

## Third Report of the Regular Limnological Survey of Lake Biwa (1968 and 1969)

### II. Benthos<sup>1)2)</sup>

By

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The regular limnological survey on benthos at four stations selected in Lake Biwa is being carried on as a part of the routine work of the Otsu Hydrobiological Station for detecting the quantitative as well as qualitative changes in benthic communities extending over a long period of time as mentioned in the previous articles (Mori et al. 1967, and Suzuki and Mori 1967).

Our collecting stations and their conditions, and the methods for collection were generally mentioned in the previous papers (Mori et al. 1967, and Suzuki and Mori 1967).

Some notable variations or changes in benthic communities were recognized during four years (1966-1969). One of these variations is a sudden appearance of *Pisidium lacustre* Woodward at Station Ie-1 through 1968. The other is a constant declining tendency in number as well as in biomass of *Spaniotoma* sp. at Station Na-3 through four years (1966-1969).

The number of individuals and total fresh weight per m<sup>2</sup>, and the average number of individuals and average fresh weight per m<sup>2</sup> calculated from three samples (sometimes from two or one samples available) are shown in the following tables (Table 1—Table 4). The number of individuals of oligochaete was counted as soon as samples were collected since October 1968 in order to prevent the counting error caused by the destruction of the body.

As animals below 10 mg body weight were too small to weigh exactly because of rapid desiccation during operation, so their body weight are given as 0.00 g in the tables. Furthermore, the next marks are used in the tables.

- : No specimen was collected.
- ? : These were uncountable.

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1) Contribution from the Otsu Hydrobiological Station, Kyoto University, No. 208.

2) JIBP-PF Publication No. 92.

- × : Collection was not carried out on account of sudden rough weather.
- ( ) : Average value calculated from one or two samples.
- bad : Weight measurement was impossible since specimens were destroyed under unfavorable condition.
- \* : These were attached to the surface of molluscan shells.
- \*\* : Dead shell.

The series of reports were edited by the Director of the Station, Syuiti Mori, and the present part, on the benthos, was arranged especially by Norio Suzuki and Syuiti Mori. The collection of samples was performed chiefly by M. Nakanishi, Y. Nakajima and T. Ueda, and other members of the Otsu Hydrobiological Station have assisted this survey in many ways.

#### A. Benthic community at Station Ie-1

Station Ie-1 is chosen as the representative of northern part of the lake or mainbasin, where is oligotrophic and about 74 m in depth.

Animals found in the samples during 1968 to 1969 were Oligochaeta, Nematoda, Chironomidae larvae, Amphipoda and Mollusca as shown in Table 1. It was noticed that a kind of bivalve mollusc, *Pisidium lacustre* Woodward, was often found only in 1968, notwithstanding any molluscs were not found during preceding two years (1966-1967) and following 1969 except January and February. About the cause of this change is considered later in the Paragraph C.

Table 1. Benthic faunal composition and their abundance at St Ie-1

Date	January 16, 1968			February 20, 1968			Average No./m <sup>2</sup> g/m <sup>2</sup>	Average No./m <sup>2</sup> g/m <sup>2</sup>
	1	2	3	1	2	3		
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)
Oligochaeta	? 0.14	? 0.07	? 0.13	? 5.0	? 0.04	? 0.11	? 0.10	? 3.7
Mollusca								
Pelecypoda								
<i>Pisidium lacustre</i>								
Woodward	1 0.00	1 0.01	—	30 0.2	1 0.01	3 0.03	1 0.02	74 0.9
Date	March 15, 1968			April 15, 1968			Average No./m <sup>2</sup> g/m <sup>2</sup>	Average No./m <sup>2</sup> g/m <sup>2</sup>
Sampling No.	1	2	3	Average	1	2		
Oligochaeta	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)
Chironomidae larvae	? 0.35	? 0.12	? 0.17	? 9.5	—	? 0.17	? 0.16	? 4.9
<i>Phaenopsectra</i> sp.	1 0.00	—	—	15 0.0	—	—	1 0.00	15 0.0
Amphipoda								
<i>Anisogammarus</i>								
<i>amandalei</i>								
(Tattersall)	—	—	—	—	—	—	1 0.02	15 0.3
Mollusca								
Pelecypoda								
<i>Pisidium lacustre</i>								
Woodward	1 0.01	—	—	15 0.2	—	—	1 0.00	15 0.0

Date	May 13, 1968					June 17, 1968					
	1	2	3	Average		1	2	3	Average		
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	Average
Oligochaeta	? 0.59	? 0.40	? 0.60	? 23.5	? 0.35	? 0.32	? 0.07	? 11.0			
Nematoda	1 0.00	—	3 0.01	59 0.2	—	2 0.00	2 0.00	59 0.0			
Chironomidae larvae (Unidentified sp.)	1 0.01	—	—	15 0.2	—	—	—	—			
Amphipoda <i>Anisogammarus</i> <i>amandalei</i> (Tattersall)	1 0.02	1 0.02	1 0.03	44 1.0	5 0.14	—	1 0.01	89 2.2			
Mollusca Pelecypoda <i>Pisidium lacustre</i> Woodward	1 0.00	—	—	15 0.0	—	3 0.02	1 0.00	59 0.3			
August 16, 1968											
Sampling No.	1	2	3	Average	1	2	3	Average			
Oligochaeta	? 0.23	? 0.47	? 0.23	? 13.8	? 0.07	? 0.11	? 0.05	? 3.4			
Amphipoda <i>Anisogammarus</i> <i>amandalei</i> (Tattersall)	4 0.14	3 0.12	—	104 3.9	—	—	1 0.04	15 0.6			

Date	September 17, 1968				October 16, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	? 0.02	? 0.14	? 0.16	? 4.7	17 0.40	? 0.12	? 0.38	755 13.3
Amphipoda								
<i>Anisogammarus</i>								
<i>amandalei</i>								
(Tattersall)			4 0.14	2.1	2 0.08	1 0.03	—	44 1.6
Mollusca								
Pelecypoda								
<i>Pisidium lacustre</i>								
Woodward	2 0.00	—	—	30 0.0	—	1 0.00	—	15 0.0
Date	November 14, 1968				December 16, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	6 0.06	19 0.12	18 0.31	636 7.3	8 0.03	11 0.08	12 bad	459 (2.4)
Mollusca								
Gastropoda								
<i>Valvata (Cincinna)</i>			1 0.00	15 0.0	—	—	—	—
<i>japonica</i> v. Martens								
Pelecypoda								
<i>Pisidium lacustre</i>								
Woodward	1 0.00	—	1 0.00	30 0.0	—	—	—	—

