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ON THE VERTICAL DISTRIBUTION OF *DIAPTOMUS DENTICORNIS* WIERZEJSKY VAR. *YEZOENSIS* KOKUBO IN LAKE SHIKOTSU

BY

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(With 2 tables and 2 figures)



KIKUCHI (1930) as well as others has described how the diurnal change in the vertical distribution of certain species of plankton is not constant but varies greatly according to the limnological condition of the lake. According to TAKAYASU, IGARASHI and SAWA (1930) in Lake Akan *Diaptomus* does not show any diurnal change in vertical distribution being found all the times abundantly on the surface of the water, while in Lake Shikotsu the same species was stated to undergo a remarkable migration, the exact data however being not given. KOKUBO with TANAKADATE (1925) mentioned briefly that in Lake Shikotsu *Diaptomus* becomes more frequent in the night on the surface but in the day-time most of them migrate downwards.

Now for us, it is most desirable to ascertain first of all whether the plankton migrates regularly or not in general .

Observation I

Diaptomus in Lake Shikotsu was investigated as it is one of the most important plankton from the economical point of view for the freshwater fishery.

To collect the plankton from various depths, about two liters of water were obtained by means of a 1050 ccm. water-bottle designated after KITAHARA. The water was examined from three different depths, namely from the surface, 25 and 50 meters.

The first series of observations was made on July 23-24, 1931. The weather was not entirely fair with weak sunlight and no moon at night.

At that season most of *Diaptomus* were adult and some of them were in the metanauplius stage. The result of the observations is shown by the table and the figure as follows:

[Transact. Sapporo Nat. Hist. Soc., Vol. XII, Pt. 2, 1932]

Table I. The vertical distribution of *Diaptomus* in Lake Shikotsu on July 23-24, 1931.

Hour	Weather	Depth (m.)	Temperature (°C)	Number
1 a. m.	C., M. b.	0	13.6	16
		25	7.0	8
		50	5.0	7
4 a. m.	C., L. b.	0	13.0	16
		25	7.0	13
		50	5.0	12
7 a. m.	C., L. b.	0	14.0	0
		25	7.5	15
		50	5.0	3
10 a. m.	C., L. b.	0	14.5	0
		25	7.5	8
		50	5.1	5
1 p. m.	C., Ca.	0	15.0	1
		25	8.0	8
		50	5.1	5
4 p. m.	M., Ca.	0	14.5	23
		25	7.5	5
		50	5.1	2
7 p. m.	R., L. b.	0	14.6	27
		25	7.6	4
		50	5.1	6
10 p. m.	C., M. b.	0	14.0	22
		25	7.5	3
		50	5.1	6

Ca. ... Calm, C. ... Cloud, L. b. ... Light breeze, M. ... Misty, M. b. ... Moderate breeze, R. ... Rain.

