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About the thermic conditions in sediment—water zone of shallow lakes in Hungary

By

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Abstract. One of the most specific characteristics of shallow lakes is that the temperatures of their sediment are not constant. The role of the sediment in shallow waters is also different as compared with deep lakes because, on the surface of the sediment, besides decomposition, certain organic matter composition also takes place. During several years, sediment temperatures, their vertical differences were measured. Sediment temperatures and those of the water columns were compared. Investigations were carried out in two Hungarian shallow lakes (lake Velence: 24 km^2, depth: 120 cm; Neusiedlersee/Fertő: 309 km^2, depth: 110 cm) and rice fields: 30 cm depth.

There are obvious thermic differences between shallow and deep lakes. Their effects on the different nutrient cycles are known but only few thermic data series can be found in the limnological literature. Even less data have been published about the thermic conditions of the sediment in spite of its importance in decomposition.

The thermic conditions of the sediment in different Hungarian shallow water bodies have been investigated. The results on three water types are discussed (I. Lake Fertő/Neusiedlersee; II. Lake Velence; III. rice field). The same type of thermistoric thermometer (accuracy: 0.2 °C) was used. The temperature was recorded in the sediment from 2 to 45 cm depth if it is not indicated otherwise.

I. Lake Fertő/Neusiedlersee

The temperature of every one cm thick sediment layer down to 42 cm-s was measured from spring to autumn at the same spot (Fig. 1). The comparison of three-three appropriate data series from two sites situated close to each other is also presented (Fig. 2). Water temperature determined the temperature of the sediment down to 30—40 cm-s. Specific heat and smaller inhomogeneity could be detected by appropriate instruments.

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II. Lake Velence

The temperature of the air, the water surface and the upper layer (3 cm) of the sediment at the same spot based on two-year-long data series (Fig. 3) and a data set of nine spots measured on 14. 07. 1955 (Fig. 3, 4, Tab 1) are presented. The temperature of the upper sediment layer followed the temperature of the water even if its warming up and cooling down was a slower process. The second data set demonstrates a close correlation between the temperature of the water and the sediment.

III. Rice fields (around Szarvas)

The temperature of the extremely shallow water rapidly followed the changes in the air temperature (Fig. 5, 6, 7). The soil (sediment) temperature was also influenced by direct solar radiation often leading to invers stratification the soil was warmer than the water.