Date	January 17, 1969				February 17, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	19 0.10	6 0.10	8 0.10	488 4.4	11 bad	5 0.10	17 0.54	488 (14.2)
Chironomidae larvae	—	—	—	—	—	1 0.00	—	15 0.0
<i>Phaenopsectra</i> sp.	—	—	—	—	—	—	—	—
Mollusca	—	—	—	—	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—
<i>Pisidium lacustre</i>	—	—	—	—	—	—	—	—
Woodward	—	1 0.00	—	15 0.0	1 0.01	—	—	15 0.2

Date	March 17, 1969				April 17, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	19 0.52	27 0.26	9 0.16	814 13.9	? 0.06	14 bad	24 bad	(844) (2.7)
Amphipoda	—	—	—	—	—	—	—	—
<i>Anisogammarus</i>	—	—	—	—	—	—	—	—
<i>amandalei</i>	—	—	—	—	—	—	—	—
(Tattersall)	—	—	—	—	—	2 0.01	—	30 0.2

Date	May 20, 1969				June 16, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	12 0.12	10 0.11	11 0.09	488 4.7	17 0.39	20 0.77	23 0.62	888 26.3
Amphipoda	—	—	—	—	—	—	—	—
<i>Anisogammarus</i>	—	—	—	—	—	—	—	—
<i>amandalei</i>	—	—	—	—	—	—	—	—
(Tattersall)	1 0.01	—	2 0.02	44 0.4	1 0.01	6 0.07	3 0.05	148 1.9

Date	July 16, 1969				August 12, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	23 0.71	20 0.69	18 0.50	903 28.1	7 0.26	15 0.27	15 0.24	548 11.4
Amphipoda								
<i>Anisogammarus</i>								
<i>annandalei</i>								
(Tattersall)	—	1 0.02	—	15 0.30	—	—	—	—

Date	September 12, 1969				October 20, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	14 bad	9 bad	15 bad	562 bad	17 0.23	6 0.14	21 0.52	651 13.2

Date	November 17, 1969				December 17, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	5 0.09	×	×	(222)	13 0.48	11 0.26	14 0.37	562 16.4
Amphipoda								
<i>Anisogammarus</i>								
<i>annandalei</i>								
(Tattersall)	—	×	×	—	—	1 0.03	—	15 0.4

### B. Benthic communities at Station Nb 2, Nb 5 and Na 3

Stations Nb 2, Nb 5 and Na 3 were chosen as representatives of the mesotrophic southern part of the lake or sub-basin. Stations Nb 2 (sand or sandy mud substratum) and Na 3 (muddy substratum) are 0.1 km off the east and west coast of the southern part of the lake respectively, and both are about 2 m in depth, while Station Nb 5 (muddy substratum) is in the central part of the southern lake and about 4.5 m in depth.

With respect to faunal composition no remarkable change was found in the samples during 1968 to 1969 in comparison with those of 1966 and 1967 (Table 2-4).





Date	March 15, 1968				April 13, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	? 0.02	? 0.02	? 0.04	? 1.2	—	—	—	—
Chironomidae larvae	—	—	—	—	—	—	—	—
<i>Spaniotoma</i> sp.	—	—	—	—	1 0.01	—	—	15 0.2
(Unidentified sp.)	2 0.00	—	—	30 0.0	—	4 0.01	—	59 0.2
Amphipoda	—	—	—	—	—	—	—	—
<i>Anisogammarus</i>	—	—	—	—	—	—	—	—
<i>amandalei</i>	—	—	—	—	—	—	—	—
(Tattersall)	—	—	—	—	—	—	1 0.03	15 0.4
Mollusca	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—
<i>decipiens</i>	—	—	—	—	—	—	—	—
(Westerlund)	4 1.27	—	—	59 18.8	1 0.62	—	1 0.01	30 9.3
<i>Yabata (Cincinna)</i>	—	—	—	—	4 0.04	—	1 0.00	74 0.6
<i>japonica</i> v. Martens	—	—	—	—	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—
<i>Corbicula sandai</i>	—	—	—	—	—	—	—	—
Reinhardt	2 1.81	—	—	30 26.8	3 2.78	—	1 0.25	59 44.8
<i>Umo biwae</i>	—	—	—	—	—	—	—	—
Kobelt	—	1 0.40	—	15 5.9	—	—	—	—





Date	November 15, 1968				December 17, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	—	3 0.00	12 0.05	222 0.7	—	—	—	—
Mollusca								
Gastropoda								
<i>Semisulcospira</i>								
<i>decipiens</i>								
(Westerlund)	1 0.02	2 0.85	2 0.30	74 17.3	—	—	—	—
Pelecypoda								
<i>Corbicula</i>								
<i>sandai</i>								
Reinhardt	2 3.23	3 3.72	8 4.99	192 177	—	—	—	—
<i>Unio biwae</i>								
Kobelt	2 2.48	—	—	30 36.7	—	—	—	—
Date	January 18, 1969				February 18, 1969			
Sampling No.	1	2	3	Average	1	2	3	Average
Oligochaeta	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	1 0.02	2 0.02	—	44 0.6	1 0.00	2 0.02	5 0.03	118 0.7
Mollusca								
Gastropoda								
<i>Semisulcospira</i>								
<i>decipiens</i>								
(Westerlund)	—	1**	—	15**	1 0.09	2 0.80	1 0.30	59 17.6
Pelecypoda								
<i>Corbicula</i>								
<i>sandai</i>								
Reinhardt	1**	1**	2**	59**	—	—	—	—
<i>Unio biwae</i>								
Kobelt	—	1 0.82	—	15 12.1	—	—	1 1.38	15 20.4



Date	May 17, 1969				June 18, 1969			
	1	2	3	Average	1	2	2	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	2 0.00	—	5 0.02	104 0.3	1 0.00	1 0.01	1 0.00	44 0.2
Chironomidae larvae (Unidentified sp.)	—	—	2 0.00	30 0.0	—	1 0.00	—	15 0.0
Amphipoda								
<i>Anisogammarus</i>								
<i>annandalei</i>								
(Tattersall)	—	—	1 0.02	15 0.3	—	—	—	—
Mollusca								
Gastropoda								
<i>Heterogen</i>								
<i>longispira</i>								
(Smith)	—	—	—	—	—	1 0.02	—	15 0.3
Pelecypoda								
<i>Corbicula</i>								
<i>sandai</i>								
Reinhardt	1 0.03	1 1.75	—	30 26.3	—	—	—	—
<i>Unio biwae</i>								
Kobelt	—	—	—	—	—	—	2 0.02	30 0.3

