Studies on the biotic productivity of Daimyojinzawa, an acidic mountain stream in Nagano Prefecture

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吉田利男：酸性河川大明神沢（長野県）の生物生産量について*

The studies on the fauna and flora in acidic streams in Japan have been made by many investigators, such as Okada and Horasawa (1937), Negoro (1938), Ide (1954) and Hirose (1961).

They reported the fact that relatively few species are distributed in acidic streams. Making contrast to the abundance of the faunistic study, only few studies have been accomplished concerning the biotic productivity in the flowing waters. The fewerness of the productivity study is mainly owing to the difficulties in the estimation of the population size of standing crops of inhabiting animals on the one hand and on the other hand in the determination of the biotic and abiotic environmental factors affecting the productivity caused by the un-uniformity in space and time of the stream ecosystem.

Because of the simplicity in fauna and flora, especially lacking of fishes in the water, the acidic stream will be a good field for the preliminary analistic study of the productivity of flowing fresh waters. For the purpose of collecting fundamental data which will be useful in the study of the energy dynamics in the more complicated inland flowing waters, an acidic stream named Daimyojinzawa at Sugadaira in Nagano Prefecture in the middle of Honshu, was selected as the studying field.

The present paper mainly deals with the faunistic and floristic composition, numbers, biomass, and the productivity of the biotic community especially in relation to pH values. The comparison of those biotic characteristics with those of neighboring streams was also made.

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Abiotic characteristics of Daimyojinzawa

1. Topographical characteristics

The Daimyojinzawa rises from a valley, about 1,900m above the sea, between Mt. Neko (2,195m) and Mt. Azumaya (2,333m), both being pleistocene volcanos, and flows down to Oobora, 1,100 m in elevation where it meets with Karasawa main stream

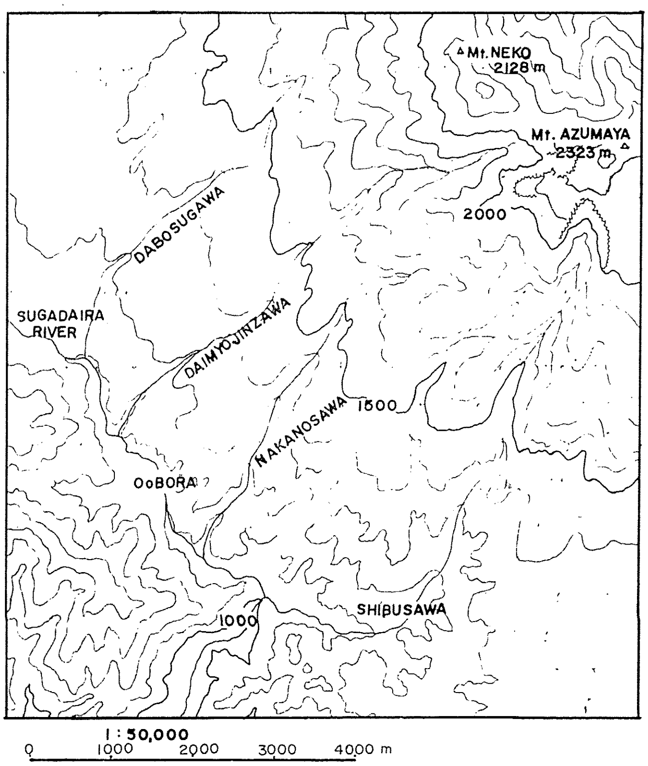

Fig. 1. Daimyojinzawa area

and becomes the Sugadairagawa, which finally meets with the River Chikuma, at Ueda City (Fig. 1). The stream bed rocks older than the Azuma volcanic formation are exposed. The Daimyojinzawa is one of the typical small mountain streams, the width of which is 1.5—2.0 m. There are many rapids, water-falls and some pools along the course. The water level is apt to change daily and seasonally. These remarkable changes in water level and relatively high velocity of water current (about 1.5 m/sec.) cause the hard movement of bottom materials and provides unsuitable habitat for the aquatic community.

2. Chemico-physical characteristics of water

It was reported by Yoshimura (1936) that no hydrochloric acid but much sulfuric acid, exists in the waters of Japanese acidic rivers, and that inorganic salts such as nitrogen and phosphate are detected. The acidification of this river seems to be due to the sulfuric acid in water originated from the dissolution of sulfur. It is considered that the exhausted sulfuric mine near the upper-most part of Daimyojinzawa is one of the sulfuric source. The pH value at the upper-most part of the river course of Daimyojinzawa is 3.5—3.6, while it is 7.0 at Oobora (Tab. 1). This increase in pH value seems to be caused by addition of water not acidic from many springs along the river course (Fig. 2).

