A Diver-operated Suction Dredge to Collect Mussels

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Abstract. Mussels were collected in gravelly sand and among large rocks on wing dams using a suction device. Suction was created by sending high-pressure water through a 3.81-cm inside diameter line from an 8-horsepower pump into a 7.6-cm outside diameter line. Sediments were pumped from the bottom into a nested screen series, and live mussels were removed. Unionid size demography was virtually identical using a suction pump and total substratum removal by hand. Comparisons of total density, species richness, and other parameters indicate that quantitative samples collected with suction are similar to those collected with total substratum methods. With appropriate equipment and personnel, suction causes little environmental impact and is an efficient way to collect mussels from a variety of substrata in large rivers.

Introduction

Since 1983 we have used divers to collect 0.25-m^2 quadrat total substratum samples from large rivers to assess density, population demography of dominant species, and community composition of freshwater mussels (Family: Unionidae) (Miller et al. 1993; Payne et al., these proceedings). Several years ago we experimented with a diver-operated suction dredge for use in a variety of substratum types to collect mussels. The device can be operated by one diver and can be used with a 0.25-m^2 quadrat for quantitative sampling. Alternatively, the dredge can be used without a quadrat to sample difficult-to-reach areas, such as among and under rocks on wing dams.

The suction dredge enabled us to increase the number of samples collected without changing crew size. Up to 100 0.25-m^2 samples per day can be collected and picked for live mussels. Typically only 20-40 total substratum samples can be collected and processed in a day.

Other workers have reported on the use of suction devices for aquatic sampling. A battery-powered suction sampler for collecting stream insects was described by Wellnitz (1991). Griffith and Andrews (1981) and Thomas (1985) examined efficiency and resulting invertebrate mortality using small suction gold dredges similar to the one described in this paper.

Description of the Suction Dredge

The suction dredge (Figure 1) consists of five major components: (1) a gasoline engine-driven pump, (2) a pressure hose, (3) a suction hose, (4) a return hose, and (5) a series of wash screens. The engine-driven centrifugal pump draws water through a 3.81-cm inside diameter pressure hose connected to a suction nozzle (Figure 2). The 3.81-cm pressure hose enters the 7.62-cm outside diameter nozzle which creates suction at the open end. The other end of the nozzle is connected to the 7.62-cm internal diameter return hose, which discharges into a stacked series of wash screens.

Use of the Suction Dredge

A diver descends to the bottom and retrieves the suction nozzle to which the pressure and return hoses are attached. A 0.25-m^2 quadrat is attached to the suction nozzle with a length of rope. The diver positions the quadrat on the bottom and requests that the surface crew start the pump. The surface crew ensures that the pump body and intake hoses are primed before starting. A separate electric pump is used to prime the gasoline pump and fill the intake line. When suction has been created, the diver begins to excavate the quadrat. The surface crew guides the return hose discharge into a series of stacked wash screens. Live mussels are picked from the substratum and placed in labeled bags. Mussels too large to pass through the nozzle are placed into a nylon mesh bag and held by the diver.

When the quadrat has been excavated, the diver notifies the surface crew. The surface crew allows sufficient time for the return hose to clear after the quadrat has been excavated. The diver

returns to the surface when all samples in the series are completed. Mussels too large to pass through the nozzle are matched with the corresponding sample obtained from the screens.

Evaluation of the Efficiency of the Suction Dredge

Wing dams, used in the upper and lower Mississippi River, are constructed from coarse cobble and riprap and are used to maintain navigation channels. In a survey conducted in Pool 5 of the Upper Mississippi River (UMR) in July 1994, 20 samples were taken with a 0.25-m^2 quadrat between two wing dams. Samples were also taken from on top of a wing dam without the quadrat; the diver used suction to collect among and under large rocks. The diver collected on the wing dam until approximately 10 mussels were obtained; this constituted a sample.

