Studies on the Aquatic Insects in the Stream Hoshioki near Sapporo[1)]

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(*With 3 Text-figures and 3 Tables*)

Up to the present numerous surveys on stream insects have been conducted in Japan but mostly confined to the rivers in Honshu, the main island of Japan. At the pioneer stage of these surveys, ecological distribution of animals in streams has mainly been studied. Thereafter an ever increasing practical necessity has promoted the work, especially in connection with fishery and aquatic pollution. The situation has been somewhat different in Hokkaido, where intensive studies of stream insects have long been neglected except for a preliminary work by Kikuchi (1956). Recently several surveys (Tsuda and Tani 1967, Tani 1967, Gose 1967a, b, Tokui and Inoue 1968, Tsuda, Watanabe and Tani 1968) were conducted mainly for the practical purposes mentioned above. These studies contributed much to clarify the stream insect fauna of Hokkaido, but sampling was limited both spatially and temporally, that is, mainly executed at the downstream section affected by human interference and usually only one sampling per year. Besides the obvious necessity of such surveys, it is indispensable to undertake a series of intensive studies at selected stream systems to enrich the lack of basic information on the stream insect assemblages in Hokkaido, as well as to apprehend their life cycles within the stream habitat, such studies, in turn, may facilitate the surveys carried out from practical points of view. As a first attempt along such aims, the present paper deals with the running water insect assemblage in the Stream Hoshioki based upon a survey continued throughout one year.

The stream surveyed: The Stream Hoshioki runs down the northern slope of Mt. Okuteine (924 m alt), west of Sapporo, northeastwards for 5.5 km before entering the Village Hoshioki. Then, across the plain it empties into the Ishikari Bay (Fig. 1A). The survey was confined to the part upstream of the village. Three stations were chosen, one (Station C) at the source, another (St. A) near the village and the third one (St. B) between C and A (Fig. 1B).

1) Stream insect surveys in Hokkaido, I.

Jour. Fac. Sci. Hokkaido Univ. Ser. VI, Zool. 19 (2), 1974.

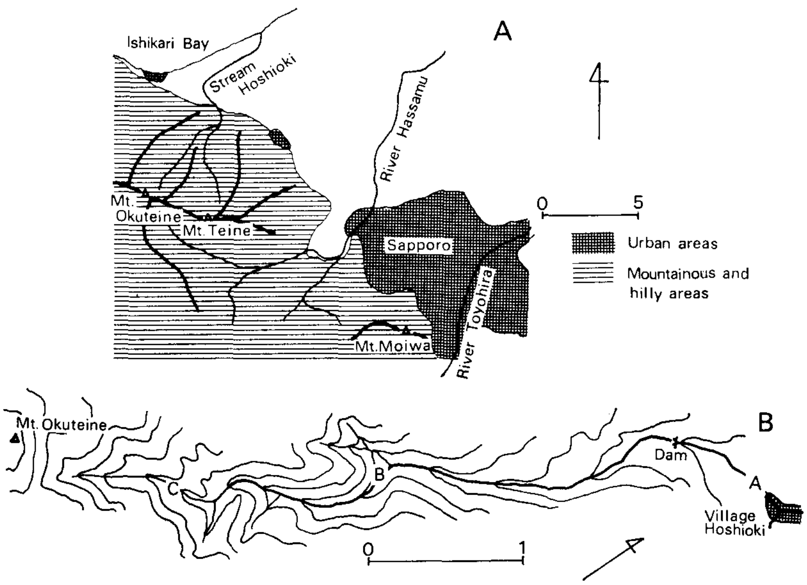

Fig. 1. Location and topography of the stream studied. A: Location of the Stream Hoshioki. B: Position of three stations.

Table 1. Topographical and physical features of three stations (Roman numbers in parentheses show month in which respective conditions were measured).

Station	A	B	C
Stream width	3.7 m (IX), 6.7 m (IV)	3.5 m (IX), 4.5 m (IV)	1.0 m(IX), 1.5 m(IV)
Substrata	pebbles	pebbles	pebbles
Altitude	100 m	320 m	560 m
Inclination	70/1000	100/1000	160/1000
Vegetation passing through	Boundary between Forest and Crop fields	Forest	Forest
Maximum and minimum water temperatures	18.0°C (VIII) 0.3°C (XII)	14.5°C (VIII) 1.7°C (XII)	13.0°C (IX) 0.6°C (XII)

Topographical and physical features of three stations are shown in Table 1. Stream width varies seasonally, being very wide in spring at snow melting, but relatively narrow in winter and late summer. Correspondingly water depth varies very much, only about 10 cm deep at C and A in drought season, while impossible

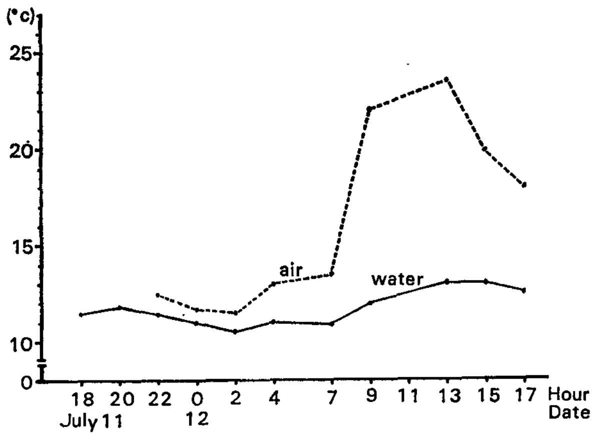

Fig. 2. Daily change of water and air temperatures at Station B on July 11～12.

to cross the stream and to take the samples from the stream center in snow melting season. In winter the snow depth reaches 2～3 m at C and B, completely covering the stream, so that the sampling must be performed after removing snow (February at B and C, April at C). At A snow depth is about one meter and the stream is open throughout winter. The water temperature also varies seasonally, daily and spatially. Fig. 2 shows the daily change of water and air temperatures on July 11～12, 1972 at B. In summer water temperature is the highest at A rising to ca. 18°C, in winter relatively constant, nearly 1°C throughout the daytime in all stations. Except the downstream part with A, the stream passes through the forest area where luxuriant broadleaf trees shade the stream, which is partly replaced by crop fields at and near A. There are no human houses and other installations upstream of the village except for a small dam to arrest erosion between A and B. Few visitors frequent there so that the stream is not polluted throughout the course surveyed.