Tab. 1. pH, water temperature (W. T.) and oxygen contents at each station (Aug. 1964)

Station	I	II	III	IV	V	VI	VII
Distance from the source (km)	0.5	2.5	3.0	3.5	4.0	4.5	5.5
pH	4.0	4.2	4.5	4.7	5.0	6.0	6.8
W. T. (°C)	8.6	18.2	18.5	25.6	16.2	19.9	16.7
Oxygen saturation (volume %)	100.2	108.7	—	—	106	121.2	105.8

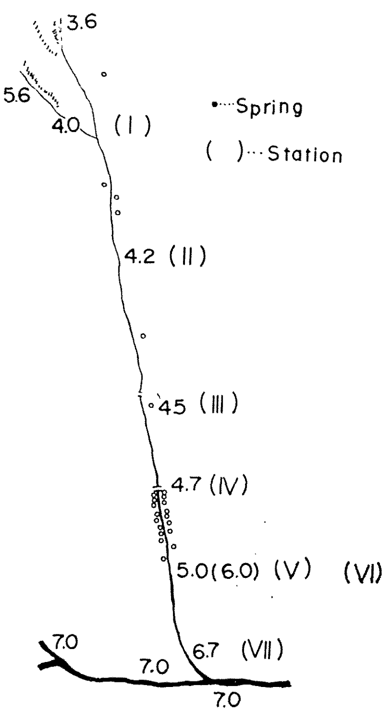

Fig. 2. Distribution of springs in Daimyojinzawa

In addition to the locational variation of pH, the seasonal and daily changes of pH are clearly observed. The exact reason of these periodical changes in pH is not apparent though, it may be sure that the amounts of rain fall and of flowing water are related to the cause of these changes.

The water temperature was about 8.6°C at the upper-most part of the stream in August 1964. It was lower than that of the middle and down part of the stream course and the average water temperature of August 1964 was 20°C. The daily change in water temperature and the remarkable relationship between air and water temperatures were observed especially in fine days (Tab. 2).

Dissolved oxygen in water was always saturated, and no remarkable relations of it to pH, water temperature and the elevation were found.

Tab. 2. Daily change in pH, water temperature (W. T.) and air temperature (A. T.) at the station IV

Time	19/Aug. 9.00	12.00	15.00	18.00	21.00	24.00	20/Aug. 3.00	6.00
pH	4.6	4.6	4.6	4.6	4.6 —4.7	4.6 —4.7	4.7	4.7
W. T. (°C)	15.9	20.7	22.1	18.2	15.8	15.5	15.3	14.4
A. T. (°C)	17.2	22.4	25.6	20.2	17.5	17.0	16.0	15.0

Biotic characteristics of Daimyojinzawa

1. Fauna and flora

Hirose (1961) reported that 25 species were found in the fauna of the acidic rivers in Nagano area, and Negoro (1938) reported 11 species of aquatic animals and 1 plant species from the Daimyojinzawa.

By the present investigation, species belonging to Diatomaceae and Conjugatae, and a small mammalian species, *Chimarrogale platycephala* were newly added to the list and totally 23 animals and 3 plants were listed (Tab. 3).

Tab. 3. Faunal and floral composition of the biotic community of Daimyojinzawa

Flora	Algae	*Diatom* sp.
		Cosmarium sp.
	Bryophyta	*Scapania irriguia* (Nees) Dum
Fauna	Insectivora	*Chimarrogale platycephala*
	Platyhelminthes	*Dugesia gonocephala*
	Plecoptera	*Scopura longa*
		Protonemura sp.
		Paraleuctra
		Alloperla sp.
	Tricoptera	*Rhyacophila articulata*
		R. sp. RA
		R. sp. RH
		Himalopsyche japonica
		Arctopsyche maculata
		Hydropsyche ulmeri
		Stenopsyche griseipennis
	Ephemeroptera	*Epeorus* sp.
		Ephemerella sp.
	Diptera	*Erioptera* sp. EA
		Antocha sp.
		Simulium sp.
		Chironomus sp. 1
		C. sp. 2

2. Seasonal changes in species composition and biomass

The quadrate method was applied to the quantitative sampling of the aquatic insects. The size of quadrate was $(30 \times 30)\ cm^2$, and three samples were taken from each one station. The mean values of these three were taken. The collected insects were fixed immediately in 70% ethyl-alcohol, and the specimens were identified and the number of individuals was counted. After the identification and counting, the samples were dried in an electric oven at 100°C for about 24 hours, and the dry weight was measured. The biomass was obtained not only in terms of the dry weight, but also in terms of the amount of total nitrogen which was determined by micro-Kjeldahl's method. The field survey was made three times a year, in spring (mean of the data in April and May), summer (July and August) and in autumn (October and November), at the station Ⅲ. The results were shown in Fig. 3 and Tab. 4. Because of drifted snow, the winter samples could not be taken and no data for winter was obtained.

