

RATE OF FILTRATION IN THE ASIATIC CLAM, *CORBICULA FLUMINEA*¹

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ABSTRACT

Filtration rate of *Corbicula fluminea* (Muller) 1774, (0.83 to 7.40 g) at 21 to 24 C in a suspension of 3,314 to 17,742 plants/ml of *Scenedesmus* sp. averaged 347 ml/hr/clam, 177 ml/hr/g total weight, 1,561 ml/hr/g soft tissue weight, and 20,499 ml/hr/g dried soft tissue weight. Rate of filtration was not strongly correlated with clam weight ($r < 0.10$). Filtration rates determined in this and other studies were compared. It was concluded that the most acceptable filtration rate for *C. fluminea* ranges from 300 to in excess of 800 ml/hr/clam.

INTRODUCTION

Filtration rate of the Asiatic clam, *Corbicula fluminea* (Muller) 1774, has been the subject of several investigations (Prokopovich, 1969; Habel, 1970; Auerbach et al., 1977; Haines, 1979; and Mattice, 1979). Computed rates may be grouped into two general categories, those in excess of 100 ml/hr/clam and those less than 100 ml/hr/clam. The purpose of this investigation was to determine the actual rate of filtration in *C. fluminea* and to delineate considerations for further determinations of filtration rate in bivalves.

MATERIALS AND METHODS

Ten *Corbicula fluminea* (0.83 to 7.40 g) were used to compute average filtration rate. Test clams were obtained from stocks maintained in the laboratory in excess of two years. Monospecific cultures of *Scenedesmus* sp. were obtained from Carolina Biological Supply Company and maintained in a variety of media including Bold's Basic Medium, Volvox Medium, and Soil-water Medium (Anonymous, 1974). To determine *C. fluminea* filtration rate a small aliquot of *Scenedesmus* culture was diluted with charcoal filtered tap water to the desired algal concentration (3,414 to 17,742 plants/ml). Two 250 ml beakers were filled with 200 ml of the diluted media. A single clam was added to one beaker, while the other beaker received no clam and functioned as a control. Actual start time of each run was recorded at the moment a clam opened its valves (less than one minute after introduction). Throughout each 1.5 to 3.0 hr run, both control and test media were maintained between 21 to 24 C and continuously aerated to

assure random distribution of algae. Clams were periodically observed to ensure their valves remained open. At the start, end, and throughout each run 0.2 ml aliquots of test media were collected and total number of algal plants enumerated at a magnification of 500x with a compound microscope. At completion of each run a 0.2 ml sample was obtained from the control media and served to confirm the observed clam-induced reduction of algal plants. Five of 7 counts were conducted for each run. Average filtration rate for each clam tested was computed with the formula developed by Jorgensen (1943). Filtration rates were determined by clam and per clam weight. Total clam weight, weight of excised soft tissue, and dried weight of soft tissue were determined to the nearest 0.01 g on a Sartorius balance. Soft tissue was blotted dry before weight was determined. Dried soft tissue weight was determined after oven drying at 37 C for 36 hr.

RESULTS AND DISCUSSION

Filtration rate of *Corbicula fluminea* averaged 347 ml/hr/clam (range = 160 to 861 ml/hr/clam). Average filtration rate varied considerably (Table 1) and was not strongly correlated with total clam or soft tissue weight ($r < 0.10$). Observed filtration rates approximated the high rates reported by Auerbach et al. (1977) and Mattice (1979), but contrasted sharply with the reduced rates reported by several other investigators (Table 2).