Method: Sampling sites were selected only at riffle at each station. Due to the limitation of available time, only two samples were collected in each sampling period. Samples were taken monthly except in winter, in which sampling was made only in December (at all stations) and Feburuary (at A and B). In April only one sample was taken at C, and result was shown by duplicating the figures to make the comparison with other data easy. At all stations samples were taken by metal quadrate (50 cm×50 cm) attached with a sieve dustpan (0.4 mm mesh). Standing downstream of the quadrate and holding the sieve with a hand, the collector transferred stones and sand within the quadrate into the vat placed on the shore. Then insects attaching on the stones or hidden in sand were collected together with those entering the sieve until no insect was found. All insects sampled were sorted in laboratory.

Results and discussions

1. Number of species and individuals sampled: Excluding chironomid larvae which were not sorted to the species, in total 13,175 specimens belonging to 82 species were collected as given in the Appendix at the end of the paper. Four major orders, Ephemeroptera, Plecoptera, Trichoptera and Diptera occupy in combination 96.3% (79 species) of total species and 99.7% (13,135 specimens) of total individuals, in the descending order as follows:

Species: Trichoptera (24 spp., 29.3%)>Ephemeroptera (20 spp., 24.4%)> Diptera (19 spp., 23.3%)>Plecoptera (16 spp., 19.5%)>Others (3 spp., 3.6%)

Individuals: Ephemeroptera (6,598, 50.1%)>Diptera (2,777, 21.1%)>Trichoptera (2,707, 20.5%)>Plecoptera (1,053, 8.0%)>Others (40, 0.3%)

1.1. Seasonal change: As seen in Fig. 3, both species and individual numbers remarkably decrease at snow melting, reaching the minimum in April, then rather rapidly recover in May to June. This tendency is common to all stations but conspicuous at B, the middle station. The poverty of both species and individuals in April is caused by spring flood and emergence of some predominant species (*Baetis* sp. A and *Epeorus latifolium*). But it is still unknown how and where some species (*Baetis* sp. A, *Epeorus ikanonis*, *Cinygma* sp. and *Mistrophora inopus*), disappearing or decreasing in April to May and recovering later, pass this flood period. The influence of spring flood due to snow melting must be kept in mind as an important factor governing the annual cycle of stream insects in Hokkaido.

1.2. Up- and downstream differentiation: The number of species is the richest in B (67 spp.) followed by C (60 spp.) and A (59 spp.), A being the poorest throughout the year except April and August. From the distribution of each species given later, the stream seems to be divided into two sections, up- and downstream each represented by C and A. The rich fauna of B is presumably due to its transitional nature, having an intermingling of both up- and downstream species. The order of total individual number is B (50.7%)>A (29.0%)>C (20.3 %). Except snow melting season (April~June) the number in each month is the highest at B. But as seen in Fig. 3, both species and individual abundance in April are A>C>B. A lower decrease at A must relate with a milder inclination and a wider stream which act in combination to decrease the washing down of substrate and stones in spite of the ample amount of water comparing with B. On the other hand, C is less affected than B because of the smaller amount of water, though the inclination is steeper and stream is narrower. Caused by its higher altitude spring flood lasts longer at C for the ample amount of remaining snow, resulting in the recovery of individual number about a month later than A and B.

2. Spatiotemporal distribution and life cycle: Based upon the distribution range, various species sampled are classified into three biotope types in habitat preference:

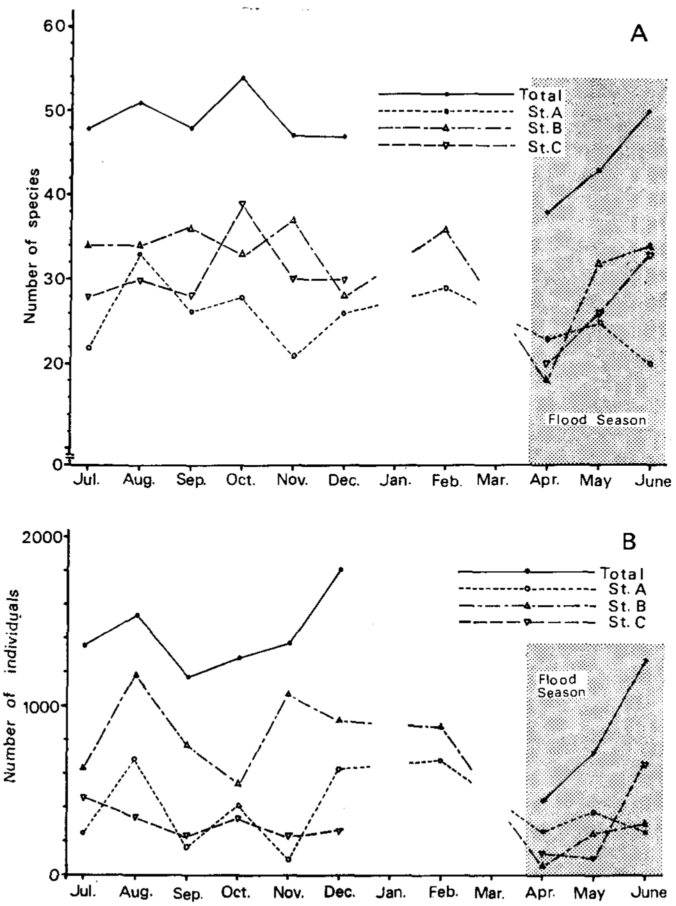

Fig. 3. Seasonal change of number of species and individuals collected from three stations. A: Number of total species in each month (excluding Chironomidae). B: Number of total individuals in each month (number at C in April is shown after duplication).

1. Eurytopic species: Species collected from all three stations without marked difference in abundance. 2. Downstream species: Species collected mostly from A and B (more than 95% of total individuals in combination A and B), rarely or never from C. 3. Upstream species: Species collected mostly from C and B (more than 95%), rarely or never from A.

Furthermore, the species are classified into three phenologic types according to the seasonal predominance (seasons are divided as follows: Spring. April to June; Summer. July to August; Autumn. September to November; Winter. December to March):

Table 2. Spatiotemporal classification of 42 relatively abundant species and biotope types of 26 species.

