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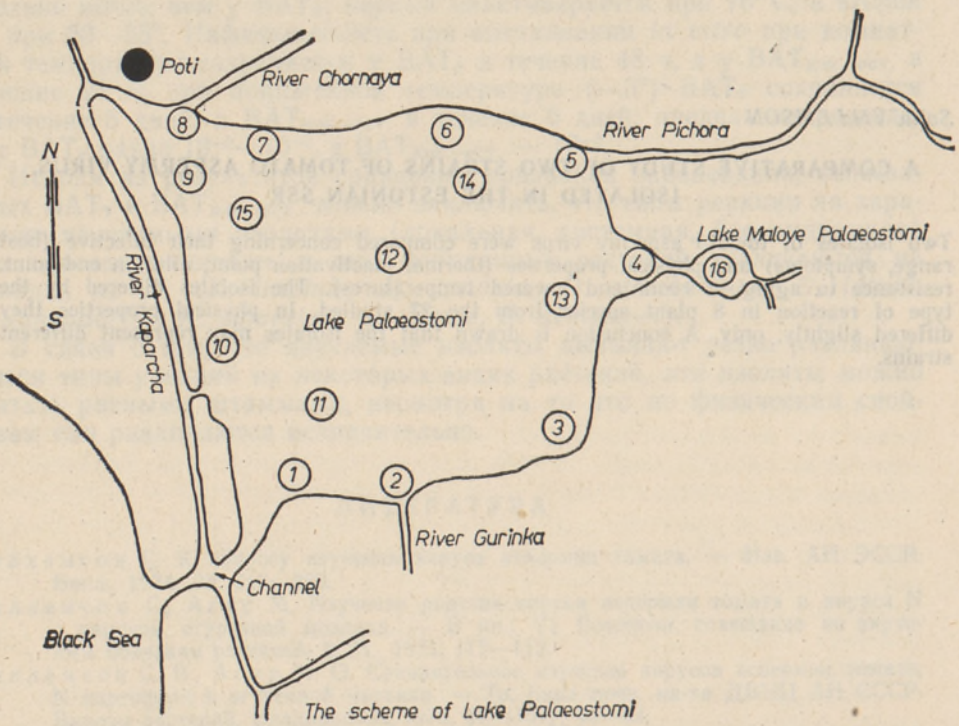
ON THE SUMMER PHYTO- AND ZOOPLANKTON OF LAKE PALAEOSTOMI

I. SPECIES COMPOSITION OF PHYTO- AND ZOOPLANKTON. BRIEF CHARACTERIZATION OF THE LAKE

Lake Palaeostomi (Fig.) is located on the shore of the Black Sea (2 km from the sea) in the vicinity of the town of Poti (Georgian SSR). It is a brackish-water lake of a relict character which, in the far past, developed from a bay of the Black Sea. The area of the lake is 17.3 sq. km, average depth 2.2 and maximum depth 4.0 m. Up to 1933 the lake was connected with the sea only via the River Kaparcha. In the December of 1933 the rising water of the lake formed a 140—160-metre-wide canal that connected the lake and the sea directly. Before the formation of the direct connection the salinity of water in the lake was relatively low and of a clearly seasonal character (low in spring, high in autumn). After the formation of the direct connection the salinity has increased and is permanently rather high (in the surface layer up to 12‰, at the bottom up to 13‰). The salinity is now connected first of all with the direction and strength of the wind, while no clear connection with seasons occurs. Strong western



The scheme of Lake Palaeostomi

winds cause great amounts of the sea water to penetrate into the lake, thus raising the salinity to a considerable extent. In general, the salinity of water in L. Palaeostomi is of a rather unstable character.

The brackish-water L. Palaeostomi is connected by a small river with a broadened part of the river, called Maloye (Little) Palaeostomi.

Material and methods

The materials of the present paper (26 quantitative and 21 qualitative samples of zooplankton as well as 27 samples of phytoplankton) were collected in the July and August of 1977 (during the ichthyological expedition of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR) in different parts of the lake, in river-mouths and in the fresh-water L. Maloye Palaeostomi connected with the lake. The locations of the sample spots can be seen in Figure, characterizations are given in Table 1.

