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On the ecology of species belonging to the genus Mesocyclops Sars (Crustacea, Copepoda) dwelling in the waterbodies of the Urals and Pri - Ural territory.

In the waterbodies of central Russia, the Urals and western Siberia four species of crustacea, related to the genus Mesocyclops, are widely distributed: M. (s.str.) leuckarti (Claus), M. (Thermocyclops) oithonoides Sars, [M.](Th.) crassus (Fisch.) and M. (Th.) dybowski (Lande).

The first three species produce mass forms of plankton in lakes, ponds and reservoirs, where they usually breed in enormous quantities. They have positive (as a food basis for fish) and negative (intermediate host of a series of parasitic worms of animals and man) economic importance. Therefore a study of these organisms, besides being of theoretical interest, has a practical importance. The last species - M. dybowski is encountered rarely, mainly in shallow water bodies with dense submerged macrophytes (ponds, the littoral^{of} lakes); they do not reach any significant numbers.

M. leuckarti inhabits the majority of our water-bodies throughout the year. In the summer the Crustacea live in the pelagial but in winter - in the pelagial (Copepodits). Here in temperatures $\gt 2^{\circ}$ it is found in an active state. M. crassus, with a lowering of the water temperature in the autumn to 11 - 12 $^{\circ}$, on the other hand, completely disappears from the water-bodies, leaving quiescent eggs for reproduction of the next generation (as also M. dybowski). The life cycle of M. oithonoides has not been completely described (Rylov, 1948; Ulomskii, 1960).

M. oithonoides, in comparison with the other mass forms of this genus (M. leuckarti, M. crassus), have a restricted range of growth depending on the character and degree of mineralisation of the water (Table 1.)

[M.] Translators addition.

Table 1.

Numbers and biomass of Mesocyclops oithonoides in the pelagic water of various water-bodies of the Urals (summer) (in thousands of specimens/m³ and mg/m³).

Water-body and its location	Date	Depth m	Water temperature °C		Minerals of the water		O ₂ content of water mg O ₂ /litre	pH	<u>M. oithonoides</u>	
			At the surface /at the bottom		Index	S‰			Numbers 1000's specimens /m ³	Biomass mg/m ³
Lake Leshchevo Orenburgsk region	25.8.1952	1.4	25.2		C ^{Ca}	0.20	8.3	7.50	14.2	90.9
Lake Turgoyak Chelyabinsk region	23.8.1947	30.2	16.9/9.8		"	-	-	-	1.7	9.0
ditto.	18.8.1956	30.0	16.5/8.0		"	0.08	4.4/3.8	7.19/ 6.90	14.5	138.9
Lake Uvil'dy	10.8.1950	30.4	18.1/8.2		"	0.20	3.7	8.0	12.2	90.0
Lake Kirety (bay)	19.7.1955	2.2	15.9		"	0.14	7.7	8.5	9.4	111.3
Lake Bol'shie Kasli (bay)	16.7.1955	2.0	16.0		"	0.15	9.0	8.0	13.3	118.2
Verkhne-Isetskii pond. Sverdlovskaya region	29.6.1955	3.5	19.0		"	0.10	14.0	8.43	3.3	34.8
Kamskoe reservoir Permskaya region	17.7.1960	5.8	22.0/20.2		"	0.13	11.6	8.55	4.5	58.5
Chermozskii bay	14.7.1960	3.5	22.5		"	0.12	11.4	7.65	3.3	27.3
In'vinskii bay	17.7.1960	5.8	21.3/20.4		"	0.16	9.7	8.45	7.8	47.5
Obvinskii bay	11.7.1960	10.4	18.0/17.7		C ^{CaNa}	0.13	9.9	7.25	2.4	22.9
In the Sylvinskaya part of the Ust'- Garevaya region (near Troitsa)	6.7.1960	8.2	19.3/16.6		S ^{Ca}	0.34	5.5	7.7	2.6	19.6

In brackish-waters, in which according to V. I. Vernadskii (1934) the salinity fluctuated between the limits of 1-10⁰/oo, crustacea, as a rule, were absent. The greatest numbers of them were observed in fresh, neutral-alkaline, water-bodies with soft calcium-hydrocarbonate water, located in the taiga, wooded steppe and steppe zones. These species penetrate long distances along the river systems to the north and south, populating in mass bodies of water of floodlands where they often dwell jointly with M. leuckarti and M. crassus.