Phenological type / Biotope type	A. All seasons (26 spp.)	B. Winter (12 spp.)	C. Summer (4 spp.)	Uncertain (26 spp.)
1. Eurytopic (35 spp.)	(13 spp.) *Paraleptophlebia* sp. **Baetis* sp. A **Epeorus latifolium* *Amphinemura* sp. *Isogenus scriptus* *Kamimuria* sp. *Rhyacophila* sp. 5 **Mistrophora inopus* *Stenopsyche griseipennis* **Hydropsyche ulmeri* *Neophylax ussuriensis* *Dinarthrodes* sp. *Simulium japonicum*	(5 spp.) *Epeorus ikanonis* *Cinygma* sp. *Paraleuctra* sp. *Rhyacophila* sp. 2 *Bibiocephala* sp. A	(2 spp.) *Ephemerella yoshinoensis* *Simulium* sp. 2	(14 spp.) *Ephemera japonica* *Baetis* sp. F *Baetiella* sp. A *Isopera* sp. 1 Perlodidae sp. 2 Perlidae sp. 2 *Alloperla* sp. A *Rhyacophila* sp. 1 *Rhyacophila* sp. 7 *Polycentropus* sp. 2 *Prosimulium yezoense* *Antocha* sp. 1 *Antocha* sp. 2 *Antocha* sp. 3
2. Downstream (15 spp.)	(6 spp.) *Ephemerella* sp. A **Baetiella* sp. B *Epeorus uenoi* *Rhithrogena japonica* *Rhyacophila* sp. RC *Rhyacophila* sp. 4	(4 spp.) *Ephemerella trispina* *Rhabdiopteryx* sp. *Arctopsyche* sp. A *Prosimulium jezonicum*	(1 sp.) *Hydropsychodes* sp.	(4 spp.) *Baetis* sp. E Perlodidae sp. 1 *Goera japonica* *Protohermes* sp.
3. Upstream (19 spp.)	(7 spp.) *Ephemerella basalis* *Ephemerella* sp. nN *Protonemura* sp. *Megarcys* sp. *Isoperla* sp. 2 *Rhyacophila articulata* ***Epiophlebia superstes*	(3 spp.) Hydroptilidae sp. *Arctopsyche* sp. B *Philorus ezoensis*	(1 sp.) *Dolophilodes* sp.	(8 spp.) *Baetis* sp. C *Nemoura* sp. *Rhyacophila* sp. 3 Limophilinae sp. *Leptocerus* sp. *Holorusia* sp. HA *Pericoma* sp. *Elmis* sp.

*Bivoltine species. **Species requiring more than one year to complete the life cycle.

Table 3. Life cycles of representative species. Italicized data are those still not clear.

Species	Spatio-temporal type	Generation per year	Phenology of young nymphs or larvae	Phenology of older nymphs or larvae	Emergence period
Ephemeroptera					
Ephemerella basalis	A–3	1	Sep.~Oct.	May~Jul.	June~Jul.
E. yoshinoensis	C–1	1	June	Aug.~Sep.	Aug.~Sep.
E. trispina	B–2	1	Feb.~Apr.	Jul.	Jul.
E. sp. nN	A–3	1	Aug.~Sep.	June~Jul.	June~Jul.
E. sp. A	A–2	1	Aug.~Sep.	Apr.~June	May~June
Paraleptophlebia sp.	A–1	1	Oct.~Nov.	May~June	May~June
Baetis sp. A	A–1	2	Jul.~Aug. and Dec.~Apr.	*All seasons*	*Apr.~Nov.*
Baetiella sp. B	A–2	*2*	Nov.~Dec. and May~June	Feb.~Sep.	*Apr.~Sep.*
Epeorus uenoi	A–2	1	Oct.~Dec.	Jul.~Aug.	Aug.~Sep.
E. latifolium	A–1	2	Sep.~Oct. and May	Feb.~May and Jul.~Aug.	Apr.~May and Jul.~Aug.
E. ikanonis	B–1	1	Dec.~Feb.	May~Jul.	May~Jul.
Rhithrogena japonica	A–2	1	Oct.~Nov.	Jul.~Aug.	Jul.~Aug.
Cinygma sp.	B–1	1	Nov.~Dec.	May~Jul.	May~Jul.
Plecoptera					
Protonemura sp.	A–3	1	*Jul.~Aug.*	*Apr.~Jul.*	*Apr.~Jul.*
Amphinemura sp.	A–1	1	*Aug.~Nov.*	*Feb.~June*	*Apr.~Jul.*
Paraleuctra sp.	B–1	1	Oct.	Dec.~Apr.	Apr.
Rhabdiopteryx sp.	B–2	1	Dec.	Apr.	Apr.
Megarcys sp.	A–3	1	June~Jul.	May	May
Isogenus scriptus	A–1	1	May~Aug.	Dec.~Apr.	Apr.
Isoperla sp. 2	A–3	1	Sep.~Nov.	June~Jul.	Jul.
Kamimuria sp.	A–1	*1*	June~Oct.	June~Sep.	June~Sep.
Trichoptera					
Rhyacophila sp. RC	A–2	1	Aug.	Feb.~June	Apr.~June
R. articulata	A–3	1	Aug.~Sep.	June~Jul.	June~Jul.
R. sp. 2	B–1	1	Feb.~May	June	June~Jul.
R. sp. 4	A–2	1	Dec.~May	Jul.~Nov.	*Aug.~Nov.*
R. sp. 5	A–1	1	Aug.~Sep.	May~June	May~June
Mistrophora inopus	A–1	2	Jul.~Aug. and Nov.	Aug.~Sep. and Feb.~Apr.	Sep.~Oct. and Apr.~May
Hydroptilidae sp.	B–3	1	Oct.	Dec.~Apr.	Apr.~May
Dolophilodes sp.	C–3	1	June	Sep.~Nov.	Oct.~Nov.
Stenopsyche griseipennis	A–1	1	Aug.~Sep.	June~Jul.	June~Jul.
Arctopsyche sp. A	B–2	1	Aug.	Feb.~Apr.	Apr.
A. sp. B	B–3	1	Aug.	Apr.~May	Apr.~May
Hydropsychodes sp.	C–2	1	*May~June*	Sep.~Oct.	Sep.~Oct.
Hydropsyche ulmeri	A–1	*2*	Aug.~and Dec.	*All seasons*	May~Oct.
Neophylax ussuriensis	A–1	*1*	Sep.~Dec.	June~Nov.	June~Nov.
Dinarthrodes sp.	A–1	1	Jul.~Nov.	Feb.~June	May~Jul.
Diptera					
Bibiocephala sp. A	B–1	1	Apr.~May	June~Jul.	June~Jul.
Philorus ezoensis	B–3	1	June~Aug.	Nov.~Apr.	Apr.
Prosimulium jezonicum	B–2	1	Nov.~Dec.	Apr.~May	Apr.~May
Simulium japonicum	A–1	2	Jul.~Aug. and Sep.~Dec.	June~Jul. and Sep.	June~Jul. and Sep.
S. sp. 2	C–1	1	Apr.~May	Aug.~Oct.	Aug.~Oct.

