# Experimental study on filtration rate of particulate materials and excretion rate of nutrients by bivalve *Corbicula japonica*

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## Introduction

Suspension-filtering bivalves, e.g. *Corbicula japonica*, are capable of filtering large amount of overlaying water to capture particulate organic materials, while they excrete nutrients available for phytoplankton. Possibility and importance of the food web has been recognized by several investigators as natural control for eutrophication. (Officer et.al, 1982; Prins, 1996). Therefore the filtration and excretion rates are the most essential factors for assessing the role of bivalves in the internal nutrient cycling in a natural water body. In this study, we have conducted a continuous-flow experiment under several temperature conditions, in order to quantify the filtration and excretion rates of *Corbicula japonica* collected from Lake Shinji.

## Materials and methods

Sediment, *Corbicula japonica* and overlying water were taken a day before the experiment at Torigasake station in Lake Shinji. The mass of water was preserved in a refrigerator at 5℃ after being passed through a 0.5 mm net in order to exclude zooplankton, sediment was checked out for the presence of other benthic animals and meanwhile bivalves were kept in vessels for acclimation. Schematic view of experimental set up is shown in Fig. 2: an opaque feed tank filled with lake water, two temperature controlled containers where experiment cores and sampling bottles were placed respectively, and a sucking pump linked to the outlet side in order to avoid crashing the POM. Water mixing in the feed tank was realized through air-bubbling after being passed through 6 N HCl solution and distilled water. Four plexiglas cores with 8 cm diameter and 50 cm height were placed in the first container, the first one was half filled with glass beads, the rest were half filled with sediment. After having added 0.5 l lake water, each of them was ramed out in order to insure full release of the interstial air and after that six clams (*Corbicula japonica*) were placed gently on the sediment surface of two cores respectively. Bivalves used in experiment with length and height ca. 2 x 1.8 cm, were selected as a medium size among 256 individuals collected at random. Differences in the length of the inlet and outlet pipes fixed in the rubber stop as well and rotation of the water inside the cores in a certain height, made feasible a full vertical mixing without resuspension and prevented immediate passing of feeding water from inlet to outlet. Lake water inside the feeding tank was kept in darkness at 10 ℃ avoiding biodegradation and photosynthesis. Flow rate was set for the retention time to be 1 hr. Samples were collected every 6 hr and preserved in a refrigerator for chemical analysis. After having finished the experiment, the average height of sediment, water and oxidation depths were measured, as well for all bivalves were measured height, length wet and dry flesh weight after drying at 60 ℃. Calibration of fluorometric readings of chl.a was done based on the method by Strickland and Parsons (1972). The experiment was carried out under three temperature conditions of 25.5, 18 and 11.4 ℃, Temperature was kept constant at least for 24 hr for acclimation of bivalves.

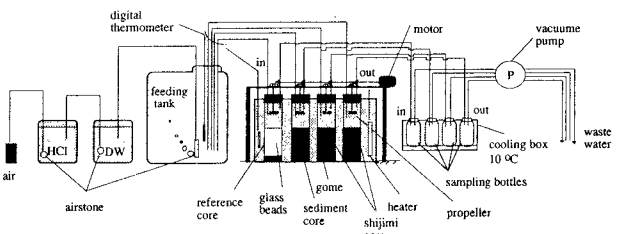


Fig. 1 Schematic view of experimiental set up

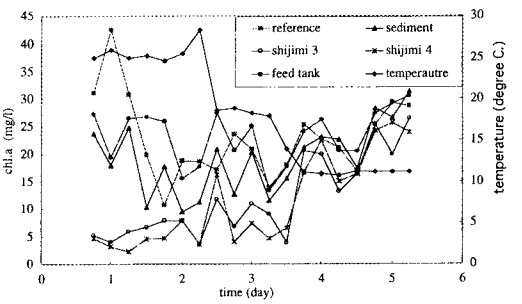


Fig. 2 Variation of chl.a in function of temperature

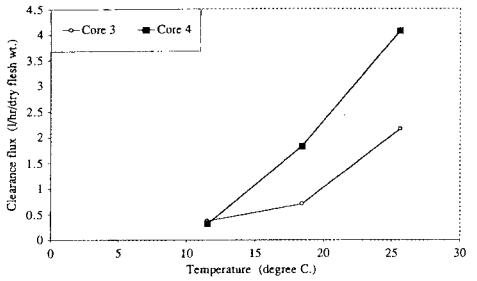

Fig. 3 Temperature dependence of clearance flux per dry flesh weight

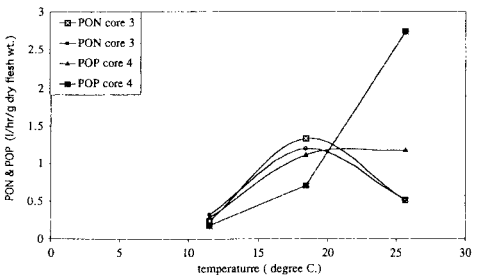

Fig. 4 Variation of PON & POP filtration rate per g dry flesh weight.