The phytoplankton samples were taken by Ruttner's batometer, fixed with formaline, concentrated by precipitation and counted on a lineated ground slide. The samples of zooplankton were taken by a small quantitative Juday net (silk N 70) and elaborated by the usual counting method

Table 1

Characterization of sample spots of L. Palaeostomi in August, 1977

Sample spot	Depth, m	Water temperature, °C	Transparency, m	Colour	pH	Salinity, ‰*	Notes
1	0.4	25.8	0.4	brownish-green	8,4	6,62	Littoral zone in the vicinity of the channel, sparse reeds, sample spot nearest to the Black Sea
2	0.8	25.6	0.7	reddish-brown	7,7	4,32	Mouth of R. Gurinka
4	2.0	26.4	0.6	brown	8,4	2,80	Mouth of the inflow of L. Maloye Palaeostomi
5	3.7	26.9	0.7	yellowish-green	9,1	2,65	Mouth of R. Pichora
6	0.9	26.7	0.7	turbid, yellowish-green	9,7		Littoral zone without vegetation on the northern shore
8	0.6	27.2	0.5	yellowish-green	8,7	5,33	Mouth of R. Chornaya
10	0.8	25.6	0.95	yellowish-green	9,0		Littoral zone without vegetation on the western shore
11	2.4	25.2	0.8	yellowish-green	8,9	6,60	Pelagic zone in the south-western part of the lake
12	2.6	25.4	0.8	yellowish-green	9,1	6,47	Pelagic zone in the centre of the lake
13	2.5	26.8	1.0	yellowish-green	8,9		Pelagic zone in the eastern part of the lake
14	2.5	26.4	0.8	yellowish-green	9,1		Pelagic zone in the northern part of the lake
15	2.6	26.0	0.8	yellowish-green	9,05		Pelagic zone in the western part of the lake

* According to R. E. Tiidor (Тийдор, in print).

(Киселев, 1956). The biomass of both phyto- and zooplankton was calculated by means of the volume of algal cells and zooplankters (Петипа, 1957; Студеникина, Черепахина, 1969); in the case of zooplankters the relations between the length of the body and weight were also used (Печень, 1965; Балушкина, Винберг, 1979).

The weight of the jellyfish *Moerisia maeotica* was stated by direct weighing. The lengths of *Harpacticoida*, *Gastropoda* juv. and *Acartia clausi* were measured and corresponding weights were taken from literature (Баркалова, 1940; Киселев, 1956; Петипа, 1957; Зимбалевская, 1966). The production of the group of rotifers dominating in zooplankton and that of *Brachionus plicatilis* occurring in masses were fixed by a physiological method repeatedly used by M. Ivanova (Иванова, 1975, 1979).

The authors are grateful to L. Kutikova, V. Monchenko, D. Naumov and A. Randveer for their help in the identification and counting of plankton.

Qualitative composition of phyto- and zooplankton

The brackish-water diatom *Rhizosolenia fragilissima* and blue-green algae *Nodularia spumigena* f. *litorea*, *Anabaenopsis arnoldii* and *Anabaena bergii* dominate in the phytoplankton of L. Palaeostomi. The subdominating species are *Nitzschia longissima* var. *reversa* and the genera *Thalassiosira* and *Coscinodiscus*.

The dominating species were the same in all the sample spots except for the fresh-water L. Maloye Palaeostomi — spot 16. Noticeable differences existed between the littoral and pelagic regions. Many fresh-water species occurred in the littoral region where the salinity is lower. With the decrease of salinity the number of species in a sample, index of species diversity and its ratio to biomass increased. In the most typical fresh-water spots 4, 5 and 16, the species of *Cyclotella* were especially numerous. The species of protococceans and euglenophytes were also most abundant here. In total, 173 taxons of algae were identified in the plankton of L. Palaeostomi. A systematic list of them follows.

List of species

\+ — single; r — rare; u — usual; f — frequent; vf — very frequent.