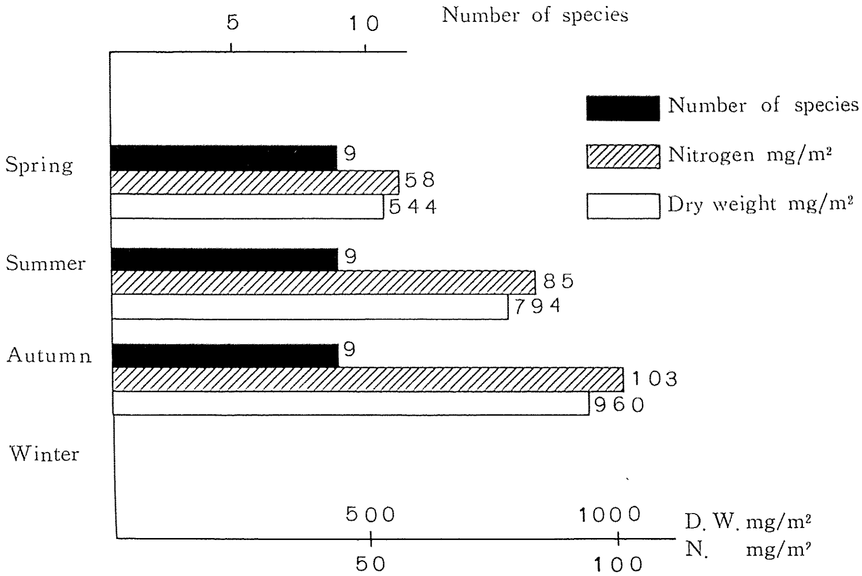

Fig. 3. Seasonal changes in species composition of aquatic insects and biomass

The seasonal change in the number of species was not so remarkable (Fig. 3). The biomass in terms of dry weight and total nitrogen showed noticeable seasonal change. They increased from spring to autumn, and the values in the autumn were more than twice as much as those in spring.

3. Change in species composition and biomass in relation to pH

As mentioned before, the pH values in Daimyojinzawa increase rather remarkably from the upper-most part of the stream to the down-part. In order to investigate the difference in the number of species and in the biomass, the samplings were made at seven stations (Fig. 2). The results are summarized in Fig. 4, 5 and Tab. 5, 6. Four

Tab. 4. Seasonal changes in species composition and

	April				May						July			
	Sample 1		Sample 2		Sample 1		Sample 2		Sample 3		Sample 1		Sample 2	
	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.
Plecoptera														
Protonemura sp.	11	12	8	16	24	31	13	24	13	34	76	28	72	37
Alloperla sp.							10	3	2	1				
Paraleuctra														
Tricoptera														
Rhyacophila articulata	10	1	18	2					24	1				
R. sp. RA	10	1	8	1			2	1					8	3
R. sp. RH											1	1	2	1
Himalopsyche japonica	6	1	5	1										
Hydropsyche sp. HA														
Arctopsyche maculata											1	2		
Ephemeroptera														
Epeorus sp.			1	1	4	4					1	1		
Ephemerella sp.	2	2	1	1	2	1								
Diptera														
Erioptera sp. EA	9	5	3	1			1	1						
Antocha sp.									1	1				
Simulium sp.					3	3			1	1			5	36
Chironomus sp. 1	6	40	3	19	3	23	30	22	10	25	2	41	4	48
C. sp. 2											2	5	5	9
Total	54	62	47	42	36	62	56	51	51	63	83	78	96	134

species were found in the places where pH values were 3. 6—4. 0 range, 8 species in pH 4. 2—5. 0, 5 species in pH 5. 0, and 9 species in the place of pH 6. *Scopura longa*, *Alloperla* sp. (Plecoptera) are dominant in the places where pH values were 3. 6—4. 2. No Tricoptera is distributed in this area. In the areas of pH 4. 2—5. 0, the above mentioned two plecopteran species, are altered to the tricopteran species, such as *Rhyacophila articulata*, *Rhyacophila* sp., *Arctopsyche maculata*. The species number of Tricoptera increases in pH 5. 0—6. 7 area, and *R. articulata*, *R.* sp. RA, *Arctopsyche maculata*, *Hydropsyche ulmeri*, *Stenopsyche griseipennis* are found from biomass at the station Ⅲ in Daimyojinzawa