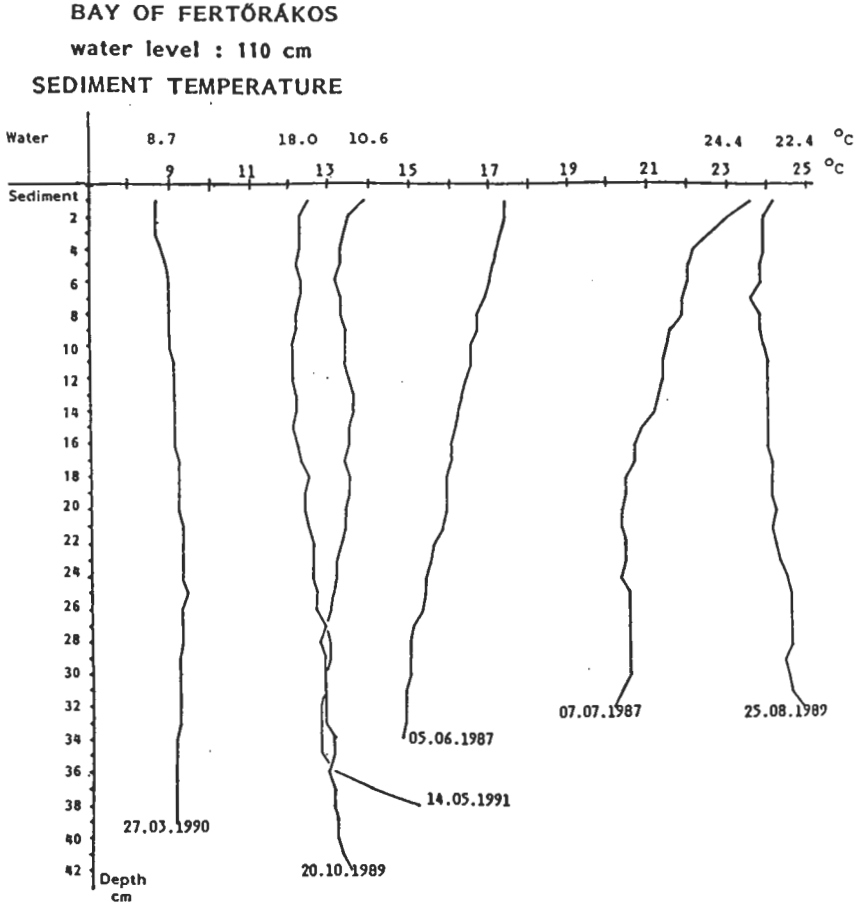
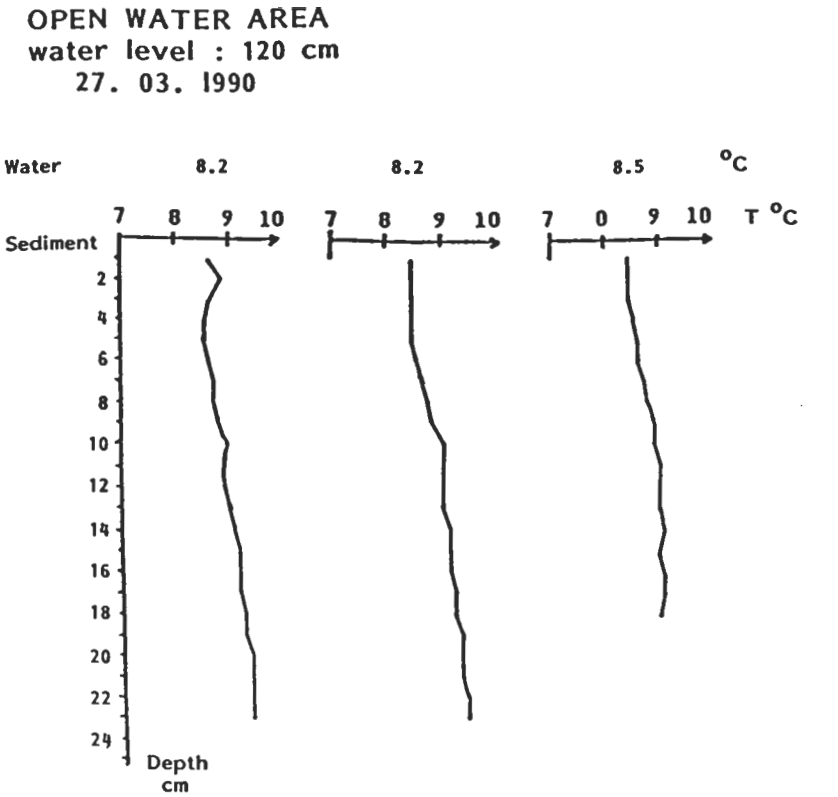


Fig. 1. Sediment temperatures data in Lake Fertő/Neusiedlersee (bay of Fertőrákos)



