ECOLOGICAL PROCESS OF BENTHIC INVERTEBRATE ASSEMBLAGES PRE AND POST IMPOUNDMENT OF A DAM: A Case Study of Takizawa dam, Saitama JAPAN

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Abstract

This study was carried out in Takizawa dam, Nakatsugawa River, Japan. The objective was to check the responses of macroinvertebrate population to trophic level, increased water temperature and removal of transported coarse particulated organic matter by the dam. The net-spinning, *Stenopsyche marmorata* species were found to be colonized in downstream after dam operation. Its production rate also higher generation per generation. From canonical correspondence analysis, this species occurs largely in very high biomass of periphyton and phytonplankton

Keywords: *Stenopsyche marmorata* CPOM, FPOM, Periphyton

1. Introduction

The river ecosystem includes its hydrology, diversity of channel and habitat types, solutes and sediments, and biota. Certain processes and properties emerge at the level of the whole ecosystem, including the flow of energy through food webs, the cycling of carbon and the nutrients such as nitrogen and phosphorus, and the origin, processing, and transport of materials from headwaters to sea (Allan J, 2007). All ecosystems require a continual input of energy to function. There are essentially four sources of energy to streams and rivers; autothonous (primary production), allochthonous (from adjacent riparian ecosystem, upstream ecosystem stream flow and ground water subsurface flow. Flow regulation by dams and subsequent environmental changes such as altered thermal and sediment regimes lead to changes of biological aspects in the stream ecosystem spatially and temporally. Macroinvertebrates can have an important influence on nutrient cycles, primary productivity, decomposition and translocation of materials. Interaction among macroinvertebrates and their food resources vary among functional groups (Wallace and Webster, 1996).

Stenopsyche marmorata is commonly found in cobble-bed streams in East Asia, including Japan. (Nishimura, 1984). It is a kind of net-spinning larva. It can dominate benthic macroinvertebrate communities because of their relatively large biomass. Its functional feeding group is gatherer and filterer. *Hydropsyche orientilis* is also net-spinning caddisfly. Its biomass is comparatively smaller than the Stenopsyche marmorata. Its functional feeding group is filterer.

The objective of the study was to check the responses of macroinvertebrate population to trophic level, increase in water temperature and removal of transported coarse particulate organic matter by the dam.

2. Materials and methods

Study Area

The study area is located in the locality of Takizawa dam (37 ° 57' N, 138 ° 53' E) which was constructed up the Nakatsugawa river, Japan. Monthly field investigation was carried out at the location of upstream and downstream of the dam from March 2005 when water is not subjected to manipulation. Interest of field sampling parameters were benthos, organic matter in the drift, benthic organic matter, periphyton and in-situ measurement of stream physical parameters (water temperature and dissolved oxygen). Laboratory work includes identification of macroinvertebrates, counting number of taxa, population and classification of functional feeding group and biomass measurement and instar analysis of Stenopsyche marmorata. Statistical result of ANOVA for macroinvertebrate population, functional feeding group composition in upstream and downstream under before and after dam operation was obtained by using Sigmastat version 3.5. Canonical correspondence analysis (CANOCO 4.5) was incorporated for the relationship building between macroinvertebrate species composition and environmental variables.

3. Results and Discussion

3.1. CPOM and FPOM in upstream and downstream of the dam

Figure (1) shows the ratio of the drift density of CPOM and FPOM in upstream and downstream of the dam. In upstream, amount of CPOM is very much higher during the seasonal falling time but in downstream, amount of FPOM is high through out the year.

3.2 Macroinvertebrate community in upstream and downstream of the dam

Figure (2) shows the temporal variation of the population density of *Stenopsyche marmorata* (nos./m^2) in downstream of the dam. After the dam operation has been started, *Stenopsyche marmorata* was found to be colonized in downstream. The high population was found around June, and November because of the newly hatched larvae formation at that time. Two generation of *H. orientilis* species has been found in both upstream and downstream of the dam before the dam operation.

Table (1) shows the production of S*tenopsyche marmorata* after dam

Year	Generation		Annual
	Nonwintering	Overwintering	
2005-2006		1.67	
2006-2007	0.62	2.98	3.60
2007-2008	6.14	3.15*	9.30*

Table (1) Production of Stenopsyche marmorata g dry weight per m^2

* means the generation not finished yet (ie. Values calculated up to December)

operation. Production rate is related to the growth rate of biomass and abundance. 2007-08 nonwintering generation showed high production (6.14 DW g/m2) although it was a flood-affected generation by the big flood in September. Some larvae were washed away and not all the larvae could emerge as adult. The population was regenerated by the oviposition of the surviving female and upstream movement (Willims and Hynes, 1976). The highest value of annual production of many reports for this species is S. marmorata is 15.47 gDW/m2 (5.17 nonwintering and 10.30 in wintering generation) (Aoya. K,1990). From our data, production of wintering generation is much higher than that of nonwintering one. It agrees with the data of Aoya. K., 1990.