		August						October						November			
Sample 3		Sample 1		Sample 2		Sample 3		Sample 1		Sample 2		Sample 3		Sample 1		Sample 2	
d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.	d. w.	No.
50	39	26	61	15	43	23	35	15	60	10	26	31	33	20	55	14	44
								2	2								
3	1							4	2	1	1	2	1	11	4	1	2
25	1							33	9	15	2	21	7	50.	9	11	13
5	1	13	1	12	1	13	1							4	2		
						19	4										
		9	2	12	5			44	8	51	5	10	1	15	1	41	3
3	1			2	1												
														1	1	1	1
				1	1			1	1								
5	4	2	6	2	5	1	1	1	12	3	37			7	112	2	16
5	8	1	8	1	5			1	19	2	45	1	23	1	46	1	11
5	3							1	2								
98	58	51	78	45	61	56	41	102	104	82	116	65	65	109	230	71	90

this area. *Protonemura* sp. is commonly distributed in wide range of pH value. Concerning the biomass, any close relationship to the change in pH was not observed.

The biomass of *Scapania* and aquatic insects, and the amount of flowing detritus show their maximum values characteristically at the places of intermediate pH values, being 4.2, 5.0 and 4.7 respectively.

4. Comparison to other streams

The Daimyojinzawa is an acidic stream, and the Dabosugawa and the Nakanosawa are neutral water streams of which the pH values are almost 7.0 (Hirose 1961).

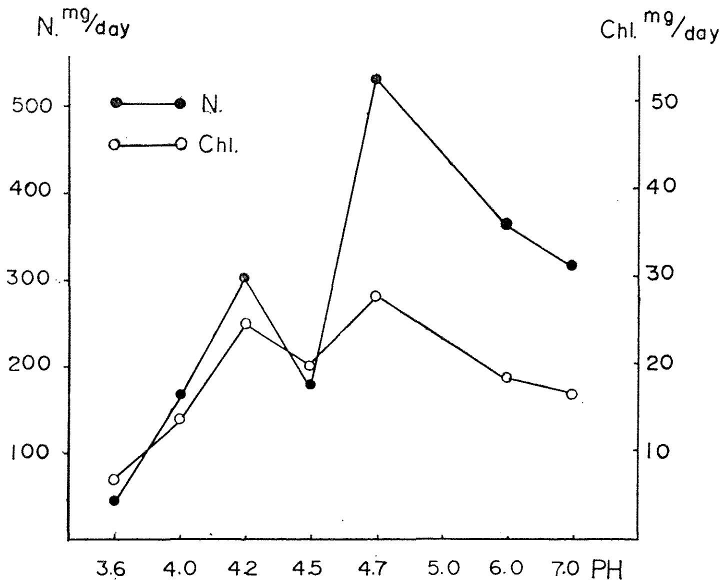

Fig. 4. Total nitrogen and chlorophyll contents in flowing water in Daimyojinzawa, Aug. 1964

Tab. 6. Changes in species composition and

	pH 4.0						pH 4.2					
	Sample 1		Sample 2		Sample 3		Sample 1		Sample 2		Sample 3	
	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.
Plecoptera												
Scopura longa	30	12	41	12	26	10	2	2				
Protonemura sp.					1	2	38	77	24	46	30	28
Alloperla sp.					3	2			2	2	1	1
Tricoptera												
Rhyacophila articulata											1	1
R. sp. RA												
Arctopsyche maculata									1	1		
Hydropsyche ulmeri												
H. sp. HA												
Stenopsyche griseipennis												
Ephemeroptera												
Epeorus sp.							1	1				
Ephemerella sp.												
Diptera												
Erioptera sp. EA												
Simulium sp.									1	3		
Chironomus sp. 1	1	13	1	13	1	10	1	53	2	48	1	34
Total	31	25	42	25	31	24	42	133	30	100	33	64

