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# LIMNOLOGICAL INVESTIGATIONS OF A SMALL LAKE EGELSEE WITH A VIEW TO FISHERIES

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ABSTRACT

The limnological conditions of Egelsee, a small lake near Mondsee in Scharfling, Austria observed during 1976 are recorded. Presence of healthy oxygen values and favourable pH values in the lake water are considered suitable for fish production. The water inflow and outflow may be important factors influencing the plankton composition of this lake.

## INTRODUCTION

Egelsee, a small lake with an area of 1.8 ha. near Mondsee in Scharfling, Austria was studied during 1976 with a view to assess the limnological conditions. Similar type of studies were made for small lakes in north Austria (Kainz 1969, 1974). This work was undertaken since Egelsee was not studied previously and for its importance of nearer to the Institute. The maximum depth noted was 3.5 m.

## MATERIAL AND METHODS

Water samples were collected with a Ruttner sampler from a station near the eastern side. Temperature was recorded immediately and samples collected for dissolved oxygen were fiixed. All samples were analysed according to standard methods. pH values were determined with WTW pH meter and conductivity was measured with a Metrohm conductivity meter. Phytoplankton samples were fixed in Lugol's Acetic acid solution and counted after sedimentation with an inverted microscope. Zooplankton samples were collected with a Schindler sampler and were made to one litre. From this 10 ml. was sedimented in a counting cell and counted through an inverted microscope. Diurnal variation studies were made by taking samples once in four hours. Primary productivity studies were made by using light and dark bottles.

## RESULTS

(i) *Temperature.* The difference between the surface and bottom values is considerably high for this shallow lake (Table 1 & 2). The range of difference is between 3.4°C to 8.4°C. Since the temperature of the stream water from Scharfling pass mountain is also similar to the surface values of the lake, the constantly low bottom temperatures indicate nonmixing of waters and ground water influence. During the diurnal variation studies, at surface the

* Work carried out at Limnology Institute, Vienna, Austria.

TABLE 1. Diurnal variation studies. Physico Chemical data

| Depth in m | Time 30.6.'76 14.00 hrs | 18.00 hrs | 22.00 hrs | 1.7.76 2.00 hrs | 6.00 hrs | 10.00 hrs | 14.00 hrs |
|---|---|---|---|---|---|---|---|
| | | | TEMPERATURE C | | | | |
| 0 | 24.2 | 24.1 | 22 8 | 22.1 | 21.0 | 22.0 | 23.8 |
| 1 | 21.3 | 21.3 | 20.4 | 20.2 | 18.2 | 20.2 | 21.5 |
| 2 | 17.1 | 16.8 | 16.9 | 16.3 | 16.6 | 16.6 | 17.6 |
| 3 | 15.8 | 14.8 | 15.5 | 14.9 | 14.0 | 15.6 | 16.0 |
| | | | OXYGEN—mg/1 with % of saturation | | | | |
| 0 | 10.69<br>138 | 11.80<br>152 | 11.79<br>148 | 11.37<br>142 | 11.85<br>145 | 11.62<br>145 | 11.19<br>143 |
| 1 | 14.68<br>180 | 14.69<br>180 | 14.30<br>173 | 14.11<br>170 | 13.37<br>155 | 11.79<br>141.5 | 13.88<br>171 |
| 2 | 11.54<br>131 | 11.85<br>133 | 11.43<br>129 | 6.61<br>74 | 9.61<br>108 | 10.76<br>121 | 11.74<br>134.5 |
| 3 | 9.53<br>105 | 6.3<br>68 | 8.79<br>96.5 | 10.80<br>117 | 6.30<br>67.1 | 8.35<br>92 | 8.9<br>99 |
| | | | pH value | | | | |
| 0 | 8.4 | 8.6 | 8.1 | 7.7 | 8.2 | 8.3 | 8.5 |
| 1 | 8.6 | 8.9 | 8.0 | 8.1 | 8.7 | 8.6 | 8.9 |
| 2 | 8.3 | 8.4 | 7.8 | 8.0 | 7.8 | 8.3 | 8.7 |
| 3 | 8.3 | 7.2 | 7.4 | 7.9 | 7.0 | 7.9 | 8.1 |
| | | | CONDUCTIVITY—ms | | | | |
| 0 | 308 | 306 | 304 | 298 | 297 | 301 | 311 |
| 1 | 325 | 323 | 326 | 329 | 331 | 328 | 323 |
| 2 | 330 | 333 | 334 | 337 | 338 | 335 | 339 |
| 3 | 340 | 348 | 341 | 346 | 346 | 330 | 345 |

maximum and minimum temperatures were 24.2°C and 21°C and at bottom they were 16°C and 14°C.