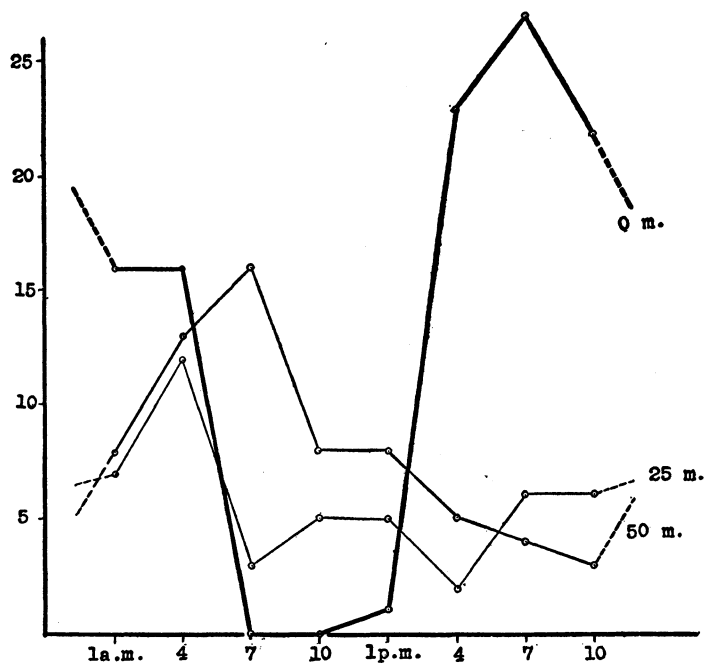


Fig. 1

Curve showing the diurnal change of frequency at the three different depths on July 23-24, 1931.

A glance at the table as well as at the figure shows clear evidence of diurnal change in the vertical distribution of *Diaptomus*. At midnight (1 a. m.) some *Diaptomus* gradually migrate from the surface downwards though majority of them remain on the surface. The frequency of *Diaptomus* increases in the deeper portions toward the dawn. From 4 o'clock a. m. the downwards migration occurs rapidly and finally no *Diaptomus* are found on the surface, shortly after sunrise (7 a. m.). During the same period at the depth of 25 meters the distribution becomes maximum, in the deeper portion being less frequent. It is understood that most of them do not migrate below 25 meters. Next, during the daytime from seven to ten o'clock all *Diaptomus* are still absent from the surface.

In the present observation the upwards migration occurs first in the early afternoon and so a few *Diaptomus* are found migrated toward the surface at 1 p. m. At 4 p. m. the surface distribution of *Diaptomus* increases markedly. The maximum frequency of *Diaptomus* at surface is attained at 7 p. m., that is shortly after sunset and afterwards with the passing of hours they again

migrate downwards to have at 11 p. m. almost the same distribution as in the evening (4 p. m.).

It is noted that in the deeper portion of the lake the diurnal change of the distribution occurs less frequently as compared with that of the shallower portion. At 50 meters depth the distribution is almost constant throughout the day except at 4 a. m. when *Diaptomus* becomes, however, more frequent than usual.

From the above one may understand that at this season at least the vertical migration of *Diaptomus* takes place most actively between the surface and the 25 meters depth.

Observation II

In the second series of observations which was carried out on August 23-24, 1931, sample water was collected from 15 meters depth besides from the three above mentioned, and furthermore 100 meters and 150 meters depths were also examined in order to find the maximum depth of the distribution of *Diaptomus*.

During the observation the weather was very fine and there was a bright moon overnight, therefore the condition of illumination differed greatly from that of the previous observation. Table II and Fig. 2 show the result.

Table II. The vertical distribution of *Diaptomus* in Lake Shikotsu on August 23-24, 1931.

Hour	Weather	Depth (m.)	Temperature (°C)	Number
6 a. m.	F., Ca.	0	21.0	2
		15	9.6	8
		25	7.5	2
		50	4.8	3
11 a. m.	F., Ca.	0	21.5	0
		15	9.5	6
		25	7.0	3
		50	4.8	2
3 p. m.	F., Ca.	0	21.5	1
		15	10.0	2
		25	—	—
		50	4.6	0

Hour	Weather	Depth (m.)	Temperature (°C)	Number
7 p. m.	F., Ca.	0	20.8	27
		15	8.4	3
		25	6.5	2
		50	4.6	2
11 p. m.	F., Ca.	0	19.5	15
		15	8.0	45
		25	6.0	2
		50	4.6	6

