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Abundance and Biomass of Macroinvertebrate Association in a First Order Stream at Mt. Jumbong, Kangwon-do

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점봉산의 한 일차하천에 서식하는 대형무척추동물의 풍부도와 현존량. 정 근 (강원대학교 농업생명과학대학 응용생물 전공)

1997년 11월부터 1998년 10월 사이에 강원도 인제군에 있는 점봉산의 한 일차하천에 서식하는 저서성 대형무척추동물을 직경 20 cm의 원통형 채집기를 이용하여 2~4주 간격으로 11회 조사하였다. 조사기간 중 수온은 0~14°C, 전기전도도는 15~25 μs cm^{-1}로 유지되었다. 곤충류는 53분류군이 채집되었으며 옆새우 등의 무척추동물도 채집되었다. 년평균 개체수 (±1 SD)는 77741±69232 · m^{-2} · yr^{-1}로서, 겨울에 높고 (12월: 171178±130468 m^{-2}) 여름에 낮았다 (6월: 29872±13078 m^{-2}). 이중에서 Chironomidae (Diptera) 중 비포식성 아과와 *Nemoura* sp. (Nemouridae: Plecoptera)는 각각 53.3%와 21.8%를 차지하였다. 현존량은 회분외중량(AFDW)으로 10 gAFDW · m^{-2} · yr^{-1}이었는데 늦겨울에 가장 높았고(2월: 16 gAFDW m^{-2}) 여름에 낮았다(6월: 3 gAFDW m^{-2}). 곤충은 이중에서 57%를 차지하였다. 현존량에서 가장 중요한 분류군은 *Gammarus* sp. (Gammaridae: Amphipoda)로서 전체의 39.8%를 차지하였으며 비포식성 Chironomidae 아과가 15.2%, *Hydatophylax* sp. (Limnephilidae: Trichoptera)는 8.5%를 차지하였다. 비포식성 Chironomidae가 여러 종으로 구성된 것을 고려하면 이 일차하천에서 가장 흔한 분류군은 *Nemoura* sp.이다. 그러나 이 일차하천에서 기능적으로 가장 주요한 대형무척추동물은 *Gammarus* sp.로 생각된다.

Key words : macroinvertebrate biomass, first order stream, Mt. Jumbong

INTRODUCTION

Streams and rivers change along their length in respect of their physical properties and, therefore, running waters display longitudinal biotic zonation (Hynes, 1970). Compared with larger down stream reaches, headwaters have their own environmental settings such as low water temperature in summer and closed canopy by forest (Hynes, 1970; Ward, 1992). With closed canopy and low light level, forest stream ecosystems in the temperate zone are largely depend their energy sources on seasonal litter inputs (Cummins, 1973; Fisher and Likens, 1973). Therefore, we can expect that insects or macroinvertebrate fauna in headwaters are different from those of downstreams (Vannote *et al*., 1980). However, most of the studies on aquatic insect communities in Korea have been done on medium size streams or on large rivers (see papers in the Korean Journal of Limnology). Such bias toward large streams seems to be reasonable. The urbanization and industrialization of the country which began in 1960s was accompanied with the deterioration of stream ecosystems, and Korean aquatic entomologists have been interested in seeking relationships between

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aquatic insects and the pollution of stream water (Kwon and Chon, 1991; Yoon *et al*., 1992; e.g., Cho *et al*., 1996). For that purpose they collected aquatic insects from somewhat large streams that received pollutants from their drainage basins and might rarely need to collect samples from small headwaters that had little chance of pollution. They collected samples quantitatively and often used Surber type samplers which cannot efficiently collect benthos from shallow or slow flowing watercourse such as a first order streams (Merritt *et al*., 1996).

Since leaf litters are the most important energy source for macroinvertebrates in forest headwaters, Chung (1996, 1997) estimated leaf litter processing rates of major leaf species in a first order stream by using plastic mesh bags. During those studies, he collected macroinvertebrates which associated with leaf litter as well as with mesh bags. But, because those studies were only lasted for 3 to 4 months, some important biological information of aquatic insects such as life cycles could not be deduced. Other problem associated with mesh bag studies is that leaf litters in mesh bags are not natural substrates (see King *et al*., 1987), and they represent only one type of habitat. Since macroinvertebrates require diverse habitat types, those collected from litter bags might not properly represent macroinvertebrate assemblages in the study stream. Therefore, in this study, the author collected macroinvertebrates from natural substrates from the stream where litter bag studies were done and described them in abundances and biomasses.