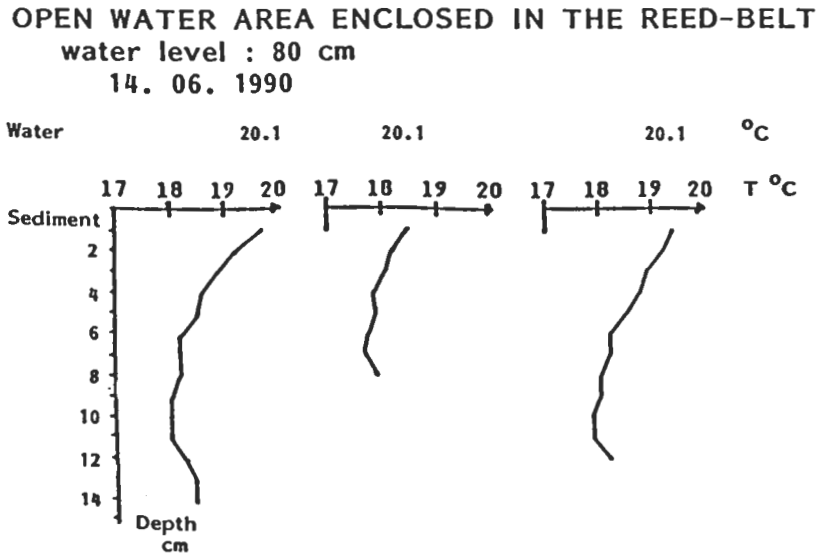


Fig. 2. Sediment temperatures data in Lake Fertő/Neusiedlersee

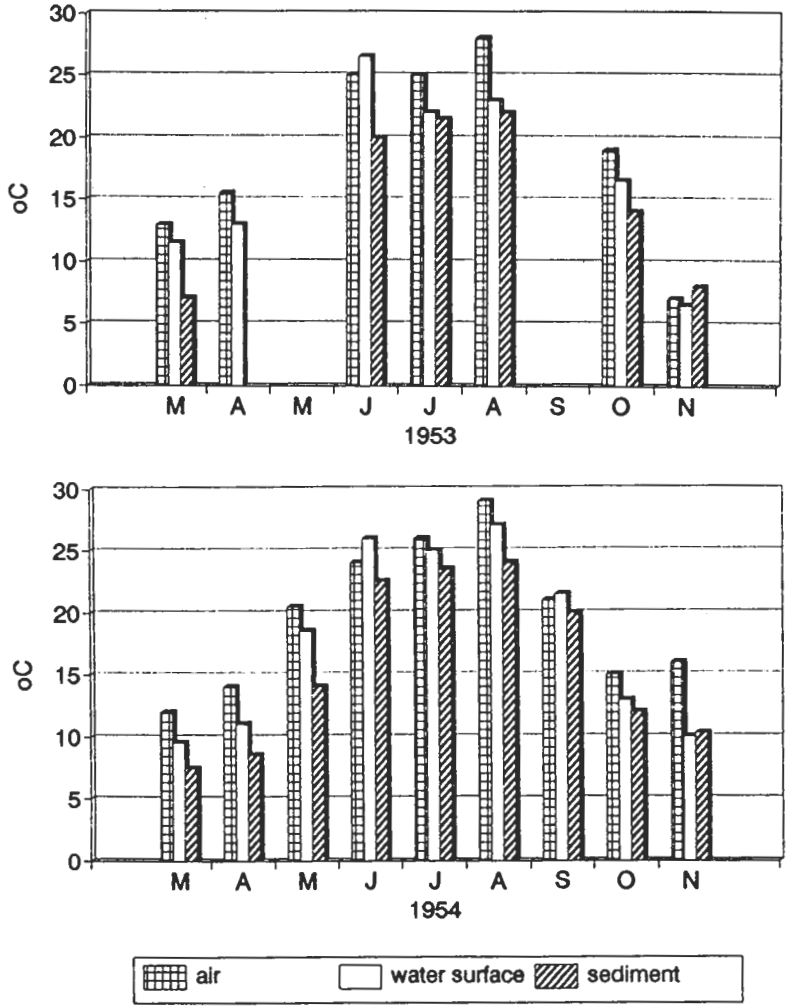


Fig. 3. Temperatures in Lake Velence ("Fürdető" water level: 140 cm)