Date	July 14, 1969						August 13, 1969										
	1		2		3		Average		1		2		3		Average		
	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No./m <sup>2</sup>	g/m <sup>2</sup>	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No./m <sup>2</sup>	g/m <sup>2</sup>	
Sampling No.	1	0.00	1	0.00	1	0.00	44	0.0	—	—	—	1	0.00	4	0.03	74	0.4
Oligochaeta	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chironomidae larvae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Phaenopsectra</i> sp.	—	—	—	—	2	0.00	30	0.0	—	—	—	—	—	—	—	—	—
Mollusca	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>decipiens</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(Westerlund)	1	0.00	1	0.96	1	0.41	44	20.3	4	2.41	—	—	—	1	0.06	74	35.7
Pelecypoda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Corbicula</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>sandai</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Reinhardt	—	—	1	0.15	2	0.32	44	7.0	1	4.3	—	—	—	—	—	15	63.6
<i>Unio biwae</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kobelt	—	—	1	0.18	—	—	15	2.7	—	—	1	0.43	—	—	—	15	6.4
<i>Anodonta calipygos</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kobelt	—	—	—	—	—	—	—	—	—	—	1	7.17	—	—	—	15	106.1
<i>Sphaerium japonicum</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>biwae</i> Mori	—	—	—	—	—	—	—	—	1	0.13	—	—	—	—	—	15	1.9







Date	May 14, 1968						June 18, 1968									
	1		2		3		Average		1		2		3		Average	
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	? 0.06	? 0.20	? 0.20	—	—	—	?	6.8	? 0.07	? 0.04	? 0.04	? 0.04	? 0.09	?	3.0	?
Nematoda	—	1 0.00	—	—	—	—	15	0.0	—	2 0.01	—	—	—	30	0.2	—
Chironomidae larvae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Tendipes plumosus</i>	—	—	—	—	—	—	—	—	1 0.02	5 0.16	—	—	5 0.15	163	4.9	—
(Meigen)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(Unidentified sp.)	—	5 0.03	4 0.03	—	—	—	133	0.9	—	—	—	—	—	—	—	—
Mollusca	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Valvata (Cincinna)</i>	—	1 0.01	—	—	—	—	15	0.2	—	—	—	—	—	—	—	—
<i>japonica</i> v. Martens	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Pisidium</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>kawamurai</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mori	—	—	—	—	—	—	15	0.2	1 0.01	—	—	—	—	—	—	—

Date	July 17, 1968				August 22, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	—	? 0.03	? 0.05	? 1.2	? 0.00	? 0.02	? 0.02	? 0.6
Nematoda	—	—	—	—	2 0.00	—	1 0.06	44 0.9
Chironomidae larvae	—	—	—	—	—	—	—	—
<i>Spantotoma</i> sp.	2 0.04	—	1 0.03	44 1.0	—	—	1 0.04	15 0.6
(Unidentified sp.)	—	—	—	—	—	1 0.00	—	15 0.0
Mollusca	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—
<i>decipiens</i>	—	—	—	—	—	—	—	—
(Westerlund)	1 0.05	—	—	15 0.7	—	—	—	—
<i>Yabata (Cincinna)</i>	—	2 0.00	—	30 0.0	—	—	—	—
<i>japonica</i> v. <i>Martens</i>	—	—	—	—	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—
<i>Corbicula</i>	—	—	—	—	—	—	—	—
<i>sandai</i>	—	—	—	—	—	—	—	—
Reinhardt	1 0.95	—	—	15 14	—	—	—	—
<i>Pisidium</i>	—	—	—	—	—	—	—	—
<i>kawamurai</i>	—	—	—	—	—	—	—	—
Mori	—	1 0.00	1 0.01	30 0.2	—	—	—	—



Date	January 18, 1969					February 18, 1969				
	1	2	3	Average	1	2	3	Average		
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	12 0.07	31 bad	13 bad	829 (3.1)	16 0.15	23 0.42	8 0.02	696 8.7		
Nematoda	2 0.01	—	—	30 0.2	—	—	—	—		
Hirudinea	—	—	—	—	—	1 0.02	—	15 0.3		
Chironomidae larvae										
<i>Spantotoma</i> sp.	1 0.01	—	1 0.01	30 0.3	1 0.04	1 0.03	1 0.04	44 1.6		
<i>Tendipes plumosus</i>										
(Meigen)	1 0.03	—	—	15 0.4	1 0.05	—	—	15 0.7		
(Unidentified sp.)	—	—	—	—	—	—	2 0.01	30 0.2		
Mollusca										
Gastropoda										
<i>Semisulcospira</i>										
<i>decipiens</i>										
(Westerlund)	—	—	—	—	—	—	1 1.20	15 17.8		
<i>Semisulcospira</i>										
<i>bensoni reiniana</i>										
(Brot)	—	1 0.01	1 0.01	30 0.3	—	—	—	—		
Pupae of										
Simuliidae*	—	—	—	—	—	—	6 0.03	89 0.4		

Date	March 15, 1969				April 18, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	48 0.15	22 bad	13 bad	1228 (6.7)	11 0.08	22 0.25	9 0.09	622 6.2
Nematoda	—	—	—	—	—	3 0.04	—	44 0.6
Hirunidea	2 0.02	—	—	44 0.4	—	—	—	—
Chironomidae larvae	—	—	—	—	—	—	—	—
<i>Pentaneura</i> sp.	—	—	—	—	—	1 0.00	1 0.00	30 0.0
<i>Spartotoma</i> sp.	5 0.14	—	2 0.06	104 3.0	—	—	—	—
(Unidentified sp.)	—	—	—	—	—	—	1 0.00	15 0.0
Amphipoda	—	—	—	—	—	—	—	—
<i>Anisogammarus</i>	—	—	—	—	—	—	—	—
<i>amandalei</i>	—	—	—	—	—	—	2 0.01	30 0.2
(Tattersall)	—	—	—	—	—	—	—	—
Mollusca	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	2 2.87	30 42.5
<i>decipiens</i>	—	—	—	—	—	—	—	—
(Westerlund)	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—
<i>bensoni reiniana</i>	—	—	—	—	—	—	—	—
(Brot)	—	—	1**	15**	1 0.02	—	—	15 0.3
Pelecypoda	—	—	—	—	—	—	—	—
<i>Unio biwae</i>	—	—	—	—	—	—	—	—
Kobelt	1 10.3	—	—	15 152	—	—	—	—
<i>Pisidium</i>	—	—	—	—	—	—	—	—
<i>kawamurai</i>	—	—	—	—	—	—	—	—
Mori	—	—	—	—	—	—	1 0.01	15 0.2
<i>Sphaerium japonicum</i>	—	—	—	—	—	—	—	—
<i>biwae</i> Mori	—	—	—	—	—	1 0.02	2 0.00	44 0.3
Pisces	—	—	—	—	—	—	—	—
<i>Rhinogobius</i>	—	—	—	—	—	—	—	—
<i>brunneus</i>	—	—	—	—	—	—	—	—
(Temminck et	—	—	—	—	—	—	—	—
Schlegel)	—	—	1 0.25	15 3.7	—	—	—	—
Pupae of	—	—	—	—	—	—	—	—
Simuliidae*	36 0.1	—	—	533 0.2	—	—	6 0.03	89 0.4