(ii) *Dissolved Oxygen.* At surface, oxygen saturation values were in between 108% to 138% and at bottom it was in between 84.5% to 105% (Table 2). At one metre depth always higher values were noted. During diurnal studies (Table 1) the values were high during daytime. The maximum amount of 175% was noted only during daytime at one metre depth.

TABLE 2. Other physical and chemical data

| Depth in m | Temperature C | Oxygen mg/l | Saturation % | pH value | Alkalinity | Conductivity | $P/PO_4$ mg/$m_3$ | $N/NH_4$ mg/$m_3$ | $N/NO_3$ mg/$m_3$ | $SiO_2$ mg/l | Fe mg/$m_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.6.76 | | | | | | | | | | | |
| 0 | 17.3 | 9.48 | 108 | 7.90 | 3.40 | 322 | — | — | — | — | — |
| 1 | 15.3 | 9.40 | 103 | 7.80 | 3.45 | 328 | 0 | 55 | 1090 | 4.8 | — |
| 2 | 15.3 | 8.34 | 91.5 | 7.65 | 3.50 | 330 | 1.1 | 55 | 1130 | 4.8 | — |
| 3 | 10.7 | 8.60 | 85 | 7.65 | 3.50 | 334 | 5.8 | 55 | 1070 | 6.7 | — |
| 18.6.76 | | | | | | | | | | | |
| 0 | 16.9 | 10.47 | 118 | 8.30 | 3.45 | 326 | — | — | — | — | — |
| 1 | 16.0 | 11.14 | 123.5 | 8.20 | 3.45 | 329 | — | — | — | — | — |
| 2 | 14.1 | 10.07 | 107 | 7.90 | 3.50 | 336 | — | — | — | — | — |
| 3 | 13.5 | 9.40 | 99 | 7.85 | 3.55 | 339 | — | — | — | — | — |
| 30.6.76 | | | | | | | | | | | |
| 0 | 24.2 | 10.69 | 138 | 8.40 | 3.60 | 308 | — | — | — | — | — |
| 1 | 21.3 | 14.68 | 180 | 8.60 | 3.60 | 325 | — | — | — | — | — |
| 2 | 17.1 | 11.54 | 131 | 8.30 | 3.55 | 330 | — | — | — | — | — |
| 3 | 15.8 | 9.53 | 105 | 8.30 | 3.55 | 340 | — | — | — | — | — |
| 5.7.76 | | | | | | | | | | | |
| 0 | 23.0 | 10.72 | 136 | 8.35 | 3.75 | 338 | 2.2 | 35 | 196 | 3.5 | 37.9 |
| 1 | 21.4 | — | — | 8.40 | 3.75 | 338 | — | — | — | — | — |
| 2 | 19.5 | 10.97 | 130 | 8.10 | 3.80 | 340 | 1.1 | 65 | 317 | 4.5 | 45 |
| 3 | 16.5 | 7.53 | 84.5 | 7.65 | 3.80 | 346 | 1.0 | 65 | 280 | 8.9 | 70.5 |

In accordance with the seasonal changes the values were high during July than in June.

(iii) *pH value.* The values range in between 7.2 to 8.9 (Table 2). Considering the values in July, higher values were noted as that of dissolved oxygen values. Also the values were high during daytime especially at one metre depth (Table 1), maximum being 8.9.

(iv) *Alkalinity.* The methyl orange alkalinty values were in between 3.40 to 3.80 (Table 2). During diurnal studies not much variation was noted. But from surface the values increase towards bottom.