M. oithonoides, as well as M. leuckarti, during the course of the whole year inhabits both shallow and deep water-bodies of the Ural. In shallow water-bodies it dwells in summer (July - August) in the pelagic waters but during the cold times (October/November to April) it migrates to the pelagic layers. In the spring-summer and the summer-autumn periods it inhabits both biotopes simultaneously. With a satisfactory gas regime in the lower layers of water and relatively high temperature of the pelagic in the winter (2-5⁰) crustacea manage an active form of life at the bottom of water-bodies. In lakes with unfavourable gas regimes in winter as well as in good ponds fed by springs, and reservoirs with low water temperatures in the periods of ice cover (0.1 - 0.3⁰) copepodit stages of M. oithonoides overwinter on the bottom in an anabiotic or close to an anabiosis state.

In the deep lakes of the Ural mountain areas with good gas regimes M. oithonoides dwells in the pelagic waters throughout the year (Table 2). In the coldwater lakes Turgoyak and Uvil'dy (almost without flow) only this species of the mass forms of Cyclops of pelagic plankton appears. In the occasional very good years the productivity of the copepods reaches in summer in Lake Turgoyak 14.5 thousand specimens /m³ (138.9 mg/m³) and in Lake Uvil'dy 14.0 thousand specimens /m³ (130.0 mg/m³). A significant quantitative growth of M. oithonoides is observed in summer also in other deep lakes of the Urals (Kirety; Bol'shie Kasli), particularly in their well warmed bays (Table 1).

The vertical distribution of M. oithonoides in deep water bodies has been more fully observed in lakes Uvil'dy and Turgoyak (Table 2). In the warmest times of the year the maximum density of crustacea lives in the warmest upper 10 metre layer of water. In September they were shown to inhabit the upper (0-10m) and middle (10-20m) layers. In late autumn, after cooling of the whole mass of the body of water, the largest numbers of M. oithonoides were observed in the middle (10-20m) and lower (20-30m) layers. During this time the adult specimens were not now found and the whole population of crustacea consisted of copepodits (II-V copepodit stages). After the freezing of the lake and establishment of the inverted temperature stratification the warmer lower and middle layers of water have the greatest density of M. oithonoides. In Lake Turgoyak which is warmer and has silt deposits, the numbers and biomass of M. oithonoides towards the end of the ice-covered period usually exceed by 8 to 9 times those in the pelagic waters of the colder Lake Uvil'dy (Table 2). In winter in these deep lakes the copepodits M. oithonoides do not sink into the pelagic where it is almost as cold as in the lower layers of water.

Table for the determination of species of the genus Mesocyclops
by ecological indicators ¹⁾

- | | | | |
|----|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 1. | (4) | Inhabiting water-bodies in winter and summer
(all the year) | 2 |
| 2. | (3) | At cold times of the year (November - April)
completely absent from the pelagic waters and
migrated into the pelagin, where at a temperature
of 2° they manage an active life-form.
Mesoeuryhaline | <u>M. (s. str.) leucarti</u> (Claus.) |
| 3. | (2) | Inhabiting pelagic waters of deep lakes the
whole year. In shallow water-bodies in winter
migrating from the pelagic waters into the
pelagin. Freshwater species | <u>M. (th.) oithonoides</u> Sars. |
| 4. | (1) | Inhabiting water-bodies only at warm times of
the year (May - September) ²⁾ | 5 |
| 5. | (6) | Mass forms of pelagic plankton of lakes and
reservoirs. Mesoeuryhaline (S upto 3°/oo)... .. | <u>M. (th.) crassus</u> (Fisch.) |
| 6. | (5) | Characteristic for dense submerged macrophytes.
Freshwater species | <u>M. (Th.) dybowskii</u> (Lande) |

The ecological peculiarities of species of the genus Mesocyclops are such accurate indicators that they can serve as reliable indicators by themselves, characterising the species. This has not always been so, for a long time only morphological differences have been used not infrequently leading to erroneous diagnosis of species: during this M. oithonoides and M. crassus are not infrequently confused and the former indication of M. dybowskii in brackish water-bodies "requires verification" (Rylov, 1948).

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- 1) With the present level of knowledge it is not possible for the present table to be fully completed but in due course ecological indicators will have a significance for diagnostic aspects not smaller than morphological distinctions.
- 2) Not taking into account quiescent eggs.

Table 2.

Numbers (specimens/m³) and wet weight (mg/m³) of the population of M. oithonoides in the pelagic waters of lakes Uvil'dy and Turgoyak.