Tab.5. Distribution of *Scapania* along the pH gradient in Daimyojinzawa

pH	3.6—4.0	4.0—4.2	4.2—4.5	4.5—4.7	4.7—5.0 (6.0)	5.0—6.8 (6.0)	Average
Distance from the source (km)	0.5	2	0.5	0.5	1	1	--
Width of the stream (m)	0.5	1	1.5	2	2	2	—
Fresh weight (gr/m²)	20	400	700	100	50	20	215
Total weight (kg)	5	800	525	100	100	40	—
Volume in chlorophyll (gr)	2	378	248	47	47	20	124

biomass in relation to pH values

pH 4.5						pH 5.0						pH 6.7					
Sample 1		Sample 2		Sample 3		Sample 1		Sample 2		Sample 3		Sample 1		Sample 2		Sample 3	
d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w.	No.	d.w,	No.
26	61	15	43	23	35	28	40	17	18	20	23	6	14	7	8	7	16
										20	4	3	1			2	3
13	1	12	1	13	1	96	7	80	5	54	6					1	1
9	2	12	5									8	7	1	1	32	29
														10	4	2	1
				19	4												
												6	9				
		2	1														
		1	1											1	1	1	1
2	6	2	5	1	1	1	1			1	3			1	1	1	1
1	8	1	5			1	29	1	13	1	40	2	78	2	158	3	65
32	78	35	61	56	41	126	77	98	36	96	76	25	109	22	173	49	117

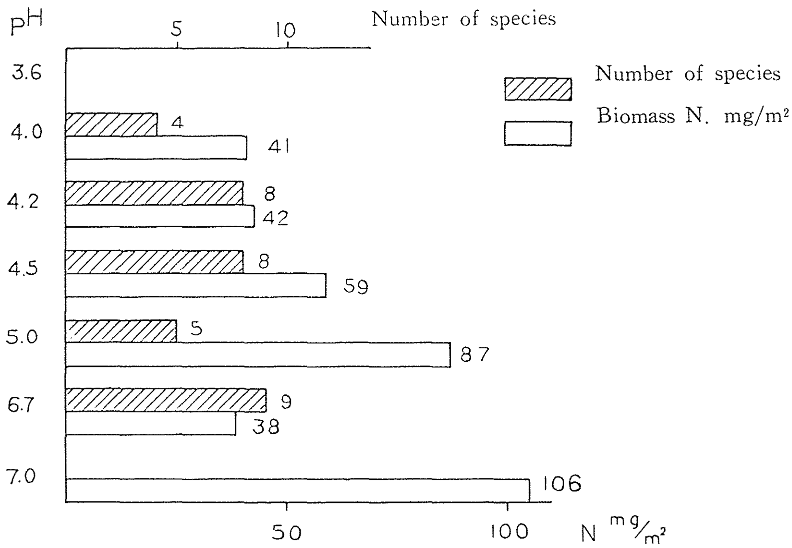

Fig. 5. Changes in number of species and biomass of aquatic insects in relation to pH values

The rocks constituting the river bed of each stream are thought to be of the same origin, and the abiotic conditions except the pH value in the three streams are very much similar. The investigations were made on the difference in the number of species and the biomass of aquatic insects of these three streams in relation to the influence of pH. The results were summarized in Fig. 6, and Tab. 7, 8, 9.

In the Daimyojinzawa two ephemeropteran species, *Epeorus* sp. and *Ephemerella*

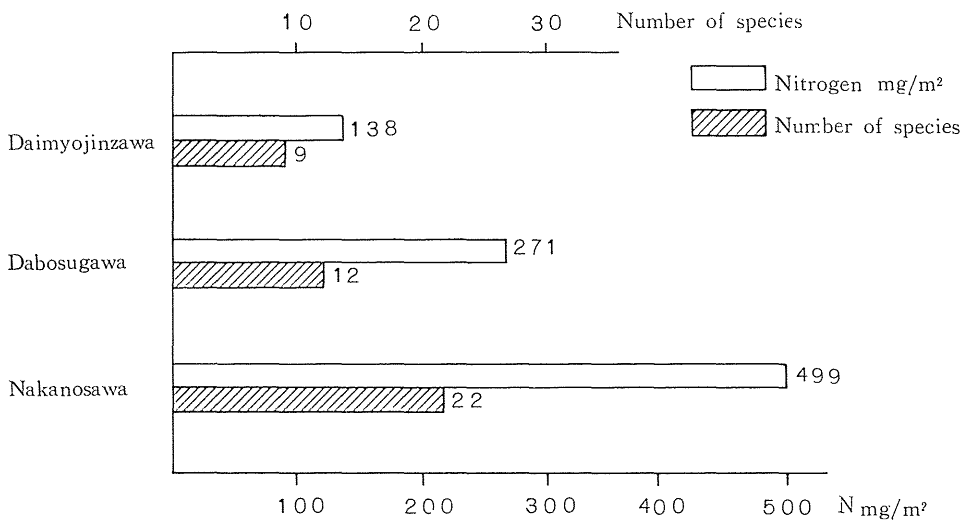

Fig. 6. Comparison of species composition and biomass along three streams, Oct. 1964