Variations in reported rates of filtration are due primarily to suspensions used. Clams select food particles by size, shape, specific gravity, and quality; they reject unacceptable particles (Jorgenson, 1966). Bivalves such as *Corbicula sandai* Reinhardt 1878 and *Sphaerium transversum* (Say) 1829, which are biologically similar to *C. fluminea*, feed predominantly upon diatoms and green algae (Hayashi and Otuni, 1967; Gale and Lowe, 1971). Filamentous algae and algae with thick gelatinous membranes are poorly utilized by filter feeding zooplankton, while blue-green algae are ingested and assimilated at reduced rates (Arnold, 1971; Porter, 1973). Suspensions of algal genera which clams positively select (*Melosira* and *Scenedesmus*) were used in studies in which *C. fluminea* filtration rates exceeded 100 ml/hr/clam. Much lower filtration rates were observed in studies by Habel (1970) and Haines (1979) where poorly utilized algae, such as colonial green algae (likely to be surrounded by thick gelatinous sheaths) and filamentous blue-green algae, dominated the suspension. The artificial soil suspensions used by Prokopovich (1969) were also probably selected against. That these media were poorly selected is further substantiated by the occurrence of considerable clam mortality in studies by Prokopovich (1969) and Haines (1979). Apparently *C. fluminea* was stressed in suspensions of poorly utilized particles and filtration rates determined using these media are anomalously low.

All three studies which reported low average filtration rates employed a turbidimeter to quantify particles in suspension. Use of a turbidimeter to measure suspended solids in water is questionable since many variables can affect the conversion of turbidity units into suspension concentration (Duchrow and Everhart, 1971). For example, Habel (1970) used turbidity to determine *Corbicula fluminea* filtration rate, and frequently observed fluctuations of 30 to 50% in phytoplankton number for identical turbidity readings. Such variability

indicates turbidity measurement is not sufficiently sensitive for accurate determination of clam filtration rates.

Based on the suspensions used and methodologies employed to measure *C. fluminea* filtration rates it is believed the actual rate ranges from 300 to in excess of 800 ml/hr/clam. It is suggested that future determinations of bivalve filtration rate use suspensions known to be positively selected and techniques of quantification other than measurement of turbidity. It may be preferable to report filtration rate as volume per weight clam (total weight, soft tissue weight, and/or dried soft tissue weight) per unit time rather than filtration rate per clam.

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FOOTNOTES

1. Also known as *Corbicula manilensis* (Philippi, 1841) and *C. leana* Prime 1864.
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Table 1. Filtration rate of ten *Corbicula fluminea* in a monospecific suspension of *Scenedesmus* sp. aerated at 21 to 24 C.¹

Weight category	Clam weight (g)		Filtration rate (ml/hr/g)	
	Average	Range	Average	Range
Total	3.72	0.83-7.40	177	34-839
Soft tissue	0.43	0.05-1.01	1,561	340-6,624
Dried soft tissue	0.05	0.01-0.20	20,499	1,700-84,500

¹ Algal concentration averaged 7,566 plants/ml, range = 3,413 to 17,742 plants/ml.

TABLE 2. Filtration rate of *Corbicula fluminea* and summary of relevant biological, physical, and methodological parameters as reported in the literature.

Study	Average of filtration (ml/hr/clam)	Clam size	Composition of test suspension	Concentration of suspension	Temperature (C)	Method
Prokopovich (1969)	54	0.8-23.0 g	Soil solutions: diatomite, commercial peat, or organic topsoil	Saturated suspension	20-24	Turbidimeter
Habel (1970)	11	33mm SL ^a	Phytoplankton (94% <i>Dictyosphaerium</i> , 6% <i>Oscillatoris</i>)	445 to 1,520 plants/ml	22-25	Turbidimeter
Auerbach et al. (1977)	816	20-30mm SL	Seston (natural open-water population)	—	18-27	Filtrable residue
Haines (1979)	11	22-28mm SL	Phytoplankton (dominated by colonial green algae and filamentous blue-green algae)	2 to 16 mg/l	25-30	Turbidimeter
Mattice (1979)	500-600	25 mm SL	Seston (Phytoplankton component = 95% <i>Melosira</i> sp.)	7 to 25 mg/l	15-19	Filtrable residue

^a SL = shell length.