Date	May 17, 1969				June 18, 1969				Average No./m <sup>2</sup> g/m <sup>2</sup>
	1	2	3	Average	1	2	3	Average	
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	4 0.04	4 0.17	5 0.03	192 3.6	7 0.10	3 0.08	2 0.03	178 3.1	
Nematoda	—	—	—	—	2 0.01	—	—	30 0.2	
Chironomidae larvae	—	—	—	—	—	—	—	—	
<i>Pentaneura</i> sp.	2 0.02	1 0.02	1 0.02	59 0.9	1 0.82	—	—	15 12.1	
<i>Tentipes plumosus</i> (Meigen)	—	—	—	—	—	—	—	(44) dead	
(Unidentified sp.)	2 0.01	1 0.01	—	44 0.3	—	1 dead 0.01	1 dead 0.01	—	
Mollusca	—	—	—	—	—	—	—	—	
Gastropoda	—	—	—	—	—	—	—	—	
<i>Semisulcospira</i> <i>decipiens</i> (Westerlund)	—	—	1 0.27	15 4.0	1 0.82	—	—	15 12.1	
<i>Valvata (Cincinna)</i> <i>japonica</i> v. Martens	—	—	1 0.02	15 0.3	—	—	—	—	
Pelecypoda	—	—	—	—	—	—	—	—	
<i>Corbicula</i> ( <i>Corbiculina</i> ) <i>leana</i> Prime	—	1 0.81	—	15 12.0	—	—	—	—	
<i>Corbicula sandai</i> Reinhardt	—	—	—	—	—	1 3.50	—	15 51.8	
Pupae of Simuliidae*	—	—	—	—	14 0.07	5 0.02	—	281 1.3	



Date	July 14, 1969						August 13, 1969					
	1	2	3	Average	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	3 0.04	4 0.03	4 0.02	163 1.3	7 0.07	6 0.02	11 0.11	355 3.0				
Nematoda	—	2 0.03	—	30 0.4	—	2 0.03	—	30 0.4				
Chironomidae larvae	—	—	—	—	—	—	—	—				
<i>Pentaneura</i> sp.	—	—	—	—	—	2 0.01	1 0.00	44 0.2				
<i>Tendipes plumosus</i> (Meigen)	1 0.03	1 0.04	2 0.06	59 1.9	1 0.02	3 0.10	—	59 1.8				
Date	September 13, 1969						October 21, 1969					
Sampling No.	1	2	3	Average	1	2	3	Average	1	2	3	Average
No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	7 0.09	2 0.06	7 0.05	237 3.0	3 0.00	4 0.13	4 0.16	163 4.3				
Nematoda	2 0.02	—	1 0.01	44 0.4	—	—	—	—				
Chironomidae larvae	—	—	—	—	—	—	—	—				
<i>Pentaneura</i> sp.	—	—	—	—	—	1 0.00	—	15 0.0				
<i>Tendipes plumosus</i> (Meigen)	—	1 0.04	—	15 0.6	—	—	2 0.05	30 0.7				
Mollusca	—	—	—	—	—	—	—	—				
Gastropoda	—	—	—	—	—	—	—	—				
<i>Semisulcospira</i> <i>decipiens</i> (Westerlund)	—	—	—	—	—	—	3 2.38	44 35.2				
Pelecypoda	—	—	—	—	—	—	—	—				
<i>Unio biwae</i> Kobelt	—	—	1 5.32	15 78.7	—	—	—	—				

Date	November 18, 1969				December 15, 1969			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	3 0.02	4 0.09	16 0.06	340 2.5	1 0.01	12 0.20	18 0.08	459 4.3
Nematoda	—	—	—	—	—	1 0.01	—	15 0.2
Chironomidae larvae	—	—	—	—	—	—	—	—
<i>Tendipes plumosus</i>	—	—	—	—	—	—	—	—
(Meigen)	—	—	—	—	1 0.01	2 0.08	1 0.01	59 1.5
Mollusca	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—
<i>Valvata (Cincinna)</i>	—	1 0.00	—	15 0.0	—	—	—	—
<i>japonica</i> v. Martens	—	—	—	—	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—
<i>Corbicula</i>	—	—	—	—	—	—	—	—
( <i>Corbiculina</i> )	—	—	—	—	—	—	—	—
<i>leana</i> Prime	—	—	—	—	1 0.88	—	1 0.00	30 13.0

Table 4. Benthic faunal composition and their abundance at St. Na 3

Date	January 16, 1968				February 17, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	? 0.19	? 0.09	? 0.09	? 5.5	? 0.33	? 0.32	? 0.34	? 14.7
Nematoda	—	2 0.01	3 0.02	74 0.4	—	1 0.01	—	15 0.2
Hirudinea	1 0.01	—	—	15 0.2	—	—	—	—
Chironomidae larvae	—	—	—	—	—	—	—	—
<i>Pentaneura</i> sp.	1 0.00	—	—	15 0.0	—	—	—	—
(Unidentified sp.)	16 0.16	7 0.07	15 0.19	56 6.2	7 0.13	12 0.22	4 0.07	340 6.2
Mollusca	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—
<i>decipiens</i>	—	—	—	—	—	—	—	—
(Westerlund)	3 1.99	2 1.20	—	74 47.2	2 1.31	—	4 3.90	89 77.1
Pelecypoda	—	—	—	—	—	—	—	—
<i>Unio biwaz</i>	—	—	—	—	—	—	—	—
Kobelt	1 0.21	—	—	15 3.1	—	2 9.80	—	30 145.0
Pupae of	—	—	—	—	—	—	—	—
Simuliidae*	3 0.01	—	3 0.00	89 0.2	54 0.92	41 0.99	88 1.71	2708 536

Date	March 16, 1968			April 13, 1968			Average	Average
	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)		
Sampling No.	1	2	3	1	2	3	No./m <sup>2</sup> g/m <sup>2</sup>	Average
Oligochaeta	? 0.38	? 0.43	? 0.15	? 0.16	? 0.21	? 0.02	? 14.2	? 5.8
Nematoda	1 0.01	—	5 0.14	—	1 0.00	1 0.00	89 2.2	30 0.0
Hirudinea	—	—	—	1 0.01	—	—	—	15 0.2
Chironomidae larvae								
<i>Pentaneura</i> sp.	1 0.01	—	—	—	—	—	15 0.2	—
<i>Spaniotoma</i> sp.	5 0.12	3 0.09	5 0.12	—	1 0.04	—	192 4.9	15 0.6
(Unidentified sp.)	1 0.01	6 0.03	2 0.01	—	—	1 0.01	133 0.7	15 0.2
Amphipoda								
<i>Anisogammarus</i>								
<i>amandalei</i>								
(Tattersall)	—	—	1 0.02	—	—	—	15 0.3	—
Mollusca								
Gastropoda								
<i>Semitsulcospira</i>								
<i>decipiens</i>	—	1 0.42	1 0.40	3 1.81	—	1 0.83	30 12.1	59 39.1
(Westerlund)								
Pelecypoda								
<i>Unio biwae</i>	—	1 0.75	—	—	—	—	15 11.1	—
Kobelt								
Pupae of								
Simuliidae*	—	—	7 0.02	9 0.03	—	—	104 0.3	133 0.4