A. All seasons species: Species more or less collected throughout the year without marked concentration in particular seasons. B. Winter species: Species collected throughout winter, including those appearing from late summer to early spring and winter to early summer. C. Summer species: Species collected throughout the summer, including those from late winter to summer.

The biotope types were clarified in 69 species. About one half of the species belongs to type 1 and the rest to type 2 and 3, each with about equal number. The prevalence of type 1 is reasonable in such a short small stream as the Hoshioki, where the distance between St. A and C is only ca. 3.5 km in staight course, and substrata do not markedly differ at both stations. Concerning phenologic types clarified in 42 species, type A occupies about 60% but C less than 10%. The poverty of type C is explained by the short summer season in Hokkaido, which makes the growth during the season difficult. Furthermore, the youngest stage may be unsuitable to pass the flood season lasting about three months, so that eggs must hatch out either after this season or enough before, to attain a fairly grown stage at the flood time. *Ephemerella yoshinoensis* adopts the latter way, passing the flood period among or under the stones. To take the former way, adults must be active under the cold weather of autumn as in *Dolophilodes* sp., or immature stages must be short as in summer generation of bivoltine species. In general body size of full-grown immatures in type C species and bivoltine species is smaller than those of type A and B with similar life forms. On the other hand, type B species live in very stable environment though the water temperature in winter is low. In contrast to type C, the species of type A including all bivoltine ones have a longer emergence period and shorter egg stage.

Table 2 shows the classification of 42 species by combining two systems explained above and biotope types of 26 species whose phenologic types are still unknown. Among them type A_1 is the richest in the species number, followed by A_3 and A_2, while C_2 and C_3 are the poorest. However the classification is still tentative. According to further accumulation of information, some species would be placed in a type different from that mentioned in the table. For instance, *Simulium japonicum* is placed in eurytopic type, but 95.7% of specimens were collected from B while only 2.8% and 1.5% respectively from A and C, which suggests the presence of a habitat preference for B.

Life cycles of 41 species collected rather abundantly are summarized in Table 3. Adult emergence period was assumed from the disappearence of older nymphs or pupae. *Baetis* sp. A, *Epeorus latifolium, Mistrophora inopus, Simulium japonicum* and *Baetiella* sp. B, *Hydropsyche ulmeri* may be bivoltine, while *Epiophlebia superstes* requires several years to complete the life cycle. Most other species are regarded as umivoltine.

3. *Relative abundance*: Dominant species, that is, percentage ratios of individuals are higher than the reciprocal of total species number multiplied by 100, are 17 species, *Baetis* sp. A (23.8%), *Simulium japonicum* (11.2%), *Cinygma* sp. (5.8%), *Mistrophora inopus* (5.2%), *Epeorus latifolium* (4.5%), *Hydropsyche ulmeri* (3.7%),

Baetiells sp. B (2.8%), *Epeorus ikanonis* (2.5%), *Ephemerella* sp. A (2.%), *Epeorus uenoi* (1.9%), *Ephemerella trispina* (1.7%), *Kamimuria* sp. (1.7%), *Protonemura* sp. (1.7%), *Stenopsyche griseipennis* (1.6%), *Ephemerella yoshinoensis* (1.5%), *Prosimulium jezonicum* (1.3%) and *Dinarthrodes* sp. (1.3%). The sum of the individuals of these species occupies 74.2% of total individual number. All six bivoltine species are included within these dominant species, occupying higher ranks (1, 2, 4, 5, 6).

3.1. Difference of faunal makeup among stations: The number of dominant species at each station is 14 (A), 12 (B) and 12 (C). Six species of these are common to all stations including four bivoltine species, two common to both A and C, and one common to C and B. The species predominant at only one station are 6 at A, 5 at B and 3 at C. The biotope type of these species are shown as follows:

Biotope type \ Stations	A	B	C
1	2	2	–
2	4	3	–
3	–	–	3

Station A is characterized by four species of type 2 (*Ephemerella trispina, Ephemerella* sp. A, *Rhabdiopteryx* sp., *Rhyacophila* sp. RC) and Station C by three of type 3 (*Baetiella* sp. B, *Epeorus uenoi, Prosimulium jezonicum*). More than 80% of individuals of three species belonging to type 2 (*Dolophilodes* sp., *Arctopsyche* sp. B, *Megarcys* sp.) were sampled at B. These species are, together with *Simulium japonicum,* considered as characteristic to B, differing from four species of type 2 mentioned above, about 60% of which were sampled at A. *Baetis* sp. A was the top ranked species at all stations, occupying respectively 20.3% (A), 25.7% (B), 24.3% (C) of total individuals. From the fact mentioned above, composition of dominant species is relatively similar among stations with mild transition from A to C.

3.2. Seasonal change: *Baetis* sp. A occupies the top rank except August, November and April. Even in these months it remains as the third ranked, replaced by *Simulium japonicum* (August and November) and *Ephemerella trispina* (April). Summarizing, the insect assemblage of the Stream Hoshioki is characterized by the following combination of predominant species (species is given in the descending order of relative abundance in each spatiotemporal combination).

	A	B	C
Summer	*Baetis* sp. A	*Simulium japonicum*	*Baetis* sp. A
	Mistrophora inopus	*Baetis* sp. A	*Dolophilodes* sp.
	Stenopsyche griseipennis	*Mistrophora inopus*	*Protonemura* sp.