MATERIALS AND METHODS

1. The study area

Macroinvertebrates were collected from a first order stream that drains the south eastern slope of Mt. Jumbong (38° 03′N, 128° 25′E). This stream flows about 600 m from its source and joins to a third order stream at 800 m above sea level. Macroinvertebrates were collected from the first 10～300 m upstream section from the confluent. The wetted width and depth of the stream section where sampling was done were ＜2.7 m and 5～10 cm as measured in early May 1997. Water temperature was measured at 2 hr interval (Hobo®temp) and ranged 0～14°C during the study period. Electronic conductivity and pH ranged 15～25 μs cm^{-1} and 5.1～6.9, respectively. Dominant species of leaf litter on stream substrata were *Carpinus cordata, Quercus mongolica, Acer* sp. and *Kalopanax pictus*.

2. Methods

Macroinvertebrates were collected by using a pipe sampler (ø 20 × 40 cm, stainless steel), from 5 randomly selected sites on each sampling day. A total of 11 sets of sampling at 4～6 weeks interval were made from November 1997 through October 1998. The sampler was pushed into the substratum at least few centimeter depth such that the water flow inside of the sampler stopped. If there was a movement of water inside of sampler, samples were abandoned and new samples were taken from the nearest upstream sites.

Large organic particles inside of the sampler were hand−picked and put into a plastic bag with macroinvertebrates associated with them. Inorganic substrates within the 10～15 cm depth were dug out and put into a 20 L plastic bucket. The water inside of sampler also poured into the bucket by using a small plastic vessel until the water inside appeared to be clear. Inorganic substrates larger than pebbles were individually hand−picked and brushed to remove attached macroinvertebrates. Water in the bucket, after agitation, were passed through a 0.25 mm sieve. Three more elutriation effectively removed most macroinvertebrates, but insects with portable mineral cases had to be hand picked from inorganic substrates in the bucket. Hand picked macroinvertebrates and all materials attained on the sieve were put into the same plastic bags mentioned above. They were treated at the site with 5～8% formalin solution. A small amount of Phloxine−B dye was added to samples to facilitate the sorting process.

In the laboratory, samples were washed with tap−water and passed through nested 1 mm and 0.25 mm sieves. All macroinvertebrates retained on the 1 mm−sieve were identified. For those attained on 0.25 mm sieve, a part of the sample (1/32～1/4) was examined, depending on the amount of substrates. Partial sampling was done by using a subsampler which used a turn table (Waters, 1969). Macroinvertebrates were sorted under a dissecting microscope. Insects were identified to the lowest taxonomic level possible by using Yoon (1995), Kawai (1985), Merritt and Cummins (1996). Some taxa such as Chironomidae and Elmidae, however, were identified at family or subfamily−level. For some young individuals which were hard to identify, or those who lost some body parts with species characteristics (e.g., gills of some Heptageniidae) during sample processing were placed to the upper taxonomic levels.

Macroinvertebrates other than insect taxa (non−insects) were identified as Turbellaria, Oligochaeta, and *Gammarus* sp. (Amphipoda, Gammaridae). Very small invertebrates such as Copepoda, Nematoda and Ostracoda were abundant, however, they were not included in the analysis because the pore size of the sieve that used in this study was too large to collect them effectively.

The body length of all macroinvertebrates were measured at mm interval under a dissecting microscope. Then, biomass (in ash free dry weight: AFDW) of each taxon was estimated by using the body length−biomass relationships (unpublished data), which had been derived from individuals within a day after treatment with 5∼8% formalin solution. For taxa the body length−biomass relationships were lacking, those of other taxa with similar body form were used. Functional feeding group allocation was done by using Merritt and Cummins (1996).

During the study, there was a heavy snow storm on the third sampling day (January 14, 1998) only above 500 m above sea level in the Mt. Jumbong area. The author arrived at the sampling site later than usual. Since the sampling was hurried under a low light condition, sediment collection and elutriation were not as complete as in other sampling days.