Date	May 14, 1968				June 18, 1968				Average No./m <sup>2</sup> g/m <sup>2</sup>	Average No./m <sup>2</sup> g/m <sup>2</sup>			
	1	2	3	Average	1	2	3	Average					
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)
Oligochaeta	—	? 0.12	? 0.01	? 1.9	? 0.05	—	—	—	—	—	? 0.02	? 1.0	
Nematoda	2 0.03	1 0.02	1 0.01	59 0.9	3 0.01	2 0.01	1 0.33	89 5.2	—	—	—	—	
Chironomidae larvae	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Pentaneura</i> sp.	—	1 0.01	—	15 0.2	—	—	—	—	—	—	—	—	
<i>Tendipes plumosus</i>	—	—	—	—	—	—	—	—	—	—	—	—	
(Meigen)	—	—	—	—	—	2 0.05	1 0.02	44 1.0	—	—	—	—	
(Unidentified sp.)	1 0.01	3 0.02	—	59 0.4	—	—	—	—	—	—	—	—	
Crustacea	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Macrobrachium</i>	—	—	—	—	—	—	—	—	—	—	—	—	
<i>niponense</i>	—	—	—	—	—	—	—	—	—	—	—	—	
(DeHaan)	—	—	—	—	—	1 0.25	—	15 3.7	—	—	—	—	
Mollusca	—	—	—	—	—	—	—	—	—	—	—	—	
Gastropoda	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—	—	—	—	—	
<i>decipiens</i>	—	—	—	—	—	—	—	—	—	—	—	—	
(Westerlund)	—	4 1.40	—	59 20.7	—	2 0.05	1 0.02	44 1.0	—	—	—	—	
<i>Heterogen</i>	—	—	—	—	—	—	—	—	—	—	—	—	
<i>longispira</i>	—	—	—	—	—	—	—	—	—	—	—	—	
(Smith)	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Gyraulus</i>	—	—	—	—	—	—	—	—	—	—	—	—	
<i>amplificatus</i>	—	—	—	—	—	—	—	—	—	—	—	—	
(Mori)	1 0.01	—	—	15 0.2	—	—	—	—	—	—	—	—	
Pupae of	—	—	—	—	—	—	—	—	—	—	—	—	
Simuliidae*	—	—	17 0.08	252 1.2	—	—	11 0.08	163 1.2	—	—	—	—	

Date	July 17, 1968			August 16, 1968			Average No./m <sup>2</sup> g/m <sup>2</sup>
	1	2	3	1	2	3	
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	—	? 0.03	? 0.02	—	—	—	15 0.0
Hirudinea	—	—	—	2 0.01	2 0.01	—	59 0.3
Chironomidae larvae	—	—	—	—	—	—	—
<i>Pentaneura</i> sp.	—	—	1 0.00	—	—	—	—
(Unidentified sp.)	1 0.00	—	—	1 0.00	1 0.00	—	30 0.0
Mollusca	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—
<i>decipiens</i>	—	—	—	—	—	—	—
(Westerlund)	4 0.51	3 0.80	13 6.14	3 0.33	8 2.15	1 0.46	178 43.5
<i>Heterogen</i>	—	—	—	—	—	—	—
<i>longispira</i> (Smith)	—	—	—	1 0.12	—	—	15 1.8
Pelecypoda	—	—	—	—	—	—	—
<i>Unio biwaë</i>	—	—	—	—	—	—	—
Kobelt	—	—	—	1 2.80	—	1 7.05	30 146
Pupae of	—	—	—	—	—	—	—
Simuliidae*	2 0.01	—	11 0.07	1 0.00	—	6 0.03	104 0.4

Date	September 13, 1968				October 17, 1968			
	1	2	3	Average	1	2	3	Average
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Oligochaeta	? 0.01	? 0.01	? 0.03	?	1 0.00	1 0.00	—	30 0.0
Nematoda	—	—	—	—	1 0.00	1 0.00	—	30 0.0
Chironomidae larvae (Unidentified sp.)	1 0.00	—	—	15 0.0	—	—	—	—
Amphipoda	—	—	—	—	—	—	—	—
<i>Anisogammarus</i>	—	—	—	—	—	—	—	—
<i>annandalei</i> (Tattersall)	—	1 0.01	—	15 0.2	—	—	—	—
Mollusca	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—
<i>Semisulcospira</i>	—	—	—	—	—	—	—	—
<i>deciptiens</i> (Westerlund)	2 0.59	7 2.43	7 1.94	237 73.4	2 0.23	1 0.11	1 0.23	59 8.4
<i>Heterogen</i>	—	—	—	—	—	—	—	—
<i>longispira</i> (Smith)	—	1 0.50	—	15 7.4	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—
<i>Unio biwae</i> Kobelt	1 4.08	—	—	15 60.4	—	—	—	—
Pupae of Simuliidae*	4 0.03	4 0.02	1 0.00	133 0.7	—	—	—	—

Date	November 15, 1968					December 17, 1968				
	1	2	3	Average		1	2	3	Average	
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)
Oligochaeta	? 0.01	? 0.01	—	? 0.3	? 0.08	? 0.13	? 0.05	? 3.9		
Nematoda	—	—	—	—	2 0.00	—	2 0.02	59 0.3		
Chironomidae larvae										
<i>Pentaneura</i> sp.	—	1 0.01	—	15 0.2	—	—	—	—		
<i>Spaniotoma</i> sp.	—	2 0.04	1 0.02	44 0.9	—	4 0.10	—	59 1.5		
(Unidentified sp.)	—	—	—	—	1 0.01	—	—	15 0.2		
Crustacea										
<i>Macrobrachium nipponense</i> (DeHaan)	—	2 0.06	—	30 0.9	—	2 0.10	—	30 1.5		
Mollusca										
Gastropoda										
<i>Semisulcospira decipiens</i> (Westerlund)	3 1.53	—	5 0.84	118 35.1	2 1.64	—	3 1.80	74 50.9		