Tab.7. Species composition in Daimyojinzawa in Oct. 1964

	Station 1		Station 2		Station 3	
	d.w. (mg)	No.	d.w. (mg)	No.	d.w. (mg)	No.
Plecoptera						
Protonemura sp.	15	60	10	26	11	33
Paraleuctra	4	2	1	1	2	1
Alloperla sp.	2	2				
Tricoptera						
Rhyacophila articulata	33	9	15	2	21	7
Arctopsyche maculata	144	8	51	5	10	1
Diptera						
Erioptera sp. EA	1	1				
Simulium sp.	1	12	3	37		
Chironomus sp. 1	1	19	2	45	1	23
C. sp. 2	1	2				

sp. were very few, instead, Tricoptera (*Arctopsyche maculata*) and Plecoptera (*Protonemura* sp.) were found commonly.

There is not so much difference in species composition between the Dabosugawa and the Nakanosawa, and in both streams *Epeorus* sp. and *Ephemerella* sp. are abundant. In addition to the difference in the species composition, there is remarkable difference in the biomass between the acidic and the neutral stream.

The biomass in the Dabosugawa and the Nakanosawa are about two and four times richer than those of the Daimyojinzawa. There are not so much difference in the number of species between the Daimyojinzawa and the Dabosugawa, but the species constituting each stream fauna are different.

Epeorus and *Ephemerella* (Ephemeroptera) predominated the Dabosugawa, but the above-mentioned species were scarcely found in the Daimyojinzawa.

5. Biotic productivity

Tab.8. Composition of species in Dabosugawa in Oct. 1964

	Station 1		Station 2	
	d.w. (mg)	No.	d.w. (mg)	No.
Plecoptera				
Paragnetina tinctipennis	28	7		
Plecoptera sp.	24	60		
Ephemeroptera				
Ephemerella sp. 1	12	14		
E. sp. 2	139	230	141	77
Baëtis sp.	7	98		
Epeorus sp.	1	1		
Potamanthus kamonis	2	2	3	1
Tricoptera				
Hydropsyche ulmeri	5	6	3	2
H. sp.			5	19
Diptera				
Chironomus sp.	53	389	23	630
Simulium sp.	1	1	2	5
Eriocera sp.	2	18		

Tab. 9. Composition of species in Nakanosawa in Oct. 1964

	Station 1 d. w. (mg)	Station 1 No.	Station 2 d. w. (mg)	Station 2 No.
Plecoptera				
Nogiperla japonica	3	2	3	2
Acroneuria stigmatica	3	2	44	5
Leuctridae sp.	1	1		
Paragnetina tinctipennis	86	17	44	18
Ephemeroptera				
Ephemerella sp. 1	73	95	10	82
E. sp. 2			3	6
Epeorus sp.	2	6	8	30
Baëtis sp. 1	10	61	2	7
B. sp. 2			5	18
Tricoptera				
Arctopsyche maculata	261	16	96	4
Rhyacophila articulata	8	13	10	12
R. nigrocephala	24	1	2	3
Hydropsyche ulmeri	32	76	15	29
Stenopsyche griseipennis	1	1	8	2
Glossosomatinae sp. 1	1	1	2	1
G. sp. 2			1	1
Coleoptera				
Psephenoides sp.	4	6	2	4
Diptera				
Chironomus sp. 1	9	294	18	279
C. sp. 2	1	3		
Simulium sp.	7	26	14	7
Eriocera sp. 1	7	1	16	1
E. sp. 2			1	2

a) Trophic level

Primary producers : A moss species, *Scapania irriguia* is the only one higher plant found in the Daimyojinzawa. The abundance of *Scapania irriguia* is concentrated at the areas in which pH range is 4.0 to 4.5. No prominent algae is found in this stream except some benthic diatom.

First consumers (Herbivores) : *Ephemerella*, *Dugesia*, *Scopura* and *Protonemura* are considered to be the first consumer. As their population density is very small, *Dugesia*, *Epeorus* and *Ephemerella* are probably not so important species as the consumer.

Secondary consumers (Carnivores) : *Erioptera* sp. EA, *Rhyacophila*, *Himalopsyche*, *Arctopsyche* and *Simulium* sp. are considered to be the secondary consumers.

Tertiary consumers (Carnivores) : Only one species *Chimarrogale platycephala* is known as the mammalian insectivores inhabiting Sugadaira area. This species had not been reported in this area untill Aug. 1964 at which one individual was first captured. Fig. 7 shows the outline of food web diagram.