Index	Water horizons m.			Everything under 1m ² of the water surface
	0-10	10 - 20	20 - 30	
		<u>Lake Uvil'dy</u>		
		<u>18.7.1950</u>		
Temperature of water °C	17.0 - 16.1	16.1 - 10.2	10.2 - 8.2	
Numbers	24630	10600	6640	418700
Wet Wt.	234,5	91,6	63,7	3898,0
		<u>11.9.1949</u>		
Temperature of water °C	14.0 - 13.5	13.5 - 11.5	11.5 - 9.0	342400
Numbers	7360	9600	17280	3080,0
Wet Wt.	62,6	83,8	161,6	
		<u>2.11.1952</u>		
Temperature of water °C	3,2	3,2	3,2 - 3,5	
Numbers	2750	4640	5180	125700
Wet Wt.	23,6	40,8	37,9	1023,0
		<u>11.3.1949</u>		
Temperature of water °C	0,3 - 1,1	1,1 - 1,4	1,4 - 2,3	
Numbers	10	90	110	2100
Wet Wt.	0,1	0,9	1,1	21,0
		<u>17.3.1951</u>		
Temperature of water °C	0,9 - 1,2	1,2	1,2 - 1,25	
Numbers	20	10	70	1000
Wet Wt.	0,2	0,1	0,7	10,0
		<u>24.4.1954</u>		
Temperature of water °C	1,0 - 1,2	1,2 - 1,9	1,9 - 2,0	
Numbers	190	460	260	9100
Wet Wt.	1,9	4,6	2,6	91,0
		<u>Lake Turgoyak</u>		
		<u>27.4.1957</u>		
Temperature of water °C	2,2	2,2 - 2,5	2,5 - 3,4	
Numbers	850	3780	3300	79300
Wet Wt.	8,5	37,8	33,0	793,0

We have only once found M. oithonoides in brackish water-bodies - Lake Burukhtal (100 hectares). A lake - the remainder of the bed of a drying up river; it is situated amongst the saline steppe of the Adamovsk river in the Orenburgsk region. The salinization of the water-body, gradually increasing due to a decreasing amount and then cessation of flow, favoured the establishing of M. oithonoides in the new body of water owing to the adaptation of this form to gradually increasing saline water. At the present time the lake presents itself as a long (about 40 km.) and narrow (upto 60 m.) arm, one end of which almost joins Lake Chalkar (50°45' latitude and 61°00' longitude), and the other is lost in the steppe. The depth of the water-body in one place attains 7.2 m. On the mineral character of the lake, it is regarded as a water body with sodium chloride water ($s = 2.32^{\circ}/00$). On 16th June 1951 with a water temperature of -19° (surface), pH = 8.38 and $O_2 = 10.5$ mgO/litre, the numbers of M. oithonoides in Lake Burukhtal reached 7.9 thousand specimens /m³ (75.8 mg/m³).

Measurement of parts of the body of M. oithonoides from Lake Burukhtal showed that, according to morphological indications produced, this species was essentially not distinguishable from individuals out of other water-bodies of the Urals: Lake Turgoyak, Verkhne-Isetsk pond (Ulomskii 1959). By correlating parts of the body they approximated to crustacea from the non-flowing Lake Turgoyak. Historically and firmly established colonies of M. oithonoides in the isolated and now saline Lake Burukhtal have a rare non-characteristic appearance by no means showing an inclination of crustacea of this species to euryhalinity.

Thus, considering types of independent examination of the forms, M. oithonoides, M. leuckarti, M. crassus, and M. dybowski can be identified not only by morphological differences (Rylov 1948), but also accurately by ecological indications. Among these crustacea M. oithonoides of southern origin appears to be the greatest coldness form of genus, since in winter and in summer it inhabits the pelagial of the deep and cold Ural lakes. After that follows M. leuckarti, wintering in an active state in the pelagial ($T^{\circ} \geq 2^{\circ}$) with a satisfactory gas regime. M. crassus and M. dybowski are not observed in water bodies in winter, they occupy the last places in this biothermal series (thermophiles).

When considering saline waters M. leuckarti and M. crassus appear to be mesoeuryhaline forms; they inhabit fresh and saline water bodies. M. oithonoides and M. dybowski, on the other hand, inhabit freshwater lakes and ponds; the rare case of these typical freshwater forms being observed in saline water-bodies appears non-characteristic. M. oithonoides, M. leuckarti and M. crassus are the mass forms of plankton of our water bodies. M. dybowski is considered to live in the calm littoral, mildly overgrown submerged vegetation; its population never reaches significant numbers.

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of the Urals].

Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.