Date	January 18, 1969				February 18, 1969				Average No./m <sup>2</sup> g/m <sup>2</sup>
	1 No. Wt.(g)	2 No. Wt.(g)	3 No. Wt.(g)	Average No./m <sup>2</sup> g/m <sup>2</sup>	1 No. Wt.(g)	2 No. Wt.(g)	3 No. Wt.(g)	Average No./m <sup>2</sup> g/m <sup>2</sup>	
Oligochaeta	—	49 0.05	25 0.05	1095 1.5	?	?	?	?	(16.2)
Nematoda	—	1 0.01	—	15 0.2	—	—	—	—	—
Chironomidae larvae	—	—	—	—	—	—	—	—	—
<i>Sapnotoma</i> sp. (Unidentified sp.)	4 0.08	1 0.03	—	74 1.6	—	—	—	—	—
Crustacea	—	1 0.00	—	15 0.0	—	—	—	—	—
<i>Palaemon paucidens</i>	—	—	—	—	—	—	—	—	—
DeHaan	—	2 0.16	1 0.69	44 12.6	—	—	—	—	—
<i>Macrobrachium nipponense</i> (DeHaan)	—	—	3 1.13	44 16.7	—	1 0.06	4 0.35	74	6.1
Mollusca	—	—	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	—	—
<i>Semisulcospira decipiens</i> (Westerlund)	1 0.80	1**	5 1.11	89 28.3	—	2 0.15	1 0.26	44	6.1
<i>Heterogen longispira</i> (Smith)	1 3.7	—	—	15 54.8	—	—	—	—	—
Pelecypoda	—	—	—	—	—	—	—	—	—
<i>Unio biwae</i> Kobelt	2 7.09	—	2 10.9	59 266.0	—	1 4.06	—	15	60.1
<i>Sphaerium japonicum biwae</i> Mori	—	1 0.00	—	15 0.00	—	—	—	—	—



Date	March 15, 1969						April 18, 1969											
	1		2		3		Average		1		2		3		Average			
	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>		
Sampling No.	30	bad	69	bad	74	0.44	—	—	2560	(19.4)	7	bad	26	bad	19	bad	770	bad
Oligochaeta	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.01	15	0.2
Hirudinea	Crustacea																	
Crustacea																		
<i>Macrobrachium</i>																		
<i>nipponense</i>																		
(DeHaan)	1	0.15	—	—	1	0.15	30	4.44	—	—	1	0.12	1	0.02	30	2.1		
Mollusca	Gastropoda																	
Gastropoda																		
<i>Semisulcospira</i>																		
<i>decipiens</i>	2	0.56	1	0.26	1	0.69	59	22.3	4	1.14	2	0.66	1	0.16	104	29.0		
(Westerlund)	<i>Radix japonica</i>																	
<i>Radix japonica</i>																		
(Jay)	1	0.29	—	—	—	—	15	4.3	—	—	1	0.06	—	—	15	0.9		
Pelecypoda	<i>Unio biwae</i>																	
<i>Unio biwae</i>																		
Kobelt	1	10.6	—	—	—	—	15	157	—	—	1	3.34	—	—	15	49.4		
Pupae of	Simuliidae*																	
Simuliidae*																		
	3	0.02	—	—	2	0.01	74	0.4	—	—	10	0.03	—	—	148	0.4		



Date	July 14, 1969						August 13, 1969									
	1		2		3		Average		1		2		3		Average	
	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No.	Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>
Sampling No.	11	0.06	16	0.03	—	—	592	1.6	22	0.01	2	0.00	13	0.05	548	0.9
Oligochaeta	4	0.02	—	—	—	—	59	0.3	1	0.00	—	—	—	—	15	0.0
Chironomidae larvae (Unidentified sp.)																
Mollusca																
Gastropoda																
<i>Semisulcospira</i>																
<i>deceptans</i>	1	0.52	3	1.68	—	—	74	40.7	4	2.41	—	—	1	0.00	74	35.7
(Westerlund)																
<i>Heterogen</i>																
<i>longispira</i>	—	—	—	—	—	—	15	213.0	—	—	—	—	—	—	—	—
(Smith)																
Pelecypoda																
<i>Unio biwae</i>																
Kobelt	1	4.28	—	—	—	—	15	63.3	—	—	—	—	—	—	—	—
<i>Corbicula</i>																
<i>sandai</i>																
Reinhardt	—	—	—	—	—	—	—	—	1	4.3	—	—	—	—	15	63.6

Date	September 13, 1969					October 21, 1969				
	1	2	3	Average	1	2	3	Average		
Sampling No.	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>		
Oligochaeta	—	5 0.07	13 0.17	266 3.6	6 0.02	8 0.03	6 0.04	296 1.3		
Nematoda	—	1 0.00	—	15 0.0	—	1 0.01	1 0.02	30 0.4		
Mollusca										
Gastropoda										
<i>Semisulcospira</i>										
<i>decepiens</i>										
(Westerlund)	2 0.98	1 0.51	3 1.40	89 42.8	3 2.35	2 1.36	—	74 54.9		
<i>Parafossarulus</i>										
<i>manchouricum</i>										
<i>japonicus</i>										
(Filsbry)	—	—	1 0.06	15 0.9	—	—	—	—		
Pupae of										
Simuliidae*	1 0.00	1 —	—	15 0.0	—	—	—	—		

Date	November 18, 1969						December 15, 1969										
	1		2		3		Average		1		2		3		Average		
	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No./m <sup>2</sup> g/m <sup>2</sup>	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No. Wt.(g)	No./m <sup>2</sup> g/m <sup>2</sup>	No./m <sup>2</sup> g/m <sup>2</sup>	
Sampling No.	20	0.16	6	0.04	—	—	503	3.7	7	0.07	7	0.12	6	0.04	296	3.4	
Oligochaeta	—	—	—	—	—	—	—	—	4	0.06	—	—	—	—	59	0.9	
Chironomidae larvae	1	0.00	—	—	1	0.00	30	0.0	—	—	1	0.01	—	—	15	0.2	
<i>Spamiotoma</i> sp. (Unidentified sp.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Crustacea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Macrobrachium nipponense</i> (DeHaan)	—	—	—	—	—	—	—	—	—	—	—	—	2	0.47	30	7.0	
Mollusca	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Gastropoda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Semisulcospira decipiens</i> (Westerlund)	{1	0.33	2	0.65	—	—	44	14.5	—	—	—	2	0.68	1	0.40	44	16.0
Pelecypoda	{2**	—	—	—	—	—	30**	—	—	—	—	—	—	—	—	—	—
<i>Heterogen longispira</i> (Smith)	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1.41	15	20.9

C. Annual variation in number and biomass of benthic animals during four years (1966-1969)

There are some remarkable annual variations or changing trends in numbers and biomasses of several benthic animals since 1966. We would like to point out some of these variations and to discuss about the causes.