CYANOPHYTA

Holopedia geminata Lagerh. r; *Merismopedia glauca* (Ehr.) Näg. u; *M. minima* G. Beck r; *Gomphosphaeria aponina* Kütz. f. *cordiformis* (Wolle) Elenk. +; *Chamaesiphon* sp. r; *Anabaena bergii* Ostenf. vf; *A. contorta* Bachm. u; *A. hassalii* (Kütz.) Wittr. f. *minor* V. Poljansk. r; *A. lemmermannii* P. Richt. +; *A. planctonica* Brunnth. u; *A. spiroides* Kleb. r; *A. variabilis* Kütz. r; *Anabaenopsis arnoldii* Aptek. vf; *Aphanizomenon flos-aquae* (L.) Ralfs r; *Nodularia spumigena* Mert. f. *litorea* (Kütz.) Elenk. vf; *Oscillatoria agardhii* Gom. +; *O. animalis* Ag. +; *O. limnetica* Lemm. f. *acicularis* (Nyg.) V. Poljansk. u; *O. margaritifera* (Kütz.) Gom. +; *O. sancta* (Kütz.) Gom. r; *O. tenuis* Ag. +; *Pelonema subtilissimum Skuja* +; *Phormidium fragile* (Menegh.) Gom. r; *Lyngbya aerugineo-coerulea* (Kütz.) Gom. +; *L. major* Menegh. var. *stepnoi* Anissim.) Elenk. +; *L.* sp. u; *Leptothrix sideropus* (Molisch) Benecke +.

CHRYSOPHYTA

Rhizochrysidiopsis vorax Geitl. +.

BACILLARIOPHYTA

Melosira ambigua (Grun.) O. Müll. r; *M. granulata* (Ehr.) Ralfs var. *angustissima* (O. Müll.) Hust. +; *M. italica* (Ehr.) Kütz. var. *valida* (Grun.) Hust. +; *M. moniliformis* (O. Müll.) Ag. var. *moniliformis* r; *M. moniliformis* var. *octogona* Grun. r; *M. moniliformis* var. *subglobosa* Grun. f; *M. varians* Ag. +; *Sceletonema costatum* (Grev.) Cl. u; *Cyclotella atomus* Hust. vf; *C. comta* (Ehr.) Kütz. r; *C. kuetzingiana* Thwait. +; *C. meneghiniana* Kütz. f; *Thalassiosira decipiens* (Grun.) Jørg. u; *Th. excentrica* (Ehr.) Cl. u; *Coscinodiscus antiquus* Grun. r; *C. oculus iridis* E. u; *C. radiatus* E. r; *Rhizosolenia alata* Brightw. f. *gracillima* A. Cl. r; *Rh. eriensis* H. L. Smith r; *Rh. fragilissima* Bergon vf; *Rh. minima* Lev. +; *Chaetoceros amanita* A. Cl. r; *Ch. perpusillus* Cl. +; *Ch. pseudosimilis* A. Cl. +; *Ch. simplex* Ostf. r; *Ch. socialis* Lauder +; *Biddulphia polymorpha* (Grun.) Wolle +; *Cerataulina bergonii* H. Per. f. *elongata* Schröder f; *Tabellaria fenestrata* (Lyngb.) Kütz. +; *Diatoma elongatum* (Lyngb.) Ag. +; *Fragilaria crotonensis* Kitt. +; *Synedra tabulata* (Ag.) Kütz. r; *S. ulna* (Nitzsch.) Ehr. u; *Cocconeis pediculus* Ehr. +; *C. placentula* Ehr. var. *euglypta* (Ehr.) Cl. r; *Rhoicosphenia curvata* (Kütz.) Grun. u; *Diploneis elliptica* (Kütz.) Cl. r; *D. interrupta* (Kütz.) Cl. var. *heeri* (Pant.) Hust. u; *D. smithii* (Breb.) Cl. r; *Navicula bacillum* Ehr. var. *minor* V. H. +; *N. gracilis* Ehr. r; *N. humerosa* Breb. r; *N. lacustris* Greg. +; *N. pusilla* W. Sm. r; *N. peregrina* (Ehr.) Kütz. r; *Pinnularia microstauron* (Ehr.) Cl. +; *Gyrosigma kuetzingii* (Grun.) Cl. u; *G. macrum* W. Sm. r; G. sp. u; *Amphiprora paludosa* W. Sm. +; *Amphora coffeaeformis* Ag. r; *A. lineolata* Ehr. +; *A. robusta* Greg. +; *A. veneta* Kütz. r; *A.* sp. r; *Cymbella sinuata* Greg. +; *Epithemia sorex* Kütz. +; *E. turgida* (Ehr.) Kütz. +; *Rhopalodia musculus* (Kütz.) O. Müll. +; *Hantzschia virgata* (Roper) Grun. var. *capitellata* Hust. +; *Bacillaria paradoxa* Gmelin u; *Nitzschia acicularis* W. Sm. f; *N. clausii* Hantzsch +; *N. linearis* W. Sm. r; *N. longissima* (Breb.) Ralfs var. *longissima* r; *N. longissima* var. *reversa* W. Sm. vf; *N. macilenta* Greg. u; *N. punctata* (W. Sm.) Grun. u; *N. recta* Hantzsch r; *N. sigma* (Kütz.) W. Sm. r; *N. tenuirostris* Mer. f; *N. vermicularis* (Kütz.) Grun. u; *Surirella ovata* Kütz. var. *salina* (W. Sm.) Hust. +; *S. striatula* Turp. +; *S.* sp. r; *Campylodiscus daemelianus* Grun. +.

