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Summer phytoplankton production measurements of two lakes from Austrian Alps using Carbon-14-technique.

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^{14}C-Messungen der Primärproduktion von Phytoplankton in zwei Seen der österreichischen Alpen

Zusammenfassung: Die Ergebnisse von je einer Untersuchungsserie eines Niederungssees (Reintaler See) und eines Hochgebirgssees (Gossenköllesee) werden in graphischer Darstellung festgehalten und kurz diskutiert. Das Vertikalprofil der Primärproduktionsrate im Reintaler See entspricht Typ I nach FINDENEGG (1964), jenes aus dem Gossenköllesee zeigt die für klare Hochgebirgsseen typische Verlagerung des Assimilationsmaximums in größere Tiefen.

During the author's UNESCO training period in Austria, an opportunity was provided to work on two small lakes (Reintaler See and Gossenköllesee) in July, 1977 and to obtain preliminary data on primary production rates of phytoplankton. The lakes are situated not far from Innsbruck, which lies right in the heart of the Alps. Reintaler See (47° 28' N: 11° 55' E) is a lowland lake (550 m a.s.l.), while Gossenköllesee is a moraine dammed seepage lake (47° 13' N : 11° 01' E) at an elevation of 2413 m a.s.l., which is about 400 m above timber line in this area.

Primary production rate had not been measured before in Reintaler See (area 275000 m^2; maximum depth: 10,5 m) and only one profile (September 1959, RODHE et al. 1966) has been published for Gossenköllesee (area 17179 m^2; maximum depth 9,8 m).

Phytoplankton primary productivity was measured by ^{14}C technique as described in VOLLENWEIDER (1969) at a single sampling station in the pelagial zone of each lake. Incorporation of ^{14}C was measured by liquid scintillation method (Efficiency: 80 %) using dioxane as a solvent (SCHINDLER, 1966).

As was to be expected, there are considerable differences between the carbon assimilation profiles of the two lakes (fig.1). According to FINDENEGG (1964) the specific features of the vertical distribution of daily production often give better indications of the trophic nature of a waterbody. The assimilation curve constructed for Reintaler See (Type 1, FINDENEGG, 1.c) points to enriched condition of lake water, which is also supported by its high production potential (366 mg C $m^{-2}d^{-1}$), near anaerobic conditions of bottom water (0,5 mg/1 of oxygen) and poor Secchi visibility (3 m).
In Gossenköllesee, the low production value (13,6 mg C $m^{-2}d^{-1}$) coupled with an orthograde oxygen curve with more or less uniform vertical oxygen distribution (10-10,6 mg/1) and higher Secchi depth (5,5 m; this is an unusual low value; visibility in this lake extends normally down to maximum depths) are indications of the oligotrophic nature of this typical high-mountain lake.

The production profile with higher values recorded for deeper layers as observed in Gossenköllesee (fig.1), as found also by RODHE et al.(1966) and NAUWERCK (1966) in various high-mountain lakes of Lappland and Tyrol, is characteristic for the summer situation in clear high-mountain lakes. There is also a characteristic depth-distribution of phytoplankton biomasse (NAUWERCK, 1966; RODHE et al., 1966). Phytoplankton countings have not been included in our own studies, but from the results of NAUWERCK (1.c.) the increased production values recorded in deeper layers of Gossenköllesee can be attributed to a corresponding depth-maximum of phytoplankton.

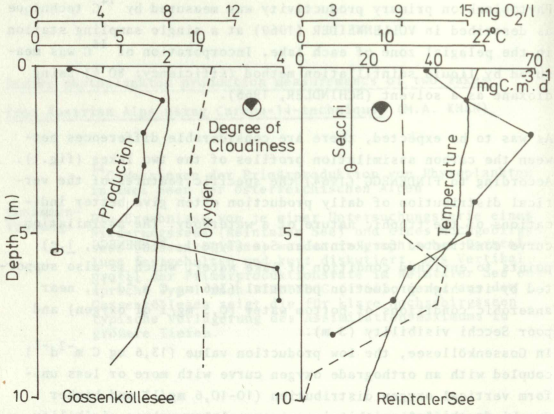

Fig.1: Phytoplankton production and oxygen distribution as a function of depth. Secchi transparency and temperature profile also shown.

RODHE et al.(1966) postulated that detrimental effects of ultraviolet light are the cause for the restriction of plankton to deep layers of high-mountain lakes in summer. According to PECHLANER (1971) a "nutrient-dependent light effect" is responsible for the depth maximum of phytoplankton in high-mountain lakes. WITT (1977), referring to an experimental fertilization of surface water of the alpine Vorderer Finstertaler See reported that high short-wave radiation is not primarily responsible for the preference of deep layers by algae. The most important factor seems to be the disproportion of high radiation energy to a minimal nutrient availibility in the epilimnion.

The present investigation reveals that summer phytoplankton production in each lake type depicts its own pattern and makes a strong plea for further intensive work based on seasonal studies on intrinsic mechanisms governing plankton primary productivity.

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