### 1. Oligochaeta

Seasonal change of oligochaete biomass obtained in 1968 and 1969 at each station is summarized in Table 5 and the variations since 1966 are illustrated in Fig 1.

Although sample size seems to be rather small to give exact estimation to the values of standing crops in the areas and therefore seems to be rather hard to discuss on the seasonal change of biomass of oligochaete, but the followings will generally be pointed out. The characteristic in biomass of oligochaete at each station is remained similarly from 1966 through 1969, that is, the greatest value was found at Station Ie-1 and the least at Station Nb 2. This was already discussed in previous article (Suzuki and Mori 1968). At Station Na 3, however, a slight but constant tendency of increase seems to be observable (Fig. 1).

Table 5.

	Ie-1		Nb 2		Na 3		Nb 5	
	1968	1969	1968	1969	1968	1969	1968	1969
	g/m <sup>2</sup>	g/m <sup>2</sup>	g/m <sup>2</sup>	g/m <sup>2</sup>	g/m <sup>2</sup>	g/m <sup>2</sup>	g/m <sup>2</sup>	g/m <sup>2</sup>
January	5.0	4.4	0.0	0.6	5.5	1.5	7.1	3.1
February	3.7	14.2	2.4	0.7	14.7	16.2	13.8	8.7
March	9.5	13.9	1.2	1.0	14.2	19.4	11.2	6.7
April	4.9	2.7	0.0	—	5.8	—	4.9	6.2
May	23.5	4.7	0.0	0.3	1.9	1.8	6.8	3.6
June	11.0	26.3	0.0	0.2	1.0	4.0	3.0	3.1
July	13.8	28.1	0.0	0.0	0.7	1.6	1.2	1.3
August	3.4	11.4	0.0	0.4	0.0	0.9	0.6	3.0
September	4.7	—	0.0	0.0	0.7	3.6	1.3	3.0
October	13.3	13.2	0.6	0.0	0.0	1.3	0.9	4.3
November	7.3	4.0	0.7	0.2	0.3	3.7	3.4	2.5
December	2.4	16.4	0.0	0.4	3.9	3.4	3.9	4.3
Average	8.5	12.7	0.4	0.4	4.1	5.2	4.8	4.2

## 2. Chironomidae larvae

Table 6.  
*Spaniotoma* sp.

	Nb 5				Na 3			
	1968		1969		1968		1969	
	No./m <sup>2</sup>	g/m <sup>2</sup>	No./m <sup>2</sup>	g/m <sup>2</sup>	No./m <sup>2</sup>	g/m <sup>2</sup>	No./m <sup>2</sup>	g/m <sup>2</sup>
January	0	0.0	30	0.3	0	0.0	74	1.6
February	0	0.0	44	1.6	0	0.0	0	0.0
March	89	2.7	104	3.0	192	4.9	0	0.0
April	15	0.4	0	0.0	15	0.6	0	0.0
May	0	0.0	0	0.0	0	0.0	44	0.3
June	0	0.0	0	0.0	0	0.0	0	0.0
July	44	1.0	0	0.0	0	0.0	0	0.0
August	15	0.0	0	0.0	0	0.0	0	0.0
September	0	0.0	0	0.0	0	0.0	0	0.0
October	0	0.0	0	0.0	0	0.0	0	0.0
November	59	1.2	0	0.0	44	0.9	30	0.0
December	44	0.6	0	0.0	59	1.5	59	0.9
Average	22	0.5	15	0.5	26	0.7	17	0.2

*Tendipes plumosus*

	Nb 5				Na 3			
	1968		1969		1968		1969	
	No./m <sup>2</sup>	g/m <sup>2</sup>	No./m <sup>2</sup>	g/m <sup>2</sup>	No./m <sup>2</sup>	g/m <sup>2</sup>	No./m <sup>2</sup>	g/m <sup>2</sup>
January	0	0.0	15	0.4	0	0.0	0	0.0
February	0	0.0	15	0.7	0	0.0	0	0.0
March	0	0.0	0	0.0	0	0.0	0	0.0
April	0	0.0	0	0.0	0	0.0	0	0.0
May	0	0.0	0	0.0	0	0.0	0	0.0
June	163	4.9	0	0.0	44	1.0	118	1.8
July	0	0.0	59	1.9	0	0.0	0	0.0
August	0	0.0	59	1.8	0	0.0	0	0.0
September	0	0.0	15	0.6	0	0.0	0	0.0
October	15	0.4	30	0.7	0	0.0	0	0.0
November	30	1.0	0	0.0	0	0.0	0	0.0
December	0	0.0	59	1.5	0	0.0	0	0.0
Average	17	0.5	21	0.6	4	0.1	10	0.2

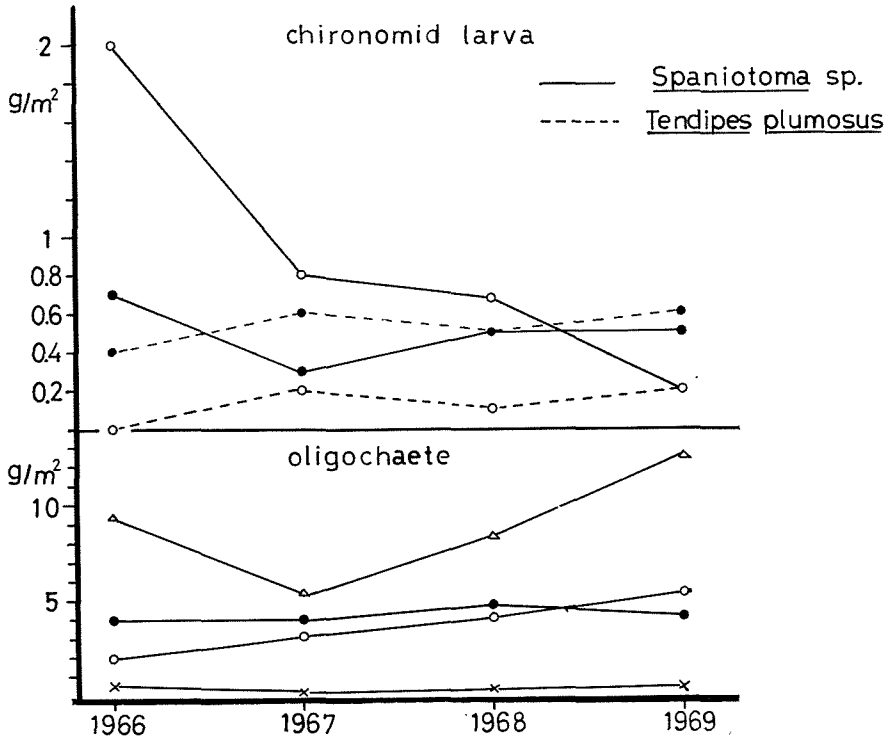


Fig. 1. Annual changes-weight of chironomid larva and oligochaete.