Autumn	*Baetis* sp. A	*Baetis* sp. A	*Dolophilodes* sp.
	Hydropsyche ulmeri	*Hydropsyche ulmeri*	*Baetis* sp. A
	Epeorus latifolium	*Baetiella* sp. B	*Mistrophora inopus*
Winter	*Baetis* sp. A	*Simulium japonicum*	*Cinygma* sp.
	Cinygma sp.	*Baetis* sp. A	*Baetis* sp. A
	Ephemerella sp. A	*Cinygma* sp.	*Protonemura* sp.
Spring	*Ephemerella trispina*	*Baetis* sp. A	*Baetis* sp. A
	Baetis sp. A	*Cinygma* sp.	*Cinygma* sp.
	Epeorus latifolium	*Neophylax ussuriensis*	*Ephemerella yoshinoensis*

Finally, the results obtained in Hoshioki are briefly compared with those in the Stream Yokoshibetsu at a suburb of Sapporo studied by Kikuchi (1956) from May to October. The total species in Yokoshibetsu is 79, belonging to nine orders, nearly same to Hoshioki in the same period. In both streams four orders, Ephemeroptera, Plecoptera, Trichoptera and Diptera occupy most of specimens (86.1% in Yokoshibetsu, 96.2% in Hoshioki). But in the former Trichoptera (35.5% against 29.3%) and other orders (13.9% against 3.8%) are richer than the latter, while Ephemeroptera (17.7% against 24.4%) and Plecoptera (11.4% againsg 19.5%) are poorer. The species accurately determined to be common to both streams are 34, which occupy 43.0% of total species numbers of both streams. As to the spatial differentiation, the surveyed section of Hoshioki is camparable to "the main brook section" of Yokoshibetsu.

Aknowledgement

The author wishes to express his cordial thanks to Dr. Shôichi F. Sakagami for his valuable guidance and Professor Mayumi Yamada for his reading through the manuscript. Furthermore, he is also indebted to Professor Matsunae Tsuda, Dr. Teiji Kawai and Mr. Kozo Tani, Nara Womens University, and Dr. Kiichi Uemoto, Sakyo Public Health Center in Kyoto, for the identification of species collected.

Summary

1) The faunal makeup, distribution and life cycles of insect assemblage in the Stream Hoshioki were studied from July 1971 to June 1972 by monthly sampling at three stations.

2) In total 82 species belonging to seven orders were collected, Ephemeroptera, Plecoptera, Trichoptera and Diptera occupy in combination more than 95% of total individual number.

3) Distribution and life cycles of 42 species were summarized. Most species are seemingly univoltine but *Baetis* sp. A, *Epeorus latifolium*, *Mistrophora inopus*, *Simulium japonicum*, *Baetiella* sp. B and *Hydropsyche ulmeri* are bivoltine and *Epiophlebia superstes* requires more than one year to complete the life cycle.

4) Predominant species are *Baetis* sp. A (23.8%), *Simulium japonicum* (11.2%), *Cinygma* sp. (5.8%), *Mistrophora inopus* (5.2%), *Epeorus latifolium* (4.5%), *Hydropsyche ulmeri* (3.7%), *Baetiella* sp. B (2.8%), *Epeorus ikanonis* (2.5%), *Ephemerella* sp. A (2.0%), *Epeorus uenoi* (1.9%), *Ephemerella trispina* (1.7%), *Kamimuria* sp. (1.7%), *Protonemura* sp. (1.7%), *Stenopsyche griseipennis* (1.6%), *Ephemerella yoshinoensis* (1.6%), *Prosimulium jezonicum* (1.3%) and *Dinarthrodes* sp. (1.3%), which occupy in combination 74.2% of total individual number.

5) Concerning the faunal makeup, no fundamental difference was observed along the section surveyed, whereas the seasonal change was more distinct and especially the influence of spring flooding due to snow melting seems very important.

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Appendix: List of species collected.

In each taxon, the number of sampled individuals in given by the combination of four figures, Total=sampled at A B C, followed by the number at each station and in each month in parentheses. The numbers of two samples are separated by a bar.

Order **Ephemeroptera** (6598=2250+3165+1183). **A.** VII(74/101), VIII(198/131), IX(12/34), X(143/51), XI(10/42), XII(122/133), II(187/300), IV(129/70), V(170/122), VI(105/116). **B.** VII(232/122), VIII(122/251), IX(277/193), X(148/147), XI(239/113), XII(176/188), II(380/237), IV(1/11), V(65/49), VI(142/72). **C.** VII(145/177), VIII(42/8), IX(31/24), X(72/37), XI(52/24), XII(78/79), IV(25), V(21/9), VI(154/205).

Ephemera japonica McLachlam (32=10+13+9). **A.** VII(4), IX(1), XII(1), II(2), V(1), VI(1). **B.** VII(1/1), VIII(1), IX(2/2), XI(5), II(1). **C.** VIII(2), X(5), V(1), VI(1).

Ephemerella basalis Imanishi (86=3+49+34). **A.** IX(1), XI(1), XII(1). **B.** IX(1/4), X(2/2), XI(7/3), II(6/6), V(3), VI(5/1). **C.** VII(4), X(4), XI(5/1), XII(1/6), V(2), VI(5/6).

Ephemerella yoshinoensis (203=94+44+65). **A.** VII(13/29), VIII(9/10), VI(17/16). **B.** VII(21/2), VIII(5/5), IX(1), VI(7/3). **C.** VII(1), VIII(7/3), IX(5/1), VI(13/35).

Ephemerella trispina Ueno (230=189+40+1). **A.** VII (9/10), II(4/6), IV(45/24), V(16/13), VI(24/38). **B.** VII(6/5), II(8/15), IV(1), V(3), VI(2). **C.** XII(1).

Ephemerella sp. nN (35=0+2+33). **B.** IX(2). **C.** VII(1/3), VIII(3), IX(1), X(4/9), XI(1), XII(3), V(1), VI(2/5).

Ephemerella sp. A (259=188+71+0). **A.** VII(6/7), VIII(12/9), IX(1/2), X(30/8), XI(4/2), XII(17/17), II(35/17), IV(7/1), V(1/3), VI(3/6). **B.** VII(3/1), VIII(4), IX(2/1), X(9/3), XI(3), XII(5/21), II(10/3), V(1/2), VI(1/2).

Ephemerella spp. (2=0+2+0). **B.** XI (2).

Caenis sp. (1=1+0+0). **A.** V(1).

Paraleptophlebia sp. (155=98+40+17). **A.** IX(2), X(3/7), XI(6), XII(3/9), II(3/2), IV(8/11), V (21/12), VI(9/2). **B.** VIII(1), X(2/1), XI(8/7), XII(5/3), II(6/4), V(2), VI(1), **C.** VIII(1), X(4/1), XI(1), XII(1/3), IV(1), V(2/1), VI(1/1).