RESULTS

1. Number of taxa

Fifty three insect taxa belong to 5 orders 30 families were identified (Table 1). Diptera was the most diverse insect order (17 taxa), followed by Plecoptera (13), Trichoptera (13), Ephemeroptera (9), and Coleoptera (1). The number of monthly appeared insect taxa was 36 on average (Fig. 1a). The number of ephemeropteran taxa were decreased from late spring and dropped to 3 in

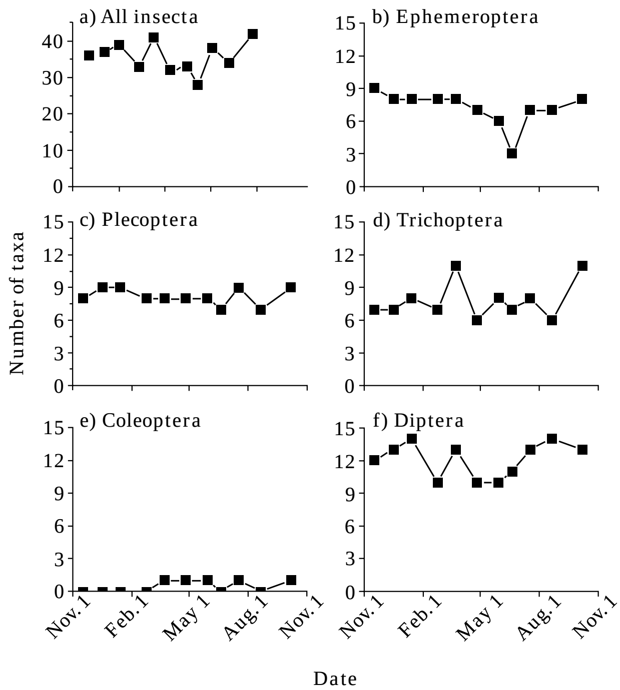

Fig. 1. Number of taxa collected during November 1997 through October 1998 by using a pipe sampler (ø20 cm, 5 replicates) in a first−order stream at Mt. Jumbong.

June but recovered rapidly (Fig. 1b). For other insect orders, there was no apparent seasonal pattern in the number of taxa (Fig. 1c−f). Three taxa of non−insect macroinvertebrates (*Gammarus* sp., Oligochaeta and Turbellaria) appeared in all sampling dates.

2. Abundance

The annual mean density (±1 SD) of macroinvertebrates were 77741±69232 · m^{-2} · yr^{-1} (Table 1). Diptera was the most abundant insect order, representing 57.7% of all macroinvertebrates, and was followed by Plecoptera (24.6%), non−insect macroinvertebrates (10.2%), Ephemeroptera (5.9%), Trichoptera (1.4%), and Coleoptera (0.1 %). The density of all macroinvertebrates was determined by several dominant taxa. The non−predatory Chironomidae (i.e. excluding Tanypodinae) was the most abundant taxon which comprised 53.3% of total density (14.2∼73.6%). The second most abundant was *Nemoura* sp. which represented 21.8% (2.4∼29.9%) of the all macroinvertebrate density. However, considering that non−predatory chironomids are composed

Table 1. Annual mean density of macroinvertebrates ($m^{-2} \cdot yr^{-1}$, n = 55) in a first order stream at Mt. Jumbong. Macroinvertebrates were collected by using a pipe type sampler (ø20 cm, 5 replicates) for 11 occasions at 4∼6 weeks intervals during November 1987 through October 1998.

Taxa	Mean±1 SD	Taxa	Mean±1 SD
Ameletus montanus	52.1±171.3	*Apsilochorema* sp.	2.3±10.4
Baetis sp.	1580.8±2353.2	*Rhyacophila articulata*	157.5±333
Cincricostella castanea	470.8±1280.9	*R. brevicephala*	151.1±485.9
Ephemera separigata	99.6±206.7	*R. narvae*	27.2±109.9
Cinygmula sp.	150.6±482.5	*R. nigrovittatus*	30.1±152.4
Ecdyonurus kibunensis	19.7±43.6	*R. shikotsuensis*	12.2±20.8
Epeorus sp.	64.3±214.5	Elmidae	115.8±467.3
Heptagenia kihada	148.8±403.7	Athericidae	4.1±30.1
Paralephlebia chocorata	1974.5±3299.3	Ceratopogonidae	559.9±656.7
Capnia sp.	137.8±409.2	non-predatory Chironomidae	41470.8±52658.2
Eucapnia sp.	0.6±4.3	Tanypodinae	1213.1±2161.2
Leuctridae	902.7±1895.1	*Dixa* sp.	96.7±348.9
Amphinemura sp.	32.4±126.4	Dolicopodidae	1.7±7.3
Nemoura sp.	16991.9±18667.2	Empididae	111.2±311.7
Protonemoura. sp.	22.6±77.9	*Pericoma* sp.	33.6±82.6
Yoraperla sp.	19.1±76.2	*Simulium* sp.	2.3±8.3
Scopula sp.	32.4±52.5	*Antocha* sp.	6.4±27
Kamimura sp.	1.2±6	*Dicranota* sp.	1087.4±1977.2
Kiotina sp.	0.6±4.3	*Hexatoma* sp.	60.8±49.5
Neoperla sp.	0.6±4.3	*Limnophila* sp.	138.4±258.2
Isoperla sp.	71.8±187.7	*Ormasia* sp.	37.1±159.7
Sweltsa sp.	925.9±1350.7	*Pedicia* sp.	11.0±23.1
Glossosoma sp.	110.0±330.4	*Pilaria* sp.	8.1±15.3
Goerodes sp.	141.9±375.6	*Tipula* sp.	18.0±32.9
Hydatophylax sp.	235.1±547.6	All Insects	69773.0±68610.4
Psilotreta sp.	210.2±429.3	*Gammarus* sp.	4167.3±3909.7
Dolophilodes sp.	0.6±4.3	Oligochaeta	3216.6±4458.4
Wormaldia sp.	13.3±69.8	Turbellaria	584.3±110.4
Plectrocnemia sp.	4.6±21.6	All Macroinvertebrates	77741.0±69233.4

