EFFICACY OF FOUR DIFFERENT SAMPLING METHODS OF WETLAND MACROINVERTEBRATES

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Abstract. Various samplers originally designed for sampling macroinvertebrates in aquatic ecosystems have been modified for use in wetlands with moderate success. Smaller, quantitative samplers often do not capture rare and mobile organisms whereas larger, qualitative samplers do not allow for density estimates. Sorting time is another important variable in deciding sampling regimes. This study examines the efficacy of four invertebrate samplers in three different wetlands.

INTRODUCTION

Background

Sampling of aquatic macroinvertebrates has become an important part of assessing water quality. While several protocols have been developed for the quantitative sampling of streams and rivers to determine macroinvertebrate abundance and diversity, work has just begun in wetland habitats. Various samplers originally designed for sampling macroinvertebrates in aquatic ecosystems have been modified for use in wetlands with moderate success. Small corers, the most widely used sampler according to a survey by Batzer et al. (2001), are considered to be quantitative although rare or mobile organisms might not be efficiently captured. Euliss et al. (1992) created a multiple tube sampler that sampled both the benthos and the water column simultaneously. This method effectively captured mobile microinvertebrates (Cladocera and Copepoda) and sedentary macroinvertebrates (Chironomidae and Oligochaeta), but no other invertebrates were captured.

The D-frame sweep net is another popular wetland sampler (Batzer 2001). Typically, the net is dragged along the substrate at a 90° angle for 1 m. This sampler efficiently captures large and mobile organisms as well as small and sedentary ones (Cheal et al. 1993), but the sampler is regarded by many biologists as being semi-quantitative (i.e., data cannot be expresses per m^2).

Increasing in popularity, activity traps consist of a funnel attached to a bottle that allows organisms to enter but makes it difficult to escape. Activity traps may be placed at various levels in the water column depending on the method in which they are secured to the substrate. Although improvements have been made on activity traps (Hanson et al. 2000), they are biased to large and mobile organisms because these traps rely upon the movement of the organisms. Thus, activity traps collect qualitative rather than quantitative data. Hyvönen and Nummi (2000) found that benthic activity traps captured similar assemblages to those captured by a corer, although, as one might expect, mobile Dytiscidae and Corixidae were missing from the core samples and the activity traps had fewer Chironomidae and Sphaeridae.

What is missing from wetland studies is a “complete” sampler, one that would combine the quantitative aspects of the corer with the ability of the D-frame sweep net to capture rare and mobile organisms. Some scientists suggest using a combination of sampling devices. For heavily vegetated wetlands, Turner and Trexler (1997) suggest using funnel traps, D-frame sweep nets, and a 1-m^2 throw trap in order to determine the most complete picture of the invertebrate community. More realistic species abundances could be obtained with these devices as compared to benthic corers, plankton tow nets, or Hester-Dendy substrates.

Another major concern in sampling wetland systems is the extensive time required to separate invertebrates from extraneous debris collected while sampling. Core samples contain large amounts of mud that is devoid of invertebrates because it is necessary to include substrate to a depth of 15 – 20 cm, or more, in order to remove an intact core sample from most wetlands. However, invertebrates only occur in the superficial substrates. Sweep net samples collect less substrate because the sampler is simply dragged along the bottom. As a result, sweep net samples require a smaller processing time commitment than core samples. Batzer et al. (2001) recommends combining sweep nets and corers, but using two or more sampling devices will add considerably more time to the sorting process.

STUDY DESIGN

This study compares the efficacy of four sampling devices: a large corer, a D-frame sweep net, a modified Ogeechee corer, and a Hess sampler (figure 1).

(1) Large corer (15.2 cm diameter). For this sampler, the device is driven into the substrate, water is removed with a hand pump and then sediment is removed by hand to a depth of 15 cm. This large corer quantitatively samples both the water column and the substