Limnology of the heliothermal Solar Lake on the coast of Sinai (Gulf of Elat)*

by

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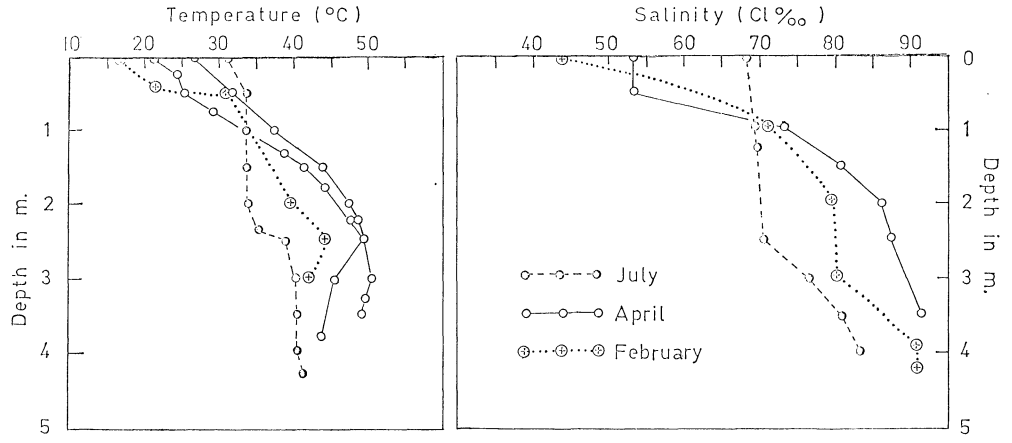
Heliothermal processes are known in meromictic lakes of Rumania [KALECSINSKY, 1901] of the West Coast of the U.S.A. [ANDERSON, 1958] and of the Antarctic continent (HOUSE et al, 1966). In all these cases, a freshwater mixolimnion covers a highly saline monimolimnion.

Solar Lake, is a 130/60 m waterbody situated 30 km south of Elat, at about 50 m from the shores of the Red Sea. The small lake has a maximum depth of 5 m.

At the time of its discovery, 16 February 1968, the surface temperature was of 16°C and increased steeply to above 40° below the 150 cm depth level. Salinities were found to be very high, increasing from a surface salinity of 42,6 Cl ‰ 0 to a maximum of 90,7 in the deeper layer.

Repeated observation, in April, July and August showed at the beginning a concomitent increase in the mixo- and monimolimnic temperatures. The later reached maxima of 50°C. On the contrary, salinity of the surface layer increased towards summer, while the values in the deep layer remained constant. In July the salinity stratification was almost inexistent and following the saline mixing, the temperatures also showed a clear tendency towards homogeneity. In August, the mixing of the two layer was complete.



Temperature and Salinity in the Solar Lake, Elat (1968)

The above described seasonal dynamics in the hydrography of Solar Lake and the thallasohalinic character of the ionic composition of the lake water, obviously rule out the possibility of a crenogenic origin of the lake. Heliothermal heating through solar irradiation occurs during the winter and spring

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when a very pronounced halocline exists in the lake. During the period of stratification, the heat stored in the monimolimnion increases proportionally with the seasonal increase in solar radiation. The seasonal dynamics of the lake are however most of all a function of changing equilibrium between evaporation and subterranean marine inflow.

Along the whole eastern shore of the lake, the shore which is near the sea, Red sea water is seeping into the lake, through a great number of small springs. These streams of inflowing water showed through the whole period of the study fairly constant salinities of 25.21 to 29.47 Cl ‰, i.e. a salinity slightly higher than that of the Red Sea. This inflow of marine water is responsible for the establishing of the relatively dilluted mixolimnion. But this layer comes into being only in the winter and spring when evaporation can be matched by the inflow. As soon as evaporation increases over the inflow, the salinity of the mixolimnion increases untill the point where wind activity destroys the halocline and consequently also the heliothermal adiabatic effect. Water level decreases in this period.

The transparency of the lake water is very variable and values as low as 220 cm Secchi reading have been found.

The bottom of the monimolimnic layer is lined by a continuous crust of gypsum crystals which has to be broken in order to reach the subjacent black anaerobic mud.

The littoral belt, down to depths of about 150 cm is formed by a thick and springy carpet of blue-green algae, several tens of centimeters thick. The algal carpet is first of all formed of *Schizothrix* sp., but also other species such as *Spirulina labyrinthiformis* and *Oscillatoria salina* are found (Mrs. I. Dor, personal communication). A thermophilic diatom, *Nitzschia thermalis* is also very frequent.

The fauna in the open water is represented exclusively by *Artemia salina* which indeed avoids the hot and anoxyc monimolimnion. The algal carpet harbours a relatively varied fauna for such a highly hyperhaline lake. There are several species of ciliates, the most interesting of them being perhaps the 3 mm long condylostomide. Among the most numerous inhabitants are representative of an unidentified rhabdocoelan flatworm which is able to survive above level salinities by means of kyst forming. Another frequent inhabitant is the harpacticoid copepod *Robertsonia salsa* a widespread inhabitant of the saline waters of the Sinai peninsula. Scattered among the specimens of this species, there are also rare representatives of another harpacticoid, *Nitocra lacustris*.

The most conspicuous inhabitants of the littoral algae are the large dytiscid beetles of the genus *Eretes* (identified Y. MARGALIT) and two species of hydrophilid beetles.

The littoral fauna and chiefly the copepods are highly reduced by the increase of the surface salinity in the summer. Nevertheless the extent of the influence of the seasonal fluctuation on the fauna is not yet clearly understood.

In the wet littoral mud of the western coast of the lake, burrowing staphylinid beetles are found as well as halophilic and amphibious oniscoid isopodes of the genus *Halophiloscia*.

Conclusions

Solar Lake on the coast of the Red Sea is a peculiar case of heliothermal meromictic basin in which the mixolimnion is seasonally established by inflowing seawater. A summer overturn and homogeneity appears as soon as evaporation prevails over marine inflow. Although much of the details of the details of this mechanism is yet unknown, it clearly suffices in order to explain the hydrological phenomena observed in the field. This type of water body is presumably to be found in many places along the Red Sea coast and probably of other tropical seas too.

The biotic community of Solar Lake is an established and fairly rich hyperhaline biocoenosis. The detailed study of the seasonal changes occuring in this population might proove to be of the highest interest. The fauna and flora belong to a zoogeographic unit which apears to be specific for the whole area of Sinai peninsula, the isthmus of Suez and probably also the Nile Delta area on one side and the Dead Sea area on the other.

Acknowledgment

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