with multiple species (e.g., Kwon and Chon, 1991) *Nemoura* sp., which appeared to be a single species, would be the most abundant taxon in this first order stream. The third most abundant taxon was *Gammarus* sp., which represented 5.4% (2.4∼10.2%) of the total density, and was followed by Oligochaeta (4.1%), *Paraleptophlebia chocorata* (2.5%), *Baetis* sp. (*B. thermiscus*+*nla*) (2.0%). These six taxa occupied 72.1∼95.4% of all macroinvertebrate density. The abundance of macroinvertebrates (Mean±1 SD) showed a clear seasonal pattern, being high in winter (171178±130468 m^{-2}) and low in summer (29872±13078 m^{-2}) (Fig. 2a), which closely followed the seasonal pattern of Chironomidae (Fig. 2e) and *Nemoura* sp. (Fig 2c).

In Ephemeroptera, three most abundant taxa represented 88.3% (56.9∼97.3%) of the ephemeropteran abundance (Fig. 2b). *P. chocorata*, *Baetis* sp., and *C. castanea* represented 43.3% (18.3∼69.2%), 34.7% (10.1∼63.1%) and 10.3% (0.0∼45.3%) of the ephemeopteran density, respectively. Plecopteran taxa were rare in summer and abundant during autumn and winter (Fig. 2c). It was because of *Nemoura* sp., which represented 88.8% (31.1∼97.6%) of plecopteran density. *Sweltsa* sp. and Leuctridae represented 4.8% (1.0∼26.6%) and 4.7% (0.6∼40.6%), respectively, of the plecopteran abundance. In Trichoptera, seasonal variation in abundance at the order level was not as clear as in other insect order (Fig. 2d). *Hydatophylax* sp. was the most abundant and represented 21.5% (1.0∼60.2%) of all trichopteran taxa, and was followed by *Psilotreta* sp. (19.2%: 1.7∼76.1%) and *Rhyacophila articulata* (14.4%: 0.8∼41.9%). The monthly proportion of these three taxa ranged 26.7% to 85.8% of the trichopteran abundance. On the other hand, Diptera