PYRROPHYTA

Cryptomonas reflexa (Marsson) Skuja r; *Cr.* sp. r; *Exuviaella cordata* Ostf. f; *Gymnodinium* sp. sp. u; *Glenodinium gymnodinium* Penard cfr. f; *Gl. sp.* u; *Peridinium balticum* cfr. f; *P. brevipes* Paulsen r; *P. globulus* var. *ovatum* (Pouchet) Schiller u; *Gonyaulax spinifera* (Clap. et Lachm.) Diesing u; *Ceratium hirundinella* (O. F. M.) Bergh t. *furcoides* (Lev.) Schröder +.

EUGLENOPHYTA

Trachelomonas granulosa Playf. +; *Tr. intermedia* Dang. r; *Tr. volvocina* Ehr. u; *Euglena ehrenbergii* Klebs var. *ehrenbergii* u; *E. ehrenbergii* var. *torta* Ded.-Stscheg. u; *E. korschikovii* Gojdics +; *E. proxima* Dang. r; *E. sp.* u; *E.* sp. r; *Lepocinclis fusiformis* (Carter) Lemm. u; *L. ovum* (Ehr.) Mink. var. *ovum* r; *L. ovum* var. *dimidio-minor* Defl. +; *Monomorphina pyrum* (Ehr.) Mereschk. r; *Phacus agilis* Skuja u; *Ph. curvicauda* Swir. r; *Ph. fominii* Roll +; *Colacium vesiculosum* Ehr. u; *Euglenopsis* sp. u; *Gonyostomum depressum* (Lauterb.) Lemm. +; *Eutreptia lanowii* Steuer u.

EUCHLOROPHYTINA

Chlamydomonas subcylindracea Korsch. r; *Pandorina morum* (Müll.) Bory +; *Tetraspora* sp. +; *Characium falcatum* Schroed. u; *Dictyochloris globosa* Korschik. r; *Pediastrum boryanum* (Turp.) Menegh. +; *P. duplex* Meyen +; *Chlorella* sp. f; *Oocystis pelagica* Lemm. +; *Ankistrodesmus acicularis* (A. Br.) Korschik. r; *A. angustus* Bern. vf; *A. minutissimus* Korschik. f; *Hyaloraphidium rectum* Korschik. +; *Kirchneriella lunaris* (Kirchn.) Moeb. r; *Dictyosphaerium pulchellum* Wood +; *D. simplex* Korschik. r; *Coelastrum microporum* Naeg. r; *C. sphaericum* Naeg. +; *Crucigenia tetrapedia* (Kirchn.) W. et W. +; *Tetrastrum glabrum* (Roll) Ahlstr. et Tiff +; *T. pulloideum* Teil. +; *T. staurogeniaeforme* (Schroed.) Lemm. +; *Actinastrum hantzschii* Lagerh. r; *Scenedesmus acuminatus* (Lagerh.) Chod. r; *Sc. armatus* Chod. r; *Sc. ecornis* (Ralfs) Chod. (=*Sc. bijugatus* (Turp.) Kütz.) +; *Sc. intermedius* Chod. u; *Sc. quadricauda* (Turp.) Breb. r; *Sc. spinosus* Chod. +; *Sc.* sp. f; *Micractinium quadrisetum* (Lemm.) G. S. Smith +; *Oedogonium pringsheimii* Cramer sec. Hirn +.