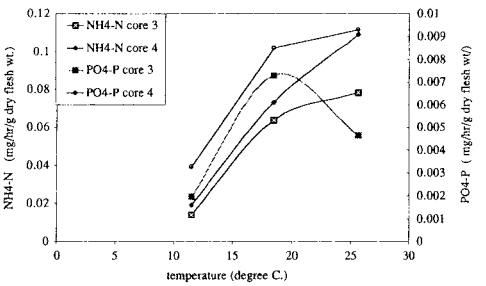

Fig.5 Excretion flux of NO4-N, PO4-P per dry flesh weight

## Procedures of chemical analyses

Dissolved inorganic nutrients $PO_4^{3-}$, $NO_3^-$, $NO_2^-$, $NH_4^+$, were analyzed with a Technicon Autoanalyzer. TN and DTP were analyzed using an autoanalyzer after autoclaving 50 ml of filtrate sample through a Whatman GF/C filter 49 mm. Chlorophyll a was determinated fluorometrically using a continuous-flow cuvette Turner Designs model 10-AU-005 after filtering 20 ml sample through a GF/F 25 mm filter. DOC was analyzed in the filtrate using a TOC Analyzer, POC and PON were analyzed in the residuals using a CHN Analyzer after being filtered through GF/F 25 mm filter.

## Results and discussions

Fig. 2 shows temporal changes in chl. a concentration of feeding tank and outflow of the experiment. There is a quite distinguishable difference of chl.a concentration among cores. The average chl.a concentration in the core containing bivalves at 25.5 and 11.4 ℃ is six times smaller that in the reference core. The chl.a concentration has a minimum at 25.5 ℃ and increases with decreasing temperature. At 11.4℃ apparently there is no distinct difference between chl.a concentration in different cores. The fact implies a huge reduction of planktonic particulate matter in water column by active filtering of *Corbicula japonica* and its temperature dependence. Based on differences of chl.a concentration in reference and shijimi cores and considering the equation (1), the average clearance rate per dry flesh weight was calculated 3.11, 1.26 and 0.351 l/hr/g dry flesh weight for temperature 25.5, 18 and 11.4 ℃ respectively (see Fig. 3).

$$Clr = Q(Cr-Csh)/(Csh*Dfw) \quad \ldots\ldots(1)$$

where Clr; is the clearance rate (l/hr/g.dry flesh weight), Cr; chl.a concentration of out flow on the reference core, Csh; chl.a concentration of outflow on the shijimi core, Dfw ; the dry flesh weight (g). Size of bivalves varied from 6 to 24 mm and the average dry flesh weight 0.595 and 0.475 g per core.

In Fig 4 are shown the variations of PON and POP filtration rates per g flesh weight as a function of temperature. Calculation are also based on equation (1). In this case filtration rate has a minimum at temperature 11.4 ℃ and a maximum at 18 ℃ except POP at core 4. In Fig 5 is shown the diagram of $NH_4$-N and $PO_4$-P excretion rates per dry flesh weight calculated from equation (2).

$$Ecr = Q(Csh-Cr)/Dfw \quad \ldots\ldots(2)$$

There is a clear temperature dependence of $NH_4$-N and $PO_4$-P excretion rates of *Corbicula japonica*. The maximum excretion rates of ammonium and phosphates were obtained at 25.5 and 20 ℃, respectively.

## Conclusion

This experiment enables us to figure out the temperature dependence and value of filtration and excretion rates of *Corbicula japonica*. Filtration rate in terms of chlorophyll a and POP and ammonium excretion rate increased as temperature increasing up to 25.5 ℃, while filtration rate in terms of PON had a maximum value at 18 ℃.

## References

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Smaal, A. C et al.,: The impact of marine eutrophication on phytoplankton and benthic suspension feeders. (1994) Royal Netherlands Academy of Science /RIKZ