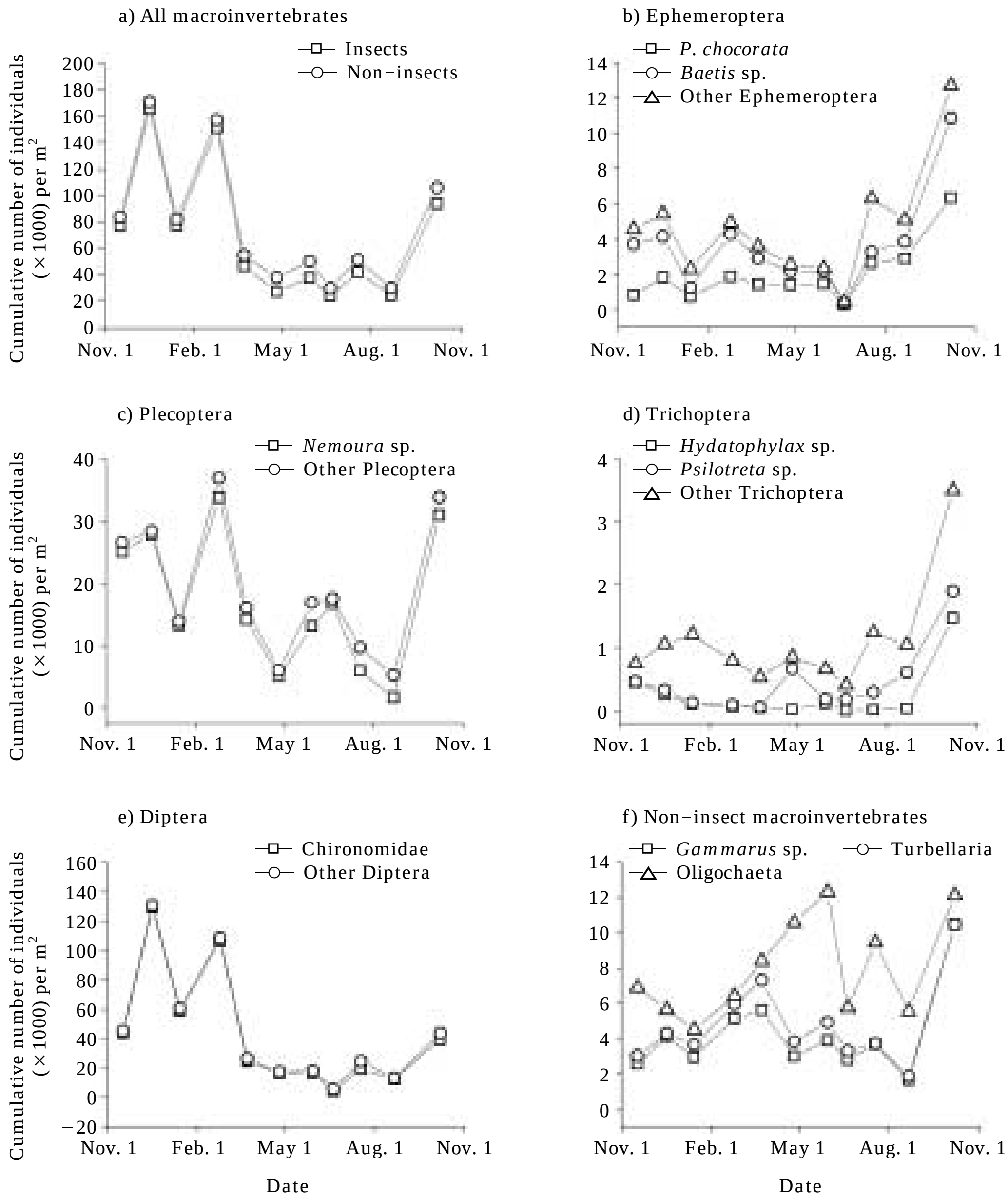

Fig. 2. abundances of macroinvertebrates collected during November 1997 through October 1998 by using a pipe sampler (ø20 cm, 5 replicates) in a first-order stream at Mt. Jumbong.

showed a strong seasonal pattern in abundance (Fig. 2e). Such variation was largely due to non-predatory Chironomidae, which represented 92.4% (73.6～97.2%) of the dipteran abundance. Tanypodinae, a predatory subfamily and the second most abundant dipteran taxa, occupied only 2.7% (1.0～7.3%) of dipteran density. The third most abundant taxon was *Dicranota* sp. (2.4%: 0.8～12.7%). These three taxa represented 80.9～99.6% of the dipteran abundance. Unlike insects, non-insect macroinvertebrates were more abundant in summer than in winter (Fig. 2f). *Gammarus* sp. was most abundant and represented 52.3% (28.2～86.1%) of the non-insect macroinvertebrate abundance, and followed by Oligochaeta (40.4%: 7.4～66.8%) and Turbellaria (7.3%: 0.1～20.0%).

3. Biomass

The biomass of macroinvertebrates, as in abundance, was high in winter and low in summer (Fig. 3a). The annual mean biomass was 10 gAFDW · m^{-2} · yr^{-1}. Insects, composed of many taxa, only occupied 57% of total biomass, while non-insect macroinvertebrates composed with 3 taxa represented other 43%. *Gammarus* sp. was the most important taxon and occupied 39.8% of total biomass, and was followed by non-predatory Chironomidae (15.2%), *Hydatophylax* sp. (8.5%), *Baetis* sp. (4.8%), *Psilotreta* sp. (4.7%), *Nemoura* sp. (3.8%) and *Hexatoma* sp. (3.1%).

