, May and June. Since 1972 the peaks have changed to March, August, November and December and many specimens of the relatively large *Melosira ambigua* and *Anaebaena* spp. have been present. Throughout 1975 the pennate diatom *Asterionella formosa* Hass. was generally abundant with peaks of the small unicellular centric diatoms *Cyclotella* and *Stephanodiscus* in March, of the filamentous centric diatom *Melosira* (mainly *M. ambigua* (Grun.) Muller) in May and July, *Diatoma elongatum* Agardh. in June and the filamentous blue–green *Anabaena flos-aquae* Breb ex Born. et Flah. in May and August.

Interestingly the decreased mean densities of phytoplankton have been associated with changes in the composition of the zooplankton. Whereas *Daphnia hyalina* var. *lacustris,* an herbivorous cladoceran, occurred infrequently before 1972, when the copepod *Cyclops strenuus* var. *abyssorum* (Sars) predominated, its numbers have since greatly increased. This observation suggests that changing concentrations of nutrients, in this instance forms of phosphorus, greatly influence the nature of the equilibrium between phytoplankton and zooplankton.

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SECONDARY PRODUCTION IN ECOSYSTEMS

The remit for an invited paper for the First International Congress of Ecology, given by Heal and MacLean (1975), was to review information on secondary production (micro-organisms to mammals) in terrestrial ecosystems (tundra to tropics). There are many estimates of productivity of individual species especially of vertebrate herbivores and insects, but data are sparse or non existent for soil fauna, decomposer microflora and for complete trophic levels. With this limitation to comprehensive comparisons an alternative approach was adopted in which annual secondary production was predicted from the hypothesis that is a function of:

(i) the input from primary production;

(ii) the consumption, assimilation and growth efficiencies of the populations, these efficiencies being broadly characteristic of taxonomic group and food;

(iii) the organisation of heterotrophic into herbivore and saprovore subsystems, with recycling of organic matter confined to the saprovores (Figure 13).

Secondary production in any terrestrial ecosystem is thus the logical consequence of the combination of these factors.

Primary production varies greatly between ecosystems and has been reasonably well estimated at a range of sites; the secondary production was calculated for these sites and compared with observed values. There was broad agreement between observed and predicted values and an absence of obvious pattern of deviation in observed from predicted values for particular trophic levels or ecosystems. This agreement suggests that, despite major differences in species composition, most terrestrial ecosystems are similar in the organisation and efficiency of secondary production, with primary production being a major cause (possibly the major cause) of variation. Discrepancies between observed and