Baetis sp. A (3140=776+1713+651). **A.** VII(11/8), VIII(149/91), IX(4/21), X(67/8), XI(1/8), XII(48/44), II(80/111), IV(26/15), V(57/17), VI(3/7). **B.** VII(96/38), VIII (70/169), IX(162/139), X(93/122), XI(149/76), XII(76/110), II(177/51), V(15/17), VI(100/53). **C.** VII(96/130), VIII(24/3), IX(20/11), X(30/21), XI(17/10), XII(18/33), IV(3), VI(111/124).

Baetis sp. C (64=0+57+7). **B.** VII(30/6), VIII(1), IX(1), XI(1/3), XII(1), II(1/4), V(1/1), VI(5/2). **C.** VII(5/2).

Baetis sp. E (10=6+4+0). **A.** VIII(3/2), IX(1). **B.** II(1), V(1), VI(1/1).

Baetis sp. F (6=1+4+1). **A.** V(1). **B.** IV(1), V(3). **C.** XII(1).

Baetiella sp. A (19=5+2+12). **A.** VII(1), X(4). **B.** X(1), XI(1). **C.** VII(4/1), IX(1), X(6).

Baetiella sp. B (371=43+316+12). **A.** VII(10/15), VIII(4/6), IX(1/2), X(1), VI(2/1). **B.** VII(15/23), VIII(13/32), IX(95/24), X(13/8), XI(10/8), XII(31/11), II(23/1), V(1), VI(5/3). **C.** VII(4/3), X(2), XI(1), VI(2).

Epeorus uenoi Matsumura (245=37+202+6). **A.** VII(1/3), VIII(7/13), X(6), V(1), VI(5/1). **B.** VII(36/39), VIII(30/24), IX(3/8), X(16/4), XI(17/1), XII(6/2), II(4), VI(11/1). **C.** VII(2), VIII(1), IX(1), X(1), XI(1).

Epeorus latifolium Ueno (598=266+253+79). **A.** VII(28/28), VIII(12), IX(2/8), X (18/27), XI(2/5), XII(7/17), II(8/12), IV(2/1), V(5/13), VI(38/43). **B.** VII(22/5), VIII(15), IX(5/13), X(13/6), XI(9/10), XII(26/14), II(32/52), IV(1), V(17/6), VI(2/5). **C.** VII(3/7), VIII(5/1), IX(6/8), X(10/6), XI(8/6), XII(4/7), IV(3), V(2), VI(1/2).

Epeorus ikanonis Takahashi (324=115+135+74). **A.** VIII(1), II(6/22), IV(17/4), V (25/39), VI(1). **B.** VII(1), VIII(1/1), IX(3/2), II(63/51), IV(4), V(1/6), VI(2). **C.** VII (22/20), IX(1), IV(6), V(7/3), VI(5/10).

Ecdyonurus sp. (1=0+1+0). **B.** VII(1).

Rhithrogena japonica Ueno (52=44+8+0). **A.** VII(1/1), VIII(1), X(14/1), XI(1/3), XII(1/4), II(5/8), VI(3/1). **B.** VII(2), VIII(1), XI(4), VI(1).

Cinygma sp. (765=374+209+182). **A.** XI(2/17), XII(44/41), II(46/120), IV(23/14), V(44/23). **B.** XI(28/1), XII(19/24), II(46/52), IV(1/4), VI(21/13). **C.** VII(7/7), X(6), XI (21/4), XII(52/27), IV(12), V(8/3), VI(15/20).

Order **Plecoptera** (1053=281+428+344). **A.** VII(4), VIII(22/19), IX(6/11), X(27/17), XI(2/10), XII(28/19), II(37/47), IV(8/9), V(12/2), VI(1). **B.** VII(42/17), VIII(39/46),

IX(27/19), X(27/17), XI(22/12), XII(23/34), II(35/8), IV(12/5), V(9/10), VI(14/10). **C.** VII(26/24), VIII(54/17), IX(15/15), X(13/17), XI(19/13), XII(20/28), IV(4), V(2/9), VI(39/29).

Protonemura sp. (225=4+123+98). **A.** VIII(2), V(1/1). **B.** VII(12/3), VIII(23/25), IX(7/2), X(2), XI(5/1), XII(6/13), II(15), IV(1/1), V(1), VI(5/1). **C.** VII(10/8), VIII(33/12), IX(1/1), X(3), XI(2), XII(11/4), V(1), VI(12).

Nemoura sp. (36=1+12+23). **A.** IV(1). **B.** VI(1/1), IV(10). **C.** VII(2/3), X(1), XI(1/1), XII(3/3), V(1), VI(8).

Amphinemura sp. (134=54+46+34). **A.** X(1/1), XI(4), XII(12/4), II(7/5), IV(5/6), V(9). **B.** IX(3), XI(3/1), XII(7/6), II(4/6), IV(3), V/(6/4), VI(2/1). **C.** VII(7/6), VIII(1), IX(1), X(1/4), XI(1), XII(1), IV(1), V(1), VI(4/6).

Rhabdiopteryx sp. (92=73+19+0). **A.** XII(6/8), II(21/37), IV(1). **B.** XI(1), XII(3/3), II(12).

Plecoptera sp. (61=18+21+22). **A.** X(2), XI(2/3), XII(9/1), II(1). **B.** X(6/5), XI(4/4), XII(1/1). **C.** VIII(1), X(1), XI(5/2), XII(2/8), IV(2), VI(1).

Megarcys sp. (74=0+2+72). **B.** VIII(1), V(1). **C.** VII(4/5), VIII(7/1), IX(6/2), X(1/1), XI(2), XII(2/3), V(1/2), VI(13/22).

Isogenus scriptus Klapalek (32=14+11+7). **A.** VIII(3), IX(1/1), X(7), II(1/1). **B.** VIII(4), X(1), XI(1), II(1/2), IV(1), V(1). **C.** X(1), XI(1), XII(2), V(3).

Isoperla sp. 1 (13=8+3+2). **A.** II(6/1), V(1). **B.** II(3). **C.** V(2).

Isoperla sp. 2 (19=0+0+19). **C.** VII(1/1), IX(2), X(1/1), XI(4/1), XII(1/6), VI(1).

Perlodidae sp. 1 (33=28+5+0). **A.** IX(4/2), X(11/5), XI(2), XII(3), II(1). **B.** X(3), XII(2).

Perlodidae sp. 2 (16=6+0+10). **A.** VIII(6). **C.** VIII(3), X(7).