Baetis sp. and *Heptagenia kihada* dominated the biomass of Ephemeroptera (1.2 gAFDW · m^{-2} · yr^{-1}) (Fig. 3b), and occupied 38% (19～57%) and 12% (0～37%), respectively, of that. *P. chocorata*, the most abundant ephemeropteran taxon, was the third in biomass. Plecopteran biomass, in spite of high abundance, was low (<1 gAFDW m^{-2}) for the most of the study period. *Nemoura* sp. occupied 44% (21～71%) of the plecopteran biomass. Trichopteran biomass was 1.5 gAFDW · m^{-2} · yr^{-1} (Fig. 3d). The biomass of *Hydatophy-*

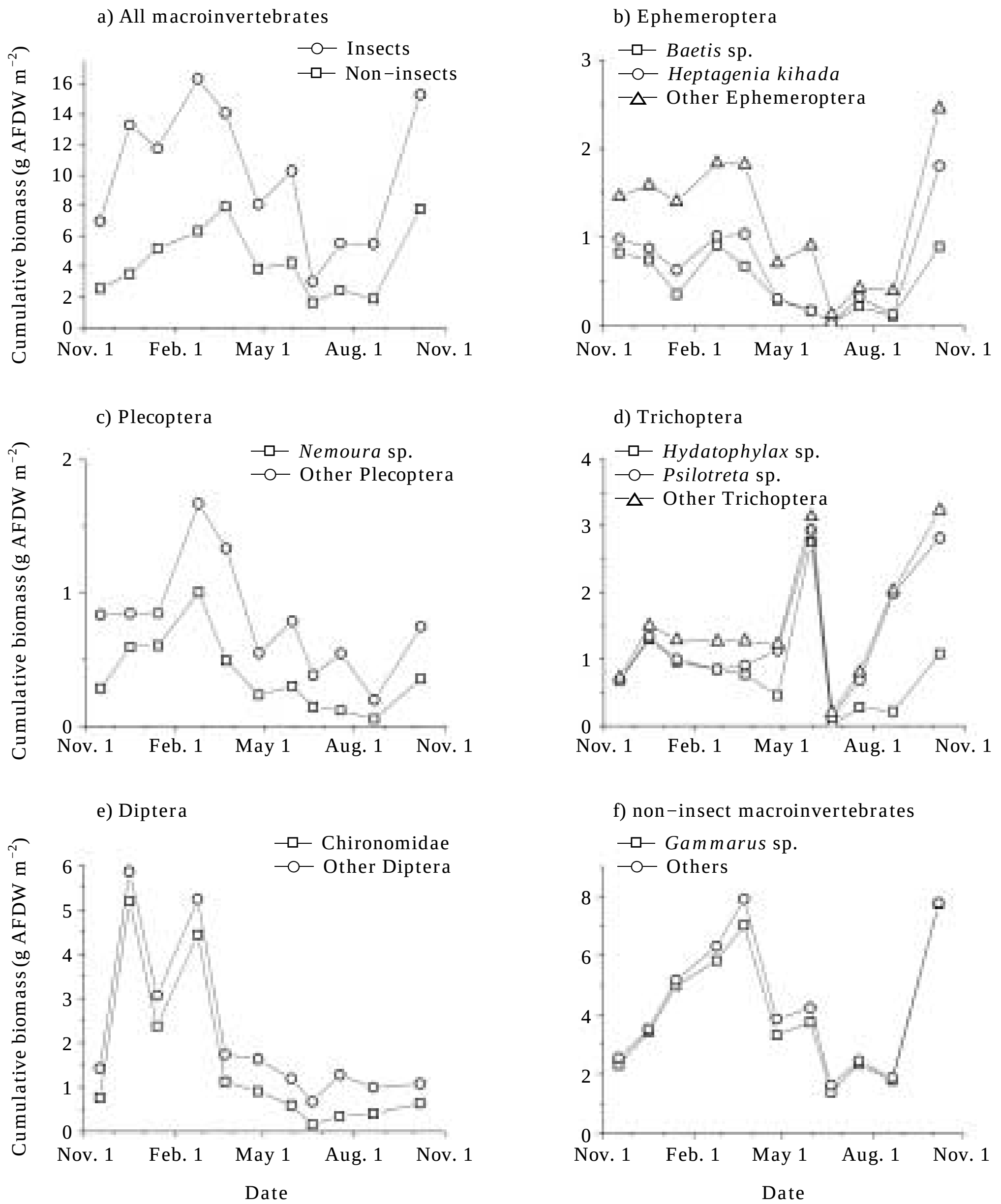

Fig. 3. Cumulative biomass of macroinvertebrates collected during November 1997 through October 1998 by using a pipe sampler (ø20 cm, 5 replicates) in a first-order stream at Mt. Jumbong.