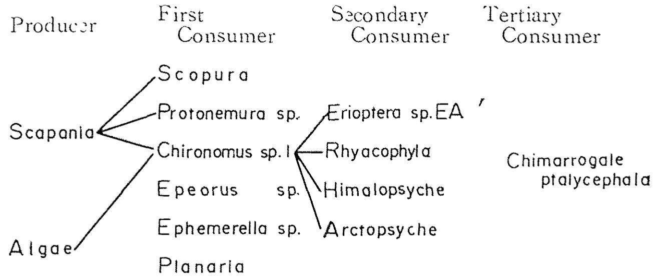

Fig. 7. Food chain and trophic level in Daimyojinzawa

b) Biomass pyramid

The dry weights of primary producer, first and secondary consumers in Daimyojinzawa were 7,933.5 mg/(30 × 30) cm^2, 30.96 mg/(30 × 30) cm^2, and 18 mg/(30 × 30) cm^2 respectively. Total surface of the Daimyojinzawa is roughly estimated as 8,250 m^2 from the map. From these values, the rough total weight of primary producer, *Scapania irriguia* in the Daimyojinzawa is calculated as 644 kg in dry weight.

The rough estimations of the biomass of first and secondary consumers are 3 kg and 1.5 kg respectively. Fig. 8 shows the biomass pyramid. It is evident that the biomass of first and secondary consumers are very small when it is compared to the biomass of primary producers.

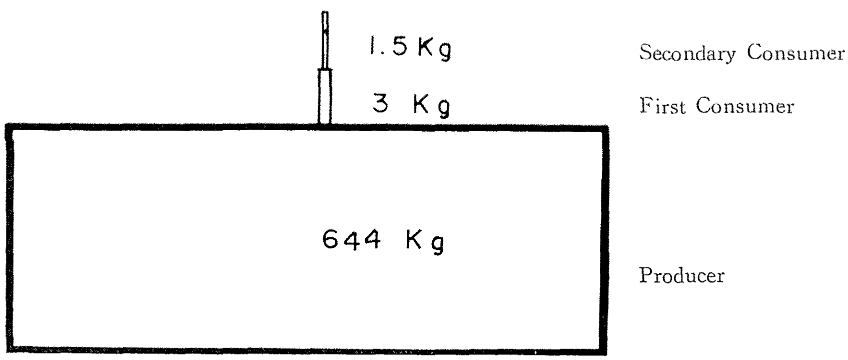

Fig. 8. Biomass pyramid in the biotic community of Daimyojinzawa

c) Productivity in a summer day

The input energy to the stream is mainly due to incident sun light and organic substance supplies from land area. The radiant energy at Kumagaya in summer is 500 cal/cm^2/day. Because of the same latitude at Sugadaira as that of Kumagaya, the radiant solar energy in Sugadaira was thought to be almost the same values as that of Kumagaya.

The total surface of the Daimyojinzawa is roughly estimated as 8,250 m^2 from the map. And the total incident solar energy given to the whole water surface of the stream was calculated to be about 4×10^7 kcal/day. The amount of organic substance originated from the outside of the river was calculated by measuring of the flowing detritus with a plankton net. But it is succeeded to estimate the energy input other than sun light with enough reliability, so the value is handled as the symbol (α).

Winkler's Dark and Light Bottle method was used in the measurement of the gross production of the primary producer. From the results, the net production and the respiration of the primary producer were 7.68 mg O_2/h/g and 4.32 mg O_2/h/g respectively. This value of the net production was converted to the value cal/cm^2/day and kcal/day. They were composed to be 25.9 cal/cm^2/day and 212,654 kcal/day, the energy efficiency (net production/input sun light) was 5.18% and 0.531% (Tab. 10, 11).

Tab. 10. Biotic productivity in each trophic level of Daimyojinzawa

Radiant energy	4×10^7 kcal/day 500 cal/cm^2/day at Kumagaya
Primary producer	
Gross production	332,642 kcal/day
Respiration	119,987 kcal/day (4.32 mg O_2/h/gr d.w.)
Net production	212,654 kcal/day (7.68 mg O_2/h/gr d.w.)
First consumer	
Gross production	—
Respiration	800 kcal/day (3,289 mg O_2/l/gr/h)
Net production	0.0098 kcal/day
Secondary consumer	
Gross production	—
Respiration	174 kcal/day (1.43 mg O_2/l/gr/h)
Net production	0.0014 kcal/day

Tab. 11. Energy efficiency in the whole area of Daimyojinzawa

O_2 kg/day			Energy efficiency (%)			Radial energy
P_G	R	P_N	P_G	R	P_N	4×10^7 kcal/day (500 cal/cm^2/day at Kumagaya)
92.839	33.488	59.351	0.831	0.299	0.531	

The net production of the consumers was calculated by the following way. The increase in biomass of the consumers in the Daimyojinzawa within three months, from spring to summer, was estimated by actual sampling, and the obtained amount was divided by the number of days. Net production of the first consumer was composed to be 0.0098 kcal/day and that of the secondary consumer 0.0014 kcal/day.