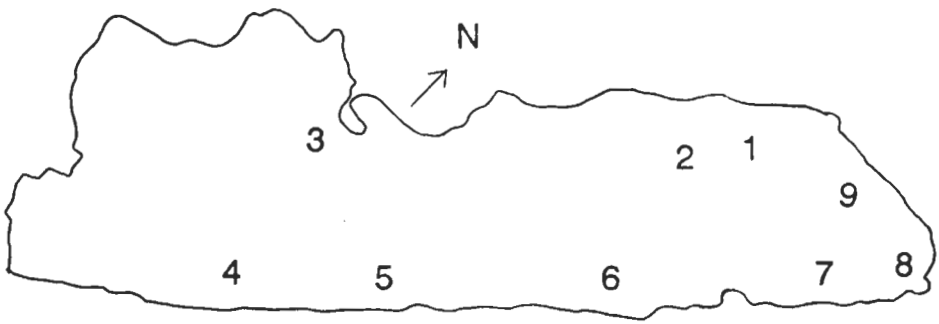


Fig. 4. Measuring sites in Lake Velence

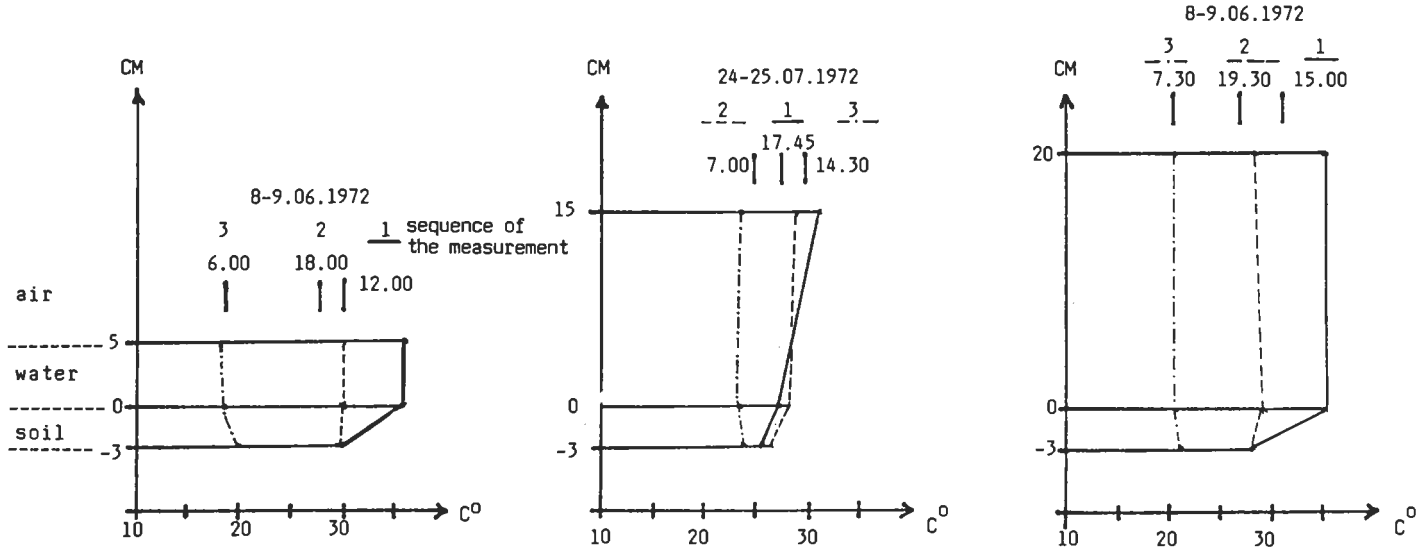


Fig. 5. Temperatures in a rice field

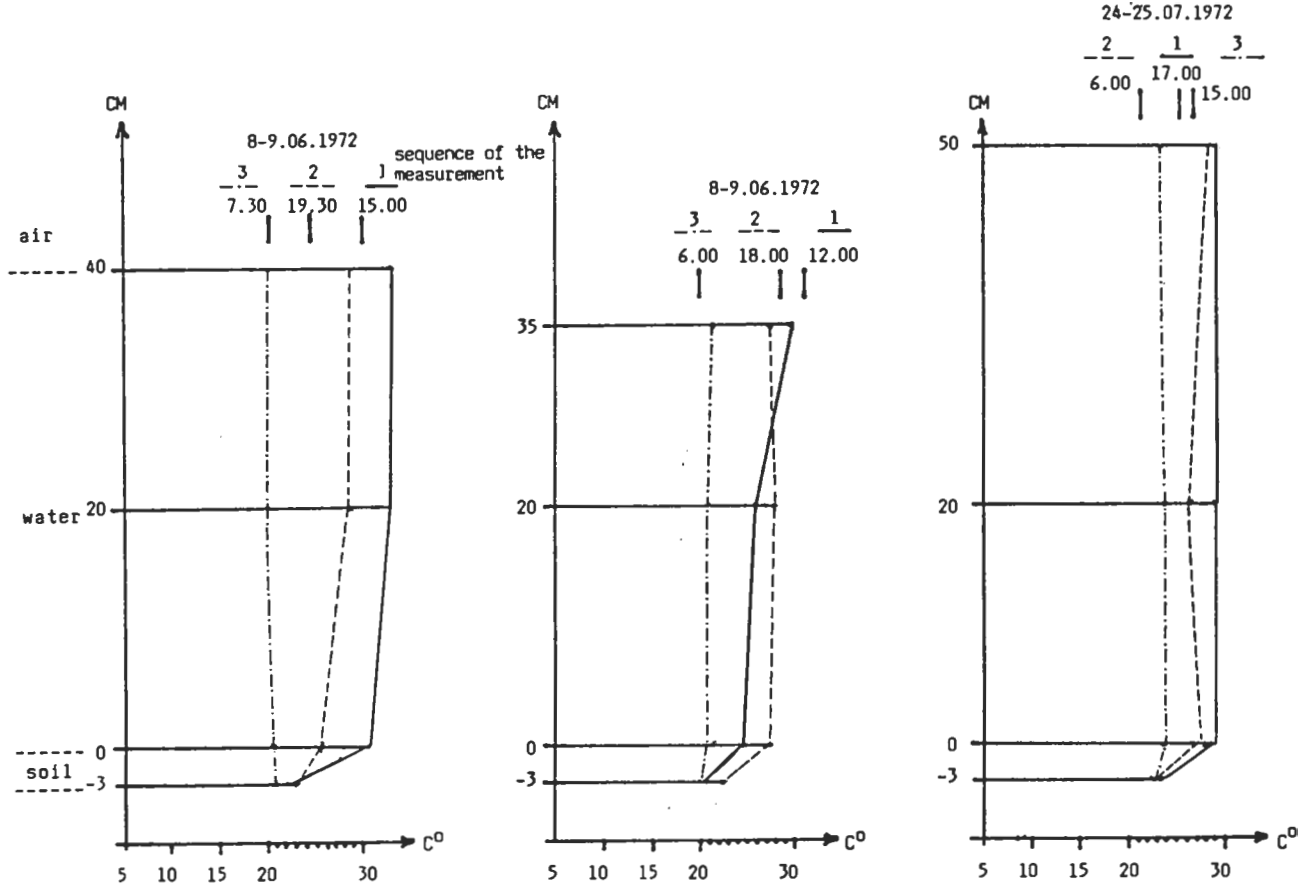


Fig. 6. Temperatures in rice fields (furrow)

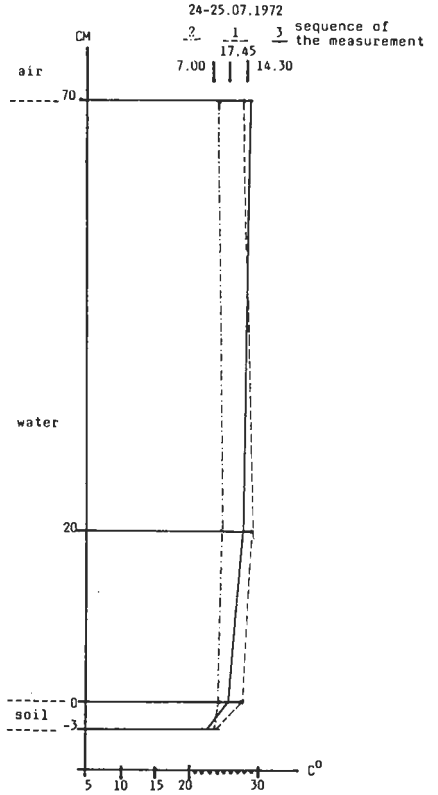


Fig. 7. Temperatures in rice field (agricultural drain)

Table 1. Temperatures data in Lake Velence — 14. 07. 1955

Measure place	Depth cm	Temperature °C		
		air	water	sediment
1.	165	23.5	24.0	20.5
2.	130	25.5	25.5	22.0
3.	170	22.0	24.0	20.0
4.	130	21.5	24.8	21.5
5.	170	23.2	24.5	22.0
6.	170	24.0	25.0	22.5
7.	130	24.0	24.5	23.0
8.	110	23.8	24.5	22.8
9.	150	24.0	25.0	22.5

Important conclusions

In shallow lakes (~3 m depth) the temperature of the sediment down to 20 to 40 cm followed the temperature of the water column above it. As a consequence decomposition takes place at a considerably higher temperature (20—30 °C verus 4 °C) for more than six months in the upper sediment layer in shallow lakes than in deep lakes within the temperate zone. It is of great importance in the nutrient cycling and the energy flow.

To a small extent solar energy reaches the surface of the sediment even in less shallow, more turbid waters (I. Lake Fertő/Neusiedlersee, II. Lake Velence). The sun directly heated by solar energy.

Sediment inhomogeneity dependent temperature fluctuations can be detected down to 20 to 40 cm-s.

A new limnological characterization of shallow waters could also be possible on the basis of the heat transmission ratio between direct solar radiation and indirect heat conduction.

REFERENCES

1. Berczik, Á. (1961): Einige Beobachtungen bezüglich der horizontalen Verteilung des Makrobenthos seichter "pannonischer" Seen. — Acta Zool. Hung. 7: 49—72.

2. Berczik, Á. (1974): Az asztatikus vizek egy típusa. (Limnológiai tanulmány rizsföldeken.) — (Manuscript) 1—310.

3. Berczik, Á. (1993): Beobachtungen über die Temperaturverhältnisse der oberen Sedimentschichten im Neusiedler See. — BFB-Bericht 79: 41—46.