$\Delta$ : Ie-1    $\times$ : Nb 2    $\bullet$ : Nb 5    $\circ$ : Na 3

Two species, *Tendipes plumosus* and *Spaniotoma* sp., within several chironomid species, appeared abundantly only at Stations Nb 5 and Na 3, but other identified species were rather scarce in amount at these stations as well as at other stations. These two species seemed to prefer shallow and muddy bottom as their habitat.

Annual variations in numbers of *Spaniotoma* and *Tendipes* are shown in Fig. 1. The number of *Spaniotoma* sp. at Station Na 3 decreased year after year. When we consider this phenomenon together with a slight increase of oligochaete worms through four years at this station, we are afraid if any eutrophication processes are advancing in this area.

### 3. Mollusca

The following species were found in the samples collected at Nb 2, Nb 5 and Na 3 during four years (1966-1969).



## Gastropoda

*Heterogen longispira* (Smith)  
*Valvata (Cincinna) japonica* v. Martens  
*Parafossarulus manchouricus japonicus* (Pilsbry)  
*Semisulcospira decipiens decipiens* (Westerlund)  
*Semisulcospira decipiens reticulata* Kajiyama et Habe  
*Semisulcospira bensoni reiniana* (Brot)  
*Radix japonica* (Jay)  
*Gyraulus amplificatus* (Mori)

## Pelecypoda

*Lanceolaria oxyrhyncha* (v. Martens)  
*Unio biwae* Kobelt  
*Inversidens bradti* (Kobelt)  
*Inversidens reiniana* (Kobelt)  
*Anodonta calipygos* Kobelt  
*Corbicula sandai* Reinhardt  
*Corbicula (Corbiculina) leana* Prime  
*Pisidium kawamurai* Mori  
*Sphaerium japonicum biwaense* Mori

Among them *Semisulcospira decipiens*, *Corbicula sandai* and *Unio biwae* were the best three in amount, so the average numbers and average biomasses of them for each year are shown in Table 7.

Table 7.

		1966		1967		1968		1969	
<i>Semisulcospira decipiens</i>	Nb 2	No./m <sup>2</sup> 13	g/m <sup>2</sup> 4.4	No./m <sup>2</sup> 22	g/m <sup>2</sup> 9.0	No./m <sup>2</sup> 50	g/m <sup>2</sup> 14.8	No./m <sup>2</sup> 28	g/m <sup>2</sup> 12.0
		(0.34)		(0.41)		(0.30)		(0.43)	
	Nb 5	7	15.7	10	8.7	10	1.0	10	9.3
		(2.24)		(0.87)		(0.10)		(0.93)	
	Na 3	25	29.1	37	27.8	110	43.2	85	36.7
		(1.16)		(0.75)		(0.39)		(0.43)	
<i>Corbicula sandai</i>	Nb 2	76	89.0	58	60.6	62	58.0	20	19.5
		(1.17)		(1.04)		(0.94)		(0.98)	
	Nb 5	4	12.1	2.5	9.3	1	1.2	1	4.3
		(3.03)		(3.72)		(1.20)		(4.30)	
<i>Unio biwae</i>	Nb 2	12	10.4	11	9.5	8	7.2	10	4.8
		(0.86)		(0.86)		(0.90)		(0.48)	
	Na 3	1	0.5	6	21.6	9	30.5	12	62.5
		(0.50)		(3.60)		(3.39)		(5.21)	

( ): Body weight (g) per individual

*S. decipiens* prefers shallower bottom of muddy substratum, while *C. sandai* prefers sandy substratum as mentioned in the previous article (Suzuki and Mori 1968). Although *Unio biwae* was often found in both Stations Nb 2 and Na 3, body weight per individual was usually greater in specimens collected at Na 3.

The annual variations in numbers and biomasses of these species were rather great. A constant tendency of decrease, however, is observable in number and biomass of *Unio biwae* at Station Nb 2 and that of increase at Station Na 3. But we can not connected these changes to any changes of environmental factors at present.

We have previously pointed out on the sudden appearance of *Pisidium lacustre* at Station Ie-1 in 1968. For the consideration on the cause of this phenomenon, we examined the results of survey of abiotic environments just above the bottom at this station from 1966 through 1969, which are illustrated in Fig. 2 (refer to the data shown in the Section I of the series of this report).

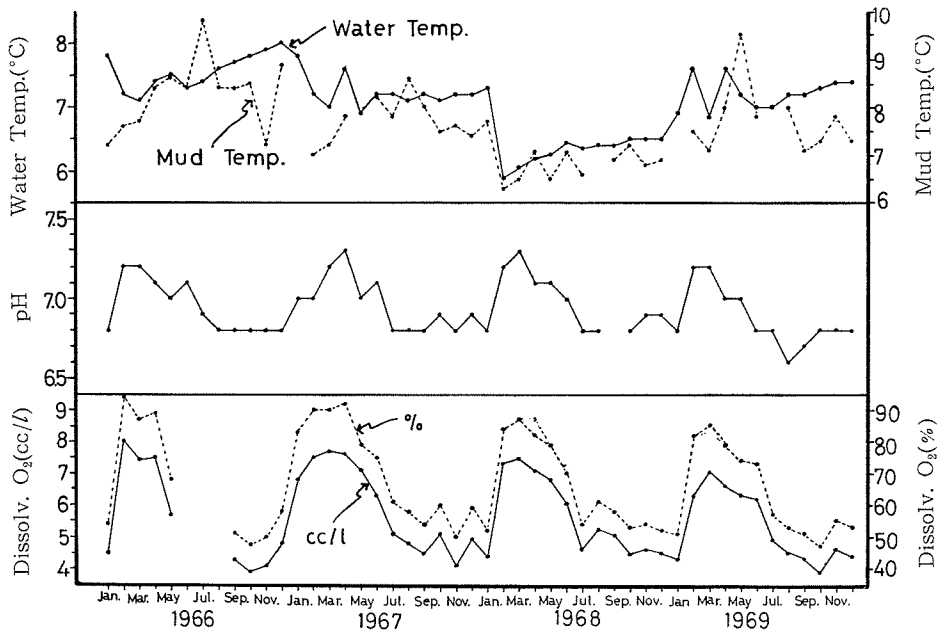


Fig. 2. Annual changes of some environmental factors (Water temperature, pH and dissolved oxygen content) of the water just above the bottom at Station Ie-1.

We can notice a remarkable low temperature through the year of 1968, which seems to suggest a interrelation between the sudden appearance of *Pisidium* and the temperature environment. Other factors seem not to be correlated.

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