lax sp. peaked at 2.7 gAFDW m^{-2} in late May when a few of late instars appeared and decrease to <0.001 gAFDW m^{-2} in late June when early instars were only collected (data not shown). The biomass of *Psilotreta* sp. also varied greatly among months, but there was not a clear seasonal pattern (Fig. 3d). Dipteran biomass was 2.2 gAFDW · m^{-2} · yr^{-1} (Fig. 3e). Chironomids represented 57% (23~88%) of it and ranged from 0.15 g to 5.2 gAFDW m^{-2}. *Hexatoma* sp., a predatory tipulid, was the second most important taxon. Their biomass was 0.3 gAFDW · m^{-2} · yr^{-1} (0.04~0.53 gAFDW m^{-2}), and represented 2~43% of dipteran biomass. The biomass of non-insect macroinvertebrate (4.3 gAFDW · m^{-2} · yr^{-1}) was dominated by *Gammarus* sp. (Fig. 3f). Their biomass was 4 gAFDW · m^{-2} · yr^{-1}, and represented 92% (85~100%) of non-insect's biomass.

4. Functional feeding group

Shredders, which include *Hydatophylax* sp. and *Gammarus* sp., represented 55% (40~69%) of total biomass (Fig. 4). Gatherers which include non-predatory chironomids, some ephemerid and Oligochaeta occupied 23% of macroinvertebrate biomass, was followed by predators (14%) and scrapers (8%). Filterers also appeared in samples but were very rare and occupied <1% of total biomass. Therefore, while the proportion of shredders was relatively higher than that predicted by River Continuum Concept (RCC: Vannote *et al*., 1980), the proportion of collectors had been maintained low throughout the study. Scrapers, at annual average, were somewhat similar to that of RCC. However, due to *Psilotreta* sp., monthly variation was very large. In August, They co-dominated the macroinvertebrate fauna with shredders.

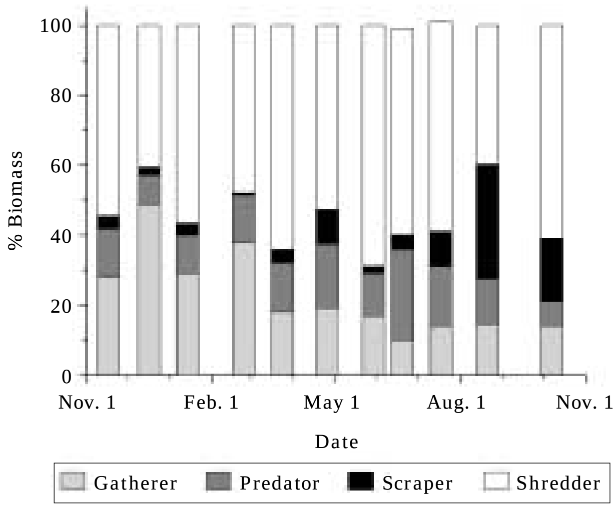

Fig. 4. Functional group structure of macroinvertebrates collected during November 1997 through October 1998 by using a pipe sampler (ø20 cm, 5 replicates) in a first-order stream at Mt. Jumbong.

DISCUSSION

1. Number of taxa

The number of insect taxa in this study was larger than those of some previous studies which included collection sites in a first order streams and collected *Gammarus* sp.. For example, Bae (1993) seasonally surveyed Gokneung stream of Mt. Bukhan, and collected 17 insect species at the uppermost sites. Bae and Yoo (1993) also collected 39 insect species from the upper most sites of Wooyi stream. They also collected a cyprinid fish at this site. Cho *et al*. (1996) collected 35 and 41 insect species from the upper most sites in two tributaries of Cheungam stream of Mt. Mudung in Kwangju area. All of these studies used Surber type nets. Considering the use of Surber nets and the appearance of Hydropsychidae with few individuals of *Gammarus* sp. in their samples, the first order streams in their studies might actually be second or higher order streams. As seen in this study, author thinks that *Gammarus* sp. is ubiquitous (see Lee, 1979) and dominant macroinvertebrate taxon in most of first order streams in Korean forest.

Since many taxa were treated at higher taxonomic level, the number of species in this stream would be far less than what actually is. For example, Chironomidae, which was treated as two taxa in this study (i.e. Tanypodiane and non-Tanypodinae or predatory and collector-gatherer Chironomidae), could include many species (e.g., Kwon and Chon, 1991; Youn and Chon, 1999). Some other taxa identified at genus level also composed of multiple species (e.g., *Tipula* sp., *Baetis* sp.). However, some species like *Ameletus costalis* and *Oyamia nigribasis* were still missing. Many of large individuals of *A. costalis* were observed in small shallow pools formed on the depression of the bed rocks and *O. nigribasis* was often found under large rocks or leaf litter deposits formed in crevices.