A total of 223 individuals and 12 species was taken on the wing dam and 50 individuals and 8 species were taken in gravelly sand between wing dams. Species diversity on the wing dam, 1.4, was similar to that between wing dams, 1.3. Evidence of recent recruitment was similar; 36% and 50% of the individuals collected on and between wing dams were less than 30-mm total shell length. The suction dredge was used effectively in this difficult-to-sample habitat. It would have been virtually

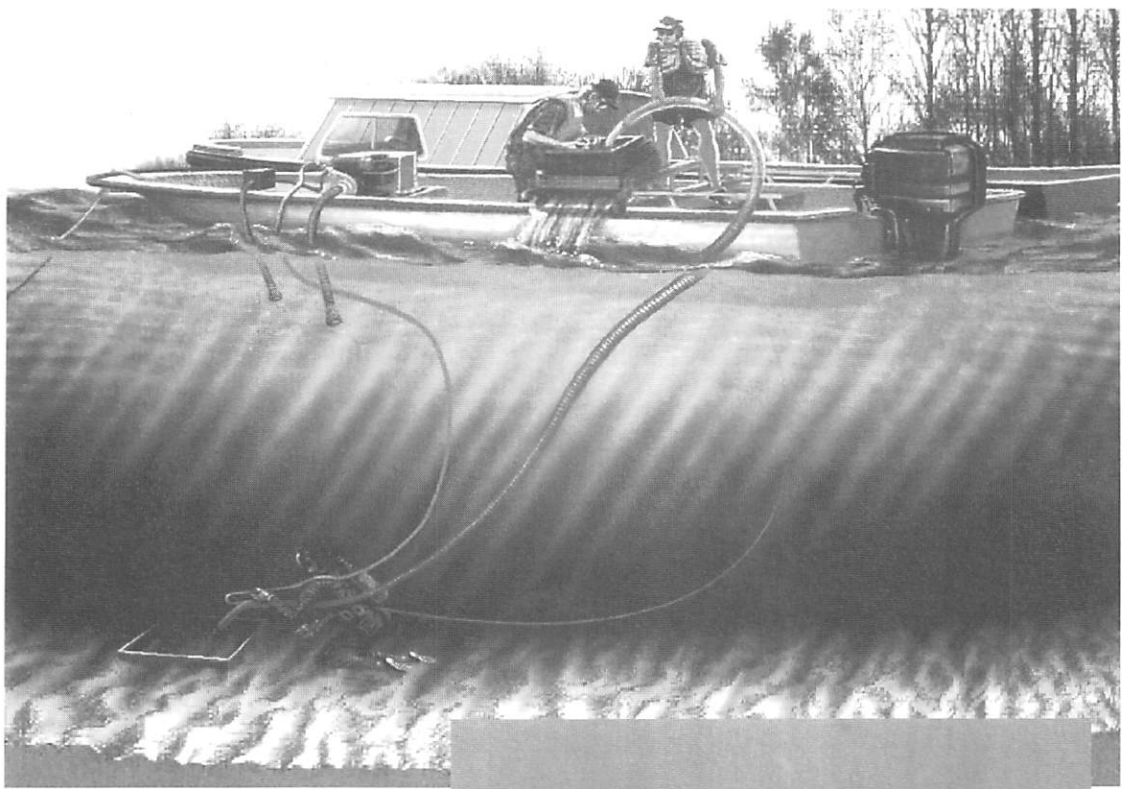

Figure 1. Use of the suction dredge.

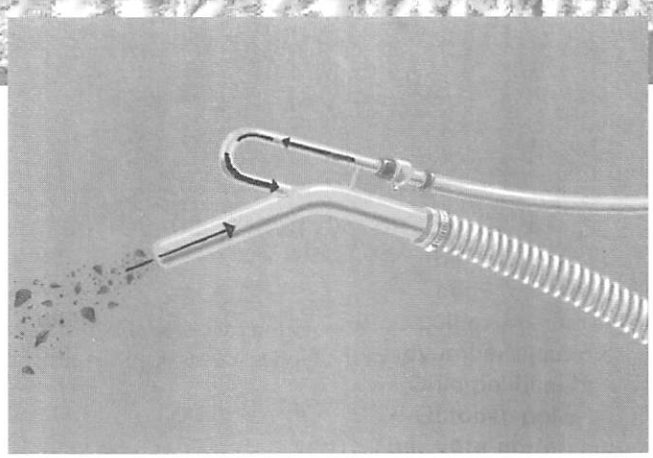

Figure 2. Nozzle of the suction dredge.

impossible for a diver to work among the cobble by hand and to obtain a size-unbiased sample.