3.3 The Ordination Diagram by CCA

These ordination diagrams were constructed using the population of macroinvertebrates and environmental data set of before dam operation and after dam operation. After dam operation, less amount of CPOM and FPOM were transported to downstream sites. Available food sources are phytoplankton and periphyton for the downstream macroinvertebrates. *Stenopsyche marmorata* species largely occurs at the sites of very high phytonplankton concentration and higher periphyton biomass. But the highest population of H. orientilis species occurs in higher periphyton biomass and average periphyton biomass condition.

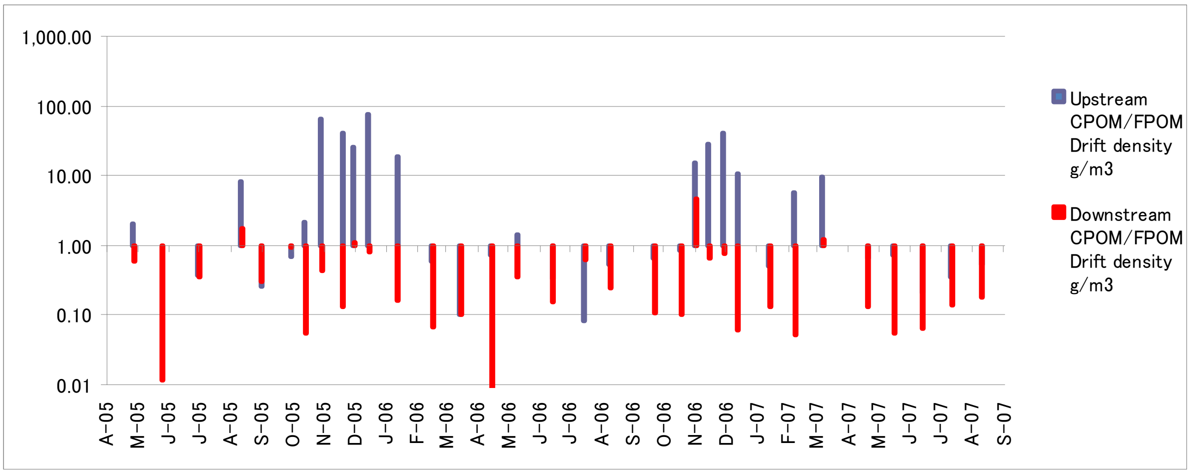

Figure (1) Temporal variation of CPOM and FPOM drift density ration in upstream and downstream

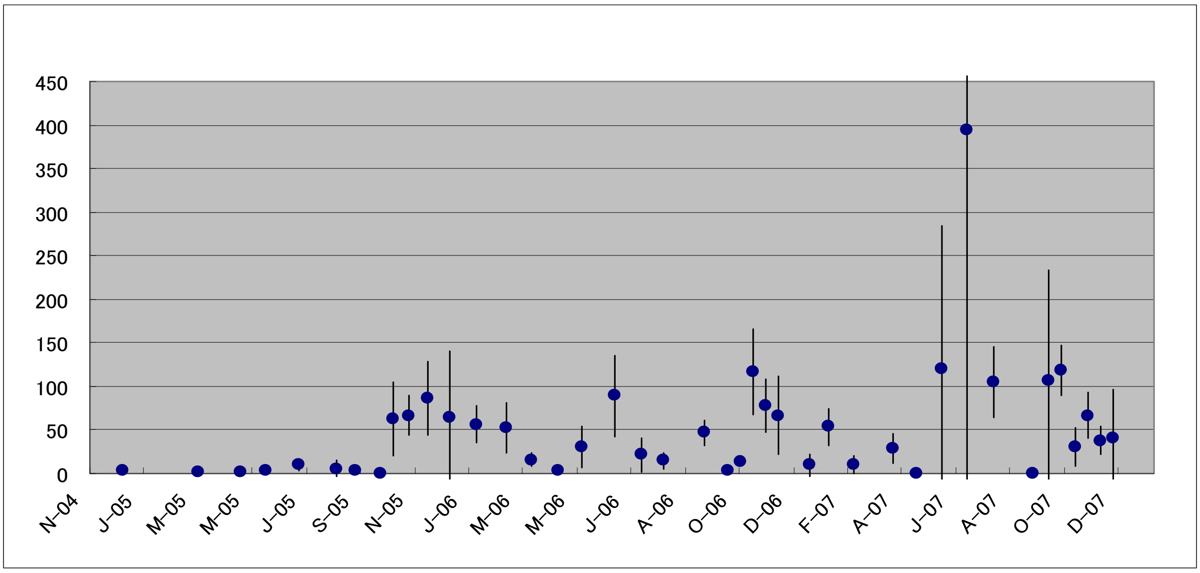

Figure (2) Temporal variation of S. marmorata in downstream before and after dam operation

4. Conclusion

The high abundance and production of *Stenopsyche marmorata* was correlated to the trophic level: higher primary production after dam operation. It was also supported by the larger stable sediment condition and warmer temperature after regulating the river water.