(v) *Conductivity.* The conductivity values were in the range of 308 ms. to 346 ms. (Table 2). The difference between the surface and bottom values was in the range of 8 ms. to 13 ms. During diurnal variation studies changes were noted both in the surface and other depths (Table 1). Comparing the alkalinity values and conductivity values, it is evident that conductivity is mostly due to hydrocarbonates.

(vi) *Other values.* The other values, namely Iron, Silicate, Phosphate, Nitrate nitrogen and Ammonia nitrogen (Table 2) indicate optimum levels. But the reason for wide difference in Nitrate nitrogen values is attributed to factors like rains and mixing of water in a shallow lake.

(vii) *Phytoplankton.* During the diurnal studies the phytoplankton was studied. *Synedra, Asterionella, Cyclotella* and *Dinobryon* were the dominant forms. Besides *Tabellaria, Fragilaria* and egg cases were noted at times, (Table 3). The difference in numbers were not following any specific pattern with reference to diurnal changes.

TABLE 3. Diurnal Variation Studies—Phytoplankton—Total number in percentage for each time

| Time / Depth in m | 30-6-'76 14.00 hrs | 18.00 hrs | 22.00 hrs | 1-7-'76 2.00 hrs | 6.00 hrs | 10.00 hrs |
|---|---|---|---|---|---|---|
| 0 | 24.6 | 17.5 | 11.1 | 30.1 | 51.2 | 37.8 |
| 1 | 44.9 | 40.8 | 57.7 | 13.6 | 5.9 | 35.8 |
| 2 | 18.3 | 27.9 | 17.4 | 31.4 | 16.0 | 25.7 |
| 3 | 12.2 | 13.8 | 13.8 | 24.9 | 26.9 | 0.7 |

(viii) *Zooplankton.* The dominant forms were the following Rotifers, namely *Keratella cochlearis, Keratella quadrata, Polyarthra trigla* and *Asplanchna* sp. Regarding copepods only nauplii and copepodites were noted and adults were very few. The variation in number (Table 4) were significant in relation to temperature and light.

TABLE 4. Diurnal Variation Studies—Zooplankton—Total number in percentage for each time.

| Time | 30-6-'76 | | | 1-7-'76 | | | |
|---|---|---|---|---|---|---|---|
| Depth in m | 14.00 hrs | 18.00 hrs | 22.00 hrs | 2.00 hrs | 6.00 hrs | 10.00 hrs | 14.00 hrs |
| 1 | 21.7 | 52.6 | 61.6 | 42.7 | 7.4 | 29.5 | 5.7 |
| 2 | 31.9 | 14.8 | 13.7 | 52.8 | 35.7 | 33.3 | 32.4 |
| 3 | 46.4 | 32.6 | 24.7 | 4.5 | 6.9 | 37.2 | 61.9 |

(ix) *Primary productivity.* The period of incubation was for 12 hours at 0, 1, 2 & 3 m. depths. The values indicate for high gross production at the surface of the lake. The transparency values were in between 0.70 to 0.80 m.

## DISCUSSION

There are no absolute fish production values for this lake but considering for fisheries, the favourable factors are the stream water and ground water. Running waters are generally rich in oxygen and ground waters will have constant temperature of their own. The lake is having healthy oxygen values. The pH values are in the range of 7.2 to 8.9 and this range is fovourable for fish production (EIFAC/T4). But the phytoplankton and zooplankton values could be unfavourable to fishes especially to plankton feeders. Considering the number of zooplankton, Rotifers occupy 80% but the role of Rotifers as fish food is still not known. As all the other factors are favourable, the water inflow and outflow of this lake may be one of the important factors influencing the plankton composition. Brook and Woodward (1956) have observed for small Scottish lakes that quantity of plankton is inversely proportional to the volume of inflow and outflow. Generally the magnitude of influence is higher in small lakes like Egelsee. In this connection it is suggested that some more studies have to be made on water quality and on the volume of inflow and outflow. Based on that the stream water into the lake can be regulated either by diverting the stream as practised in carp culture ponds (Bank and Krush 1963) or by some other means. Likewise the water outflow also has to be regulated. With this improvement there are ample opportunities for improvement in plankton and fisheries.

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