CONJUGATOPHYTINA

Closterium acutum (Lyngb.) Breb. var. *linea* (Perty) W. et W. u; *Cl. navicula* (Breb.) Lütkem. var. *inflatum* W. et W. +; *Cl. pronum* Breb. f. *brevius* (W. West) Kossinsk. +; *Cosmarium laeve* Rabenh. +; *C.* sp. r; *Mougeotia* sp. r; *Spirogyra* sp. r.

A survey of the history of the investigations of the zooplankton of L. Palaeostomi is given in an article by J. Haberman and L. Kutikova (Хаберман, Кутикова, in print).

In the summer of 1977 40 species of rotifers, 6 cladocerans and 11 species of copepods were identified in L. Palaeostomi (together with L. Maloye Palaeostomi). In addition, jellyfish *Moerisia maeotica*, *Polychaeta* juv., *Balanus* juv., *Gastropoda* juv., *Decapoda* juv., *Insecta* juv., *Mysidacea* sp. also occurred — in total 64 forms of 10 animal groups. As regards the number of species, euryhaline fresh-water species dominate (43 out of 57), while quantitatively the brackish-water and euryhaline marine forms are in the majority.

In the summer zooplankton species of rotifers and copepods occur in the greatest numbers, while cladocerans are very few. The number of species in the lake is rather low, obviously due to the salinity which is too high for the fresh-water forms and too low for the marine ones.

List of species

The occurrence in L. Palaeostomi is marked with +, that in the L. Maloye Palaeostomi with o.

ROTATORIA

Asplanchna brightwelli Gosse +, o; *Bdelloida* +; *Brachionus angularis* Gosse +, o; *B. budapestinensis* Daday +; *B. calyciflorus typica* Pallas +, o; *B. calyciflorus amphiceros* Ehr. +, o; *B. falcatus* Zach. +; *B. plicatilis* Müll. +, o; *B. quadridentatus brevispinus* Ehr. +; *B. quadridentatus rhenanus* Lauterb. +; *B. rubens* Ehr. +; *B. urceus* (Linnaeus) +, o; *Colurella adriatica* Ehr. +; *C. colurus* (Ehr.) +; *Dipleuchlanis propatula* (Gosse) +, o; *Eosphora ehrenbergi* Weber +; *Euchlanis dilatata* Ehr. +, o; *E. dilatata lucksiana* Hauer o; *Filinia longiseta* (Ehr.) +; *Hexarthra fennica* (Lev.) +, o; *H. oxyuris* (Zern.) +; *Keratella tropica monospina* (Klaus) +; *Lecane arcuata* (Bryce) o; *L. bulla* (Gosse) +, o; *L. closterocerca* (Schm.) +, o; *L. grandis* (Murray) +; *L. decipiens* (Murray) o;

L. luna (Müll.) +; *L. ungulata* (Gosse) o; *Lepadella patella* (Müll.) o; *L. patella oblonga* (Ehr.) o; *Polyarthra major* Burckh. +; *P. remata* Skor. +, o; *P. vulgaris* Carlin +, o; *Ptygura* +; *Synchaeta cecilia* Rouss. +, o; *S. curvata* Lie-Petersen +; *Testudinella patina* (Herm.) +, o; *Trichocerca marina* (Daday) +; *T. rattus carinata* (Ehr.) o; *T. weberi* (Jenn.) o; *Tripleuchlanis plicata* Lev. o.

COPEPODA

Acartia clausi Giesb. +; *Calanipeda aquae dulcis* Kritsch. +, o; *Cryptocyclops bicolor bicolor* (Sars) +, o; *Eucyclops serrulatus* (Fish.) +; *Eurytemora velox* Lillj. +; *Mesocyclops leuckarti* (Claus) +, o; *Oithona minuta* Kritsch. +; *Canuella perplexa* T. et A. Scott +; *Nitocra lacustris* (Schmank.) +, o; *Mesochra aestuarii* (Gurn.) +; *Ergasilus* sp. +.