5.References

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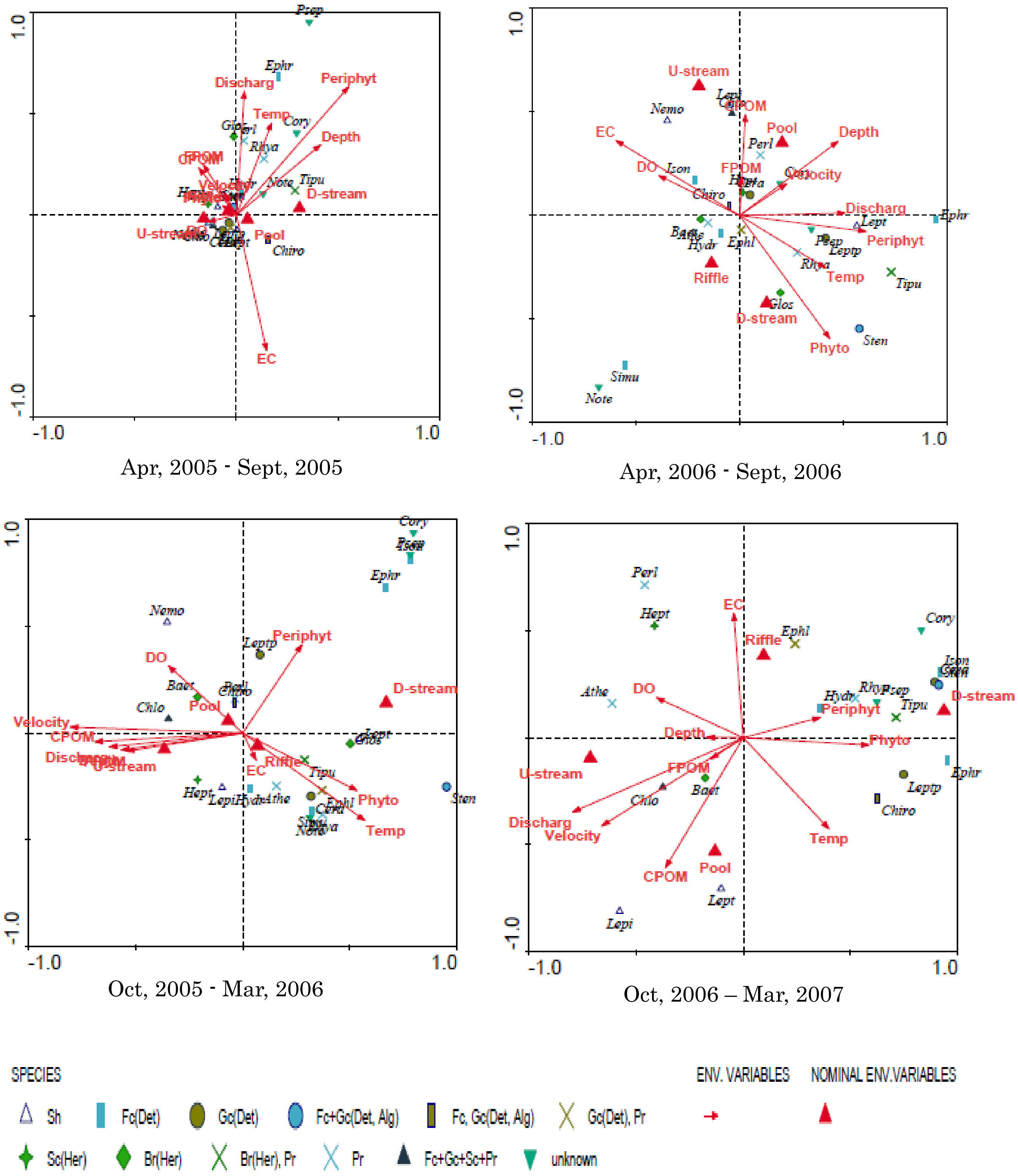

Baet : Baetidae; Ison: Isonychiidae; Hept: Heptageniidae; Leptp: Leptophlebiidae; Ephr : Ephemeridae; Ephl: Ephemerellidae; Nemo: Nemouridae; Perl: Perlodidae; Chlo : Chloroperlidae; Cory: Corydalidae; Note : Noteridae; Psep: Psephenidae; Tipu: Tipulidae; Simu: Simuliidae; Cera: Ceratopogonidae; Chiro: Chironomidae; Athe: Athericidae; Glos : Glossosomatidae; Rhya: Rhyacophilildae; Sten: Stenopsychidae; Hydr: Hydropsychidae; Lept: Leptoceridae; Lepi: Lepidostomatidae

Figure (3) Results of Canonical Correspondence Analyses for Invertevrate community