Ca.....Calm, F.....Fine

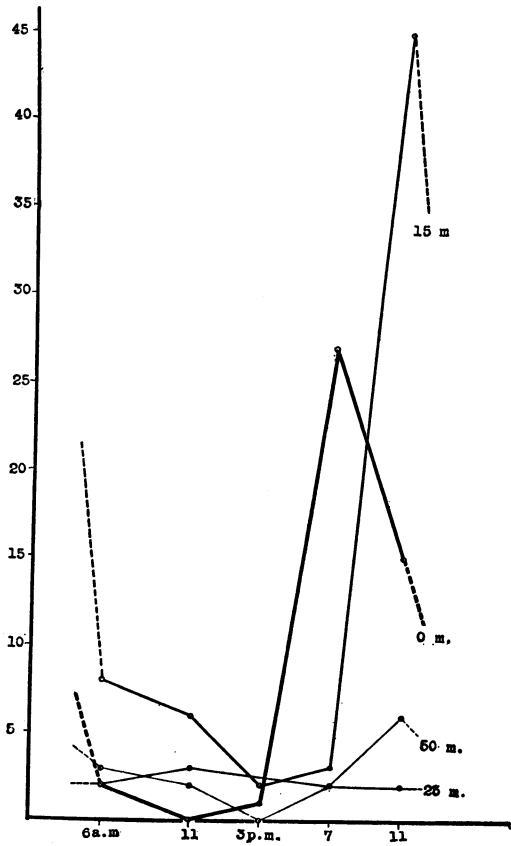


Fig. 2

Curve showing the diurnal change of frequency at four different depths on August 23-24, 1931.

From the above it will be seen that the minimum abundance of *Diaptomus* at surface is found at 11 a. m. In the early afternoon only a few are found near the surface. A remarkable upwards migration takes place during the evening until most of them come to the surface at 7 p. m. Afterwards a part of them migrates downwards and at 11 p. m. the frequency at surface becomes about a half of the maximum number. The most striking diurnal change is found at the level of 15 meters below the surface. In this depth the maximum abundance is observed at 11 p. m. while in the evening it reaches its minimum number. At 25 meters or 50 meters depth we always see only a few *Diaptomus* and the frequency is not so much varied within a day as compared with the superficial part. In the very deep part 100 or 150 meters below the surface no *Diaptomus* is found.

One sees from the above that in Lake Shikotsu *Diaptomus* undergoes in general a diurnal migration showing a striking change in vertical distribution. Apart from the oxygen content of the water in which *Diaptomus* occurs, one can enumerate the environmental factors which influence the migration such as temperature and illumination. So far as the temperature is concerned it is kept nearly constant in any depth throughout a day. Thus it has little to do with the migration. Here the influence of light upon *Diaptomus* is naturally taken into account. The downwards migration from the surface toward midnight may be a result from the effect of illumination upon the animal. As a matter of fact in the places deeper than 25 meters where the influence of light is very little, the frequency of *Diaptomus* is almost constant day and night. Probably the influence of oxygen which shows apparently no change by time in the lake is not very great.

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摘 要

支笏湖に於けるディアプトウムスの垂直分布に就て

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Diaptomus denticornis WIERZEJSKY var. *jezoensis* KOKUBO は支笏湖に於ける浮游生物中主要なる部位を占め、其の出現は夏期に於て最も多し。同期に於ける之が垂直分布の晝夜変化を見るに表面に於ては、未明より正午に至りて其の分布最も多し、其後時間の経過と共に漸次表面に浮游し來り薄暮に及んで maximum に達し、短時間内に於ける變化顯著なり。其後再び深部に移動す。斯かる垂直運動の経過は比較的規則正しく行はるも、天候に依り影響を受くる事も亦大なり。即ち晴天に於ては、午后三時過ぎに於て初めて急激なる上昇運動を認め得たるに對し曇天に於ては、正后過ぎ早くも表面に現はれたるもの若干あり。而して分布の時間的偏差は表面より十五米附近に於て最も多く、二十五米以下に於ては少く、五十米以下に於ては終日少數の個體のみ分布す。更に垂直運動の範圍は百米以内に於ては、より深部に於ては *Diaptomus* の發見困難なり。

以上の事實より少くとも斯かる營養湖に於ては光りの變化が *Diaptomus* の垂直移動に關し最も重大なる影響を有するものと考察さる。

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