Discussion

Scapania irriguia has been found only from two places in Japan, the Daimyojinzawa and the River Yukawa at Hakone Volcano, Kanagawa Prefecture. This is a yellow-green liverwort, 2—3 cm tall, and covers the surface of the rock in the most rapid streams. Negoro (1938) mentioned, "Both the Daimyojinzawa and the Yukawa are the acidic stream, so *Scapania* will be a good index plant of acidic river".

In the Daimyojinzawa *Scapania irriguia* grows only in the area with low pH value and is hardly found in the neutral areas of the Daimyojinzawa and in other neutral area in streams or rivers such as the Dabosugawa, the Nakanosawa, the Sugadaira-gawa and the Kangawa.

It has previously been mentioned that *Chimarrogale platycephala* is a tertiary consumer. The aquatic insects, salamanders and fishes are considered to be the food material of this animal. If the population size of this animal is large, the influence of this animal upon the distribution and abundance of aquatic insects will be very important especially at the place lacking fishes. Unfortunately, the only one capture of this animal has been made so far, and no information of the population size and of behavior in this area is yet obtained, so the role of this animal in this river ecosystem will be the subject for farther investigation.

In addition to *Scapania*, *Protonemura* will be a good index animal of the acidic stream. This insect is distributed widely from the upper-stream to down-stream in the Daimyojinzawa. On the contrary, this species is never found in other neutral streams or rivers. Hirose (1961) also reported that no *Protonemura* was found in the neutral Kangawa. It is apt to be thought that the biomass in the acidic stream increases in proportion to the dilution of acidity. If so, when the pH increases from the upper-stream to down-stream, the biomass should be larger in the down part of the stream, than in the upper-part. The present investigations in the Daimyojinzawa did not support this hypothesis, and the biomass was maximum at the middle part of the stream where the pH 4.2—5.0.

As is shown in the diagram of biomass pyramid (Fig. 8), the most part (99%) of the biomass is occupied by *Scapania*. So, the maximum biomass in the middle part will be based on the maximum growth of *Scapania* which will be closely connected with the optimum pH range of this species.

The investigation of the seasonal change of biomass in the middle areas of the River Koma in Saitama Prefecture (Yoshida, unpublished), evidently shows that the biomass is very small in summer and it increases in autumn, then reaches the maximum in winter. It begins to decrease again in spring. The reason in this case will be explained as follows. The most of aquatic insects become adult from spring to summer and migrate from water to land, consequently, the biomass of the aquatic insects decreases in summer. The adults lay eggs and they become larvae and grow gradually from autumn to winter. In the Daimyojinzawa, however, the biomass did not decrease in summer, but decreased during winter.

The crepancy between the Komagawa and the Daimyojinzawa will be due to the high mortality of larva in winter season in the Daimyojinzawa. However, to make clear this thing, farther study of the life history and life table of each species must be necessary.

As no data about energy efficiency and biotic productivity in other streams or rivers has been known, the comparison to the other streams in Japan can not be made now.

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摘　要

長野県菅平，大明神沢（酸性河川）の生物生産量について1964年春から秋にかけて調査した。生物相として植物3種(*Scapania* ほか2種)・動物23種（カワネズミ・オナシカワゲラほか21種）があげられた。

現存量は季節的に顕著に変化し，秋に最大値となる。現存量・種類組成と pH 値の間にある種の関係が見られる。種類数と現存量は pH 4.0～4.7 の地域で最大となる。

大明神沢の種類数と現存量は他の中性河川よりもかなり少ない。大明神沢における現存量ピラミッドを見ると，生産者（*Scapania*)，一次消費者（草食性水生昆虫）と二次消費者（肉食性水生昆虫）では，おのおのおゝよそ 644 kg，3 kg と 1.5 kg であった。

夏の晴れた1日の大明神沢全域での生産者・一次消費者・二次消費者の純生産量はおのおの 216,654 kcal，0.0098 kcal，0.0014 kcal と推定される。

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