Taxonomic composition of major taxa in this study was similar to those of litter bags studies (Chung, 1996, 1997). However, there were some differences in rare taxa. Three taxa (*Ecdyonurus dracon*, *Pteronarcys sachalina*, and *Micrasema* sp.) which appeared in litter bags were not collected. On the other hand, 12 taxa were added in this study.

2. Abundance

The abundances of macroinvertebrates in this study appeared to be the highest among Korean stream studies (generally <10000 m^{-2}). The author thinks that the soft substrata in the study stream provided more habitat space for aquatic insects than substrata with relatively hard surface in down streams did. The low abundance of Chironomidae and *Nemoura* sp. in January 1998 seemed to be attributable to the incomplete sampling of substratum under a bad weather condition. Leaf packs are seasonally abundant in upper reaches of headwaters and they could provide more space for insects such as *Nemoura* sp. and chironomids. Also, the smaller mesh size and subsampling greatly increased the efficiency of collecting and counting small individuals.

3. Biomass

Biomasses of macroinvertebrates were estimated in several Korean freshwater studies. For examples, Kim (1968) and Ra and Cho (1986) measured the wet weight of aquatic insects after blotting excessive preservative solution. Yoon *et al*. (1990) measured dry weight of macroinvertebrates from Paltang reservoir and used it to estimate the total biomass of macroinvertebrates of the whole reservoir. Since ash free dry weights can be deduced from dry weight by using proper conversion rates, the biomass of this study could be compared with those of other studies. However, since these studies used somewhat different sample processing methods which could affect data seriously (Leuven *et al*., 1985; see Benke *et al*., 1999), comparison among these studies would not have much value.

4. Functional feeding group

Functional group structure of this stream, at the first glance, was somewhat different from that predicted by RCC (Vannote *et al*., 1980), largely in the proportions of shredders and collectors. But, considering that the headwater reaches include streams of the first through third order (Ward, 1992) and that *Gammarus* sp. is largely restricted to the first order and the upper part of second order streams, the proportion of shredders in this stream seems to be within the range that RCC predicted. A similar argument could be used to explain low collector biomass; in downstream reaches of headwaters, ephemeropteran collectors and filter−feeding trichopteran individuals would increase their abundance and biomass while shredders become less abundant.

In conclusion, while *Nemoura* sp. was the most abundant, *Gammarus* sp. seemed to the most important macroinvertebrate in the first order streams in Korean forests. They appeared to be ubiquitous in small streams in our country (Lee, 1979), and were abundant in first order streams in forests which the author have visited. Since *Gammarus* sp. has been known to process large particulate organic matters and performs other functional roles as collector and predator (e.g., Delong *et al*., 1993; Kelly *et al*., 2002), studies on their ecology will greatly help to understand Korean headwater stream ecosystems.

ABSTRACT

Macroinvertebrates from a first order stream at Mt Jumbong, Kangwon−do, was examined for their abundance and biomass. Sampling was done by using a pipe sampler (ø20 cm) for 11 occasions (n = 5) at 4∼6 weeks intervals during November 1997 through October 1998. Water temperature and electronic conductivity of the study stream ranged 0∼14°C and 15∼25 μs/cm, respectively. During the study, 53 insect taxa and 3 non−insect taxa were collected. Annual mean number of individuals (±1 SD) was 77741 ±69232 · m^{-2} · yr^{-1}, being high in winter (±1 SD) (December: 171178±130468 m^{-2}) and low in summer (±1 SD) (June: 29872±13078 m^{-2}). Non−predatory subfamilies of Chironomidae and *Nemoura* sp. occupied 53.3% and 21.8% of annual abundance. Annual mean biomass was 10 g · m^{-2} · yr^{-1} in ash free dry weight (AFDW), being high in late winter (February: 16 gAFDW m^{-2}.) and low in summer (June: 3 gAFDW m^{-2}). *Gammarus* sp. represented 39.8% of the total biomass

and was followed by non-predatory subfamilies of Chironomidae (15.2%) and *Hydatohylax* sp. (8.5%, Limnephilidae: Trichoptera). Since the non-predatory subfamilies of chironomidae were composed of many species, *Nemoura* sp. was the most abundant taxon. However, *Gammarus* sp. was surely the most important taxon to the functional aspects of this first order stream ecosystems.

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