Samples were collected with a suction dredge and by total substratum methods in the main channel of Pool 10 of the UMR near Prairie du Chien, Wisconsin, in 1994. Population demography of the dominant threeridge (*Amblema plicata plicata*) collected with both methods was compared (Figure 3). A total of 182 *A. p. plicata* was collected from 30 substratum samples. Minimum and maximum shell lengths were 12.2 mm and 105.5 mm; 39% were less than 50 mm total shell length. Sixty-four *A. p. plicata* were collected from 10 0.25-m^2 samples using suction. Size ranged from 15.4 to 106.4 mm and 22% were less than 50-mm total shell length. Sediments were washed into the same sizes of screens and hand picked; any demographic differences would be caused by collection method.

Discussion and Summary

Wellnitz (1991) stated that disadvantages of his battery-powered suction device were the likelihood of clogging the screen and the need to see organisms; neither of these problems exist with this dredge. The environmental effects of a suction dredge are minor; Thomas (1985) reported that in three 10-m sections located immediately downstream of the dredge, aquatic insect abundances were unaffected ($P > 0.05$). Dredging did decrease the percentage of <6.4-cm-diameter particles, which could affect species richness and diversity.

Griffith and Andrews (1981) and Thomas (1985) reported that dredged areas had essentially completely recolonized within approximately 1 month of dredging. Thomas (1985) cited a report by the California Fish and Game Department that found 7% mortality after entrainment of benthic invertebrates through a 10-cm suction dredge. Mortality was attributed to a substantial amount of gravel that accumulated in the suction dredge. Griffith and Andrews (1981) reported that only 26 of 3,623 macroinvertebrates were either dead or had severe body-wall extrusions. Most of these dead insects were emerging mayflies in the genus *Centroptilum* and were probably susceptible to physical disturbance.

With appropriate equipment and personnel, suction is an efficient technique for collecting mussels from a variety of substrata. Mussel mortality is rare since material does not go through the pump. Based on results of studies with similar devices, dredged zones quickly recover and suction causes little mortality of soft-bodied insects.

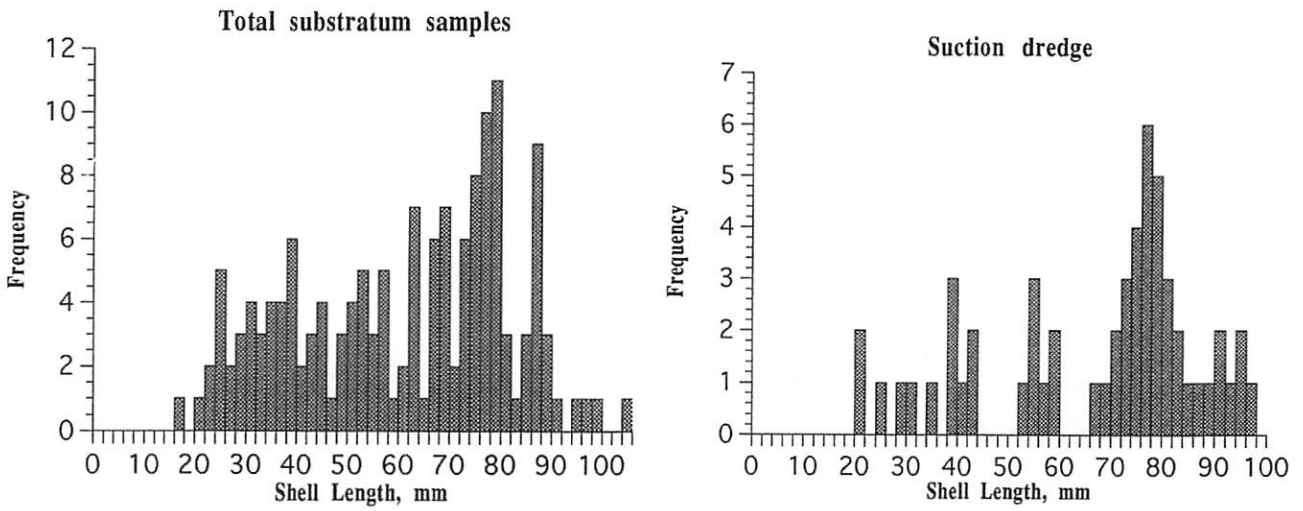

Figure 3. Population demography of *Amblema plicata plicata* from a site in the east channel of the Upper Mississippi River near Prairie du Chien, Wisconsin, 1994.

Acknowledgments

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