Perlodidae sp. 4 (5=0+1+4). **B.** IX(1), **C.** VIII(4).

Perlodidae spp. (6=0+3+3). **B.** X(1), XI(2). **C.** VIII(1), X(1), XII(1).

Kamimuria sp. (228=55+146+27). **A.** VII(4), VIII(13/10), IX(7), X(15/2), XII(1/1), II(1/1). **B.** VII(21/9), VIII(15/15), IX(18/12), X(14/10), XI(6/4), XII(6/8), V(1), VI(4/3). **C.** VII(2/1), VIII(5/1), IX(4/7), X(3/1), XI(1/1), VI(1).

Perlidae sp. 2 (11=1+8+2). **A.** VIII(1). **B.** VII(3/3), IX(1), X(1). **C.** VIII(1), IV(1).

Alloperla sp. A (66=18+27+21). **A.** VIII(1/5), IX(1/1), XI(1), XII(2), II(1), IV(1/2), V(1/1), VI(1). **B.** VII(6/2), VIII(2), IX(1/1), X(1), XII(1), IV(1), V(5), VI(2/5). **C.** VIII(1), IX(4/2), X(3), XI(3/7), XII(1).

Alloperla sp. B (2=1+1+0). **A.** IV(1). **B.** VI(1).

Order **Trichoptera** (2707=778+1183+746). **A.** VII(12/38), VIII(166/125), IX(39/57), X(106/54), XI(10/7), XII(15/22), II(25/21), IV(11/4), V(16/20), VI(16/14). **B.** VII(93/50), VIII(58/169), IX(110/59), X(87/58), XI(75/66), XII(18/31), II(65/95), IV(1/11), V(56/30), VI(37/23). **C.** VII(43/18), VIII(123/65), IX(68/41), X(98/62), XI(59/33), XII(11/20), IV(27), V(11/13), VI(35/19).

Rhyacophila sp. RC (122=64+58+0). **A.** VIII(26/24), IX(2/3), X(2/5), II(2). **B.** VII(6/7), VIII(5/4), IX(7/4), X(5/2), XI(2/2), XII(3/1), II(5), IV(1), VI(2/2).

Rhyacophila articulata (41=0+0+41). **C.** VII(6/4), VIII(2/2), IX(3/1), X(3/2), XII(2/2), IV(1), V(1), VI(9/3).

Rhyacophila sp. 1 (24=4+14+6). **A.** VII(1), VIII(1), X(1), VI(1). **B.** VII(3/1), VIII(2), IX(2/3), X(1), V(2). **C.** IX(1), V(1/1), VI(2/1).

Rhyacophila sp. 2 (53=17+16+20). **A.** II(5/4), IV(1), V(1/4), VI(1/1). **B.** II(2), V(6/7), VI(1). **C.** V(2/1), VI(8/9).

Rhyacophila sp. 3 (13=1+6+6). **A.** VII (1). **B.** VII(1), VIII(1/1), IX(1/1), VI

(1). C. VII(2), VIII(2/1), VI(1).

Rhyacophila sp. 4 (83=32+51+0). A. VII(3), X(16/5), XI(1), XII(2/1), II(1), V(3). B. VII(6/4), VIII(2), IX(7/5), X(3/2), XI(6/2), XII(1/6), II(4/1), V(1), VI(1).

Rhyacophila sp. 5 (62=36+15+11). A. VIII(10), IX(3/2), X(5/4), XI(1), XII(3/4), II(3), VI(1). B. IX(7/2), X(1/1), XII(1), II(1/1), V(1). C. IX(1), X(3), IV(2), V(1), VI (4).

Rhyacophila sp. 6 (1=0+1+0). B. VII(1).

Rhyacophila sp. 7 (17=7+3+7). A. VIII(1), IX(2/1), X(1), XI(1), VI(1). B. IX(2), XI(1). C. X(4/2), XII(1).

Rhyacophila spp. (7=3+2+2). A. VII(1), IX(1/1). B. X(2). C. VIII(1), X(1).

Mistrophora inopus Tsuda (686=202+392+92). A. VII(8), VIII(83/33), IX(3/9), X(22/5), XI(1/3), XII(3/6), II(12/12), IV(1), VI(1). B. VII(4/2), VIII(27/81), IX(2/3), X(38/13), XI(44/29), XII(4/12), II(25/73), IV(6), V(19/10). C. VIII(9), IX(15/4), X(5/5), XI (22/4), XII(2/1), IV(15), V(4/6).

Hydroptilidae sp. (14=0+8+6). B. X(4), XI(2), II(2). C. IX(1/1), X(1), XI(1), XII(1), IV(1).

Stenopsyche griseipennis McLachlan (205=117+72+16). A. VII(2), VIII(32/38), IX (8/10), X(10/7), XI(1), XII(4/3), II(1/1). B. VII(9/1), VIII(2/15), IX(17/5), X(3/10), XI (1), XII(5), II(2), V(1), VI(1). C. VIII(1), IX(1/4), X(2/3), XI(3/2).

Dolophilodes sp. (357=0+77+280). B. VII(13/7), VIII(5/9), IX(1/3), X(1), XI(2), VI(23/13). C. VII(34/10), VIII(62/32), IX(27/13), X(41/9), XI(22/20), XII(1), V(1), VI(8).

Polycentropus sp. 2 (6=4+0+2). A. VII(3), VIII(1). C. IX(1), IV(1).

Arctopsyche sp. A (40=8+32+0). A. VIII(1/5), IX(1), X(1). B. VIII(4/17), IX (6/2), X(1), XI(1), II(1).

Arctopsyche sp. B (114=0+1+113). B. VIII(1). C. VIII(43/18), IX(8/7), X(18/10), XI(2/2), XII(2/2), V(1).

Hydropsychodes sp. (18=18+0+0). A. IX(6/5), X(3/4).

Hydropsyche ulmeri Tsuda (492=153+294+45). A. VII(17), VIII(10/23), IX(14/22), X(40/11), XI(4/1), XII(2/2), II(2), V(4/1). B. VII(35/26), VIII(13/23), IX(56/28), X(26/17), XI(14/19), XII(8/3), II(7/4), V(2/1), VI(9/3). C. VII(2), VIII(4/9), IX(9/2), X(6), XI (1/2), XII(1), IV(1), V(2/2), VI(2/2).

