Application of a Biological Tracer in Transporting Water Volumes during Eutrophication of Mondsee

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ABSTRACT. The oligotrophic alpine lake Mondsee belonging to the system of eight lakes in the Salzkammergut region in Austria represented during our investigation the plankton distribution model in those parts of water areas that are situated in front of the estuaries of intensely eutrophicated mountain inflow torrents, such as Wangauer Ache and Fuschler Ache. Simultaneously with water sampling, measurements by drift floats were made to detect the water inflow direction and speed at several depths down to the bottom. The results have shown that horizontal as well as vertical plankton movement is an efficient biotracer for water flow parameters. Samples were collected in a "chessboard" way and also vertically at 5 m distances. Zoo-, phyto- and bacterioplankton were evaluated.

Life-deficient oligotrophic alpine lakes are eutrophicated from a number of small lateral affluents around their periphery, including two major ones – Wangauer Ache and Fuschler Ache. The small affluents are usually dry and when an area of land is inundated, they fill with water and carry away nutrients from the surrounding meadows into the lakes. The lake Mondsee (Fig. 1) does not represent a closed integrity in the landscape. In its northern region it takes water from the lake Zellersee and on the opposite side the water runs out into lake Attersee. These lakes are linked with others.

Fig. 1. Lake Mondsee; attitude is 481 m; tributaries are designated by outside arrows, the lake circulation by inside arrows; stage – wind-free, – the numbers inside the arrow indicate the range of streaming in cm/s, the number next to the arrow denotes the depth of the measurement in m. The drawn arrow position implies the direction of streaming, – – – – derived direction of water streaming, – – – – tributaries.
Eutrophication is one of the factors that played an important role in the evolutionary process (Pimm 1980 and Morin 1995). Our aim is to save the genofond subjected to numerous life-limiting environmental factors that had undergone several changes during the Earth’s evolution. Microorganisms and organisms with a major environmental valency were able to adapt to the changed natural conditions through biodiversity in individual species. Links between the biodiversity and the ecosystem enable the maximum amount of species to be preserved (Tilman 1994; Tilman and Dawning 1996; Naem et al. 1994; Čerňáková and Ferienčík 1999).

MATERIALS AND METHODS

Collection and treatment of samples. Water samples were collected in October, 1996, using a motor-boat and subsurface floats permitting one to lift from a strictly defined depth and, at the same time, to perform the stream, velocity, direction and temperature measurements. All samples were evaluated microscopically on the day when they were taken. Bacteria, micromycetes and algae were cultivated in culture media in which the number of outgrown colonies was determined.

Profiles of water sampling. Samples were collected in several profiles in the area where the affluents Wangauer Ache and Fuschler Ache empty into the lake (Fig. 2, Table 1).

Fig. 2. View from above on to the lake and tributary area under investigation: 1 - leeward zone with a slow return stream, 2 - stream split from the main stream parallel to the shore, 3 - undersurface flow from the Wangauer Ache; — — — arrows denoting the water circulation in the lake; — — — — trajectories of the direction of water streaming; — — — demarcation of the analyzed space of Mondsee; — — — fictitious connecting line between Wangauer Ache and Fuschler Ache; — — — — contour lines of the depth of the bottom in the lake; their marking by numbers indicates the depth of the bottom; ••••••••••••••• the demarcation of the analyzed space of Mondsee with regard to the territory of Fuschler Ache; A, B, C, D, E, F - points of water sampling; G, M, P - points of the sampling area in the port area (not visible in this view); •••••• points of the measurement on the lake surface where the gauging instrument for measuring the rate and direction of the water was sunk to the certain depth; WD - wind direction; for further explanation of symbols see Fig. 1.

Microbiological water analysis. Microbiological water analysis was performed according to the Czechoslovak Norm (ČSN) 1982; the Slovak Technical Standard (STN) 1998; the National Normalization Groups (ISO) and the Slovak Technical Standard (STN) 1998. The analysis included the following.

Determination of the total count of bacteria on nutrient agar at 22 ± 0.5 °C and 37 ± 0.5 °C during 1 d was done according to STN (1998) and ČSN (1982).