CLADOCERA

Alona rectangula Sars +, o; *Bosmina longirostris* (O. F. Müller) +; *Ceriodaphnia pulchella* Sars +; *Chydorus sphaericus* (O. F. Müll.) +; *Diaphanosoma brachyurum* (Lievin) +; *Podon polyphemoides* (Leuck.) +.

OTHER GROUPS

Moerisia maeotica (Ostr.) +; *Balanus* juv. +; *Decapoda* juv. +; *Gastropoda* juv. +; *Polychaeta* juv. +; *Insecta* juv. +, o; *Ostracoda* sp. +; *Mysidacea* sp. +.

Table 2

Faunistic-ecological groups of zooplankton in L. Palaeostomi

Brackish-water species	Marine species	Fresh-water species
Calanipeda aquae dulcis	*Acartia clausi*	*Mesocyclops leucarti*
Eurytemora velox	*Canuella perplexa*	*Cryptocyclops bicolor bicolor*
Mesochra aestuarii	*Oithona minuta*	*Eucyclops serrulatus*
Nitocra lacustris	*Synchaeta curvata*	*Ergasilus sp.*
Brachionus plicatilis	*Trichocerca marina*	*Alona rectangula*
Hexarthra fennica	*Podon polyphemoides*	*Bosmina longirostris*
Hexarthra oxyuris	*Moerisia maeotica*	*Ceriodaphnia pulchella*
Colurella adriatica	*Polychaeta* juv.	*Chydorus sphaericus*
	Gastropoda juv.	*Diaphanosoma brachyurum*
	Balanus juv.	*
	Decapoda juv.	34 species of rotifers

The zooplankters of L. Palaeostomi clearly fall into three faunistic-ecological groups (Table 2). The main faunistic-ecological groups are the brackish-water and marine ones. The number of the representatives of these groups is relatively small, but many of them are numerous, while *Brachionus plicatilis* and *Polychaeta* juv. even occur in masses. As for the fresh-water species, they are the biggest group as regards the number of species but they do not occur abundantly as practically all the species are represented by single specimens. The coexistence of the marine, brackish-water and fresh-water ecological groups is very characteristic of the water bodies connected with the sea (Popescu-Marinescu, 1974, Мончeнко, 1974, etc.).

The survey of the zooplankton of L. Palaeostomi is continued in the following parts of the present article (II. The number, biomass and production of zooplankton; III. Different groups of zooplankton; IV. Quantitative data on phytoplankton and relations with zooplankton.).

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PALEOSTOMI JÄRVE SUVINE FÜTO- JA ZOOPLANKTON

I. Füto- ja zooplanktoni liigiline koostis. Järve lühiiseloomustus

1977. aasta juulis ja augustis võetud proovide alusel domineerivad Paleostomi järve (Gruusia NSV) fütoplanktonis riimveelised räni- ja sinivetikad *Rhizosolenia fragilissima, Nodularia spumigena* f. *litorea, Anabaenopsis arnoldii* ja *Anabaena bergii.* Zooplankton jaguneb selgelt kolme faunistilis-ökoloogilisse rühma — riimvee-, mere- ja mageveeliigid, kusjuures domineerivad kaks esimest.

Юта ХАБЕРМАН, Реэт ЛАУГАСТЕ

ЛЕТНИЙ ФИТО- И ЗООПЛАНКТОН ОЗЕРА ПАЛЕОСТОМИ

I. Видовой состав фито- и зоопланктона. Краткая характеристика озера

В фитопланктоне оз. Палеостоми (Грузинская ССР) доминируют солоноватоводные диатомовые и синезеленые *Rhizosolenia fragilissima, Nodularia spumigena* f. *litorea, Anabaenopsis arnoldii* и *Anabaena bergii.* Зоопланктон разделяется на 3 фаунистико-экологические группы: морские, солоноватоводные и пресноводные виды. Доминируют солоноватоводные и морские виды.