Neophylax ussuriensis (159=43+89+27). A. VII(5/4), VIII(2), IX(1), X(6), XI(1), XII(1), II(1), IV(1), V(4/5), VI(9/3). B. VII(13/1), VIII(14), IX(2), XI(4), II(3/14), IV(1), V(25/9), VI(1/2). C. IX(1), X(7/1), XI(5/3), XII(1/6), IV(3).

Limnophilinae sp. (4=0+0+4). C. II(1), VI(1/2).

Goera japonica Banks (2=2+0+0). A. VIII(1), IX(1).

Brachycentrus sp. (1=0+1+0). B. VII(1).

Dinarthrodes sp. (170=67+44+59). A. VII(1/4), IX(1), X(7/5), XI(1/2), XII(1/5), II(1/1), IV(9/3), V(7/7), VI(4/8). B. IX(1/1), X(4/10), XI(3/7), XII(1/4), II(4/2), IV(1/3), V(1/1), VI(1). C. VII(1/2), VIII(1), IX(6), X(3/30), XI(3), XII(2/7), IV(2), V(1), VI(1).

Leptocerus sp. (16=0+7+9). B. VII(2), VIII(1), IX(1), X(1), XI(1/1). C. VIII(1), IX(2/2), X(3), VI(1).

Order **Diptera** (2777=513+1873+391). A. VII(8/19), VIII(15/17), IX(2/8), X(7/3), XI(4/2), XII(155/133), II(34/31), IV(15/17), V(13/24), VI(4/2). B. VII(44/36), VIII(419/72), IX(39/49), X(45/9), XI(217/321), XII(337/115), II(60/8), IV(5/6), V(12/19), VI(47/13). C. VII(22/8), VIII(23/8), IX(18/14), X(22/12), XI(14/10), XII(17/8), IV(6), V(13/23), VI(92/81).

Bibiocephala sp. A (35=15+6+14). A. V(3/11), VI(1). B. VII(2), V(1/1), VI(1/1). C. VII(2), V(2/10).

Bibiocephala sp. B (3=0+3+0). **B**. II(3).
Philorus ezoensis Kitakami (27=0+24+3). **B**. VIII(1), X(15), XI(2/1), XII(3), II(1), VI(1). **C**. XII(3).
Prosimulium jezonicum Matsumura (173=18+155+0). **A**. XI(3), XII(2/1), II(3/5), IV(1/3). **B**. XI(20/31), XII(65/14), II(21/2), IV(2).
Prosimulium yezoense Shiraki (11=3+7+1). **A**. IV(1), V(2). **B**. VII(2/2), IV(1), V(1), VI(1). **C**. VII(1).
Simulium japonicum Matsumura (1476=41+1412+23). **A**. VIII(3/1), X(2), XII(27), II(1), IV(1/4), V(2). **B**. VII(2/9), VIII(404/40), IX(13/37), X(22/7), XI(186/283), XII(265/97), II(28/4), IV(2), V(2), VI(9/2). **C**. VII(4), VIII(1), XI(1), XII(3), V(1), VI(1/12).
Simulium sp. 2 (107=6+66+35). **A**. VIII(1), IX(2/1), X(1), IV(1). **B**. VII(7/8), VIII(4/12), IX(5/2), V(2/2), VI(20/4). **C**. VII(6/3), VIII(10/1), IX(3), X(1), V(1), VI(7/3).
Antocha sp. 1 (52=12+21+19). **A**. VII(3), VIII(2), X(1/1), XI(1), XII(2), II(1), V(1). **B**. VII(4/1), IX(4), X(1/1), XI(5/1), II(1), V(2), VI(1). **C**. VII(4/1), IV(C), V(1), VI(5/5).
Antocha sp. 2 (31=4+7+20). **A**. VIII(3), IV(1). **B**. VIII(1), IX(1), X(1), II(1), IV(3). **C**. VIII(1), IX(2/1), X(4/4), XI(1), XII(1/1), VI(3/2).
Antocha sp. 3 (9=4+0+5). **A**. IX(4). **C**. X(4), XI(1).
Antocha sp. 4 (1=1+0+0). **A**. VIII(1).
Antocha sp. 5 (1=0+0+1). **C**. X(1).
Tipula sp. TA (8=5+2+1). **A**. XII(1/2), V(2). **B**. VIII(1), XII(1). **C**. VIII(1).
Holorusia sp. HA (13=0+0+13). **C**. X(6), XI(2), XII(5).
Pericoma sp. (4=0+0+4). **C**. X(2), XII(2).
Psychoda sp. (1=0+1+0). **B**. VII(1).
Chironomidae (819=401+167+251). **A**. VII(5/19), VIII(9/11), IX(3), X(4/1), XI(2), XII(123/130), II(31/24), IV(11/8), V(8/7), VI(3/2). **B**. VII(29/13), VIII(10/17), IX(17/9), X(6/1), XI(3/5), XII(7), II(5/2), IV(2/1), V(7/13), VI(15/5). **C**. VII(5/4), VIII(10/7), IX (16/10), X(12), XI(10/9), XII(8/2), IV(3), V(9/12), VI(76/58).
Antherix sp. 1 (4=2+1+1). **A**. VIII(1), IV(1). **B**. VIII(1). **C**. VI(1).
Antherix sp. 2 (1=1+0+0). **A**. V(1).
Antherix sp. 3 (1=0+1+0). **B**. X(1).

Order **Odonata**

Epiophlebia superstes Selys (29=0+19+10). **B**. VII(1), VIII(4/2), IX(2/2), X(3), XI(2), VI(2/1). **C**. VIII(1), IX(3), XI(1), IV(1), VI(1/3).

Order **Megaloptera**

Protohermes sp. (3=3+0+0). **A**. VIII(1), VIII(1), IX(1).

Order Coleoptera

Elmis sp. (8=0+6+2). **B**. X(1/1), XII(2), II(1/1). **C**. VII(1), IV(1).

Total (13,175=3,825+6,674+2,676). **A**. VII(94/163), VIII(402/292), IX(60/110), X (283/125), XI(26/61), XII(320/307), II(283/399), IV(163/100), V(211/168), VI(126/132). **B**. VII(412/225), VIII(642/540), IX(455/322), X(311/232), XI(555/512), XII(556/368), II(532/349), IV(19/33), V(142/108), VI(242/119). **C**. VII(237/227), VIII(242/99), IX(132/97), X(205/128), XI(145/80), XII(126/135), IV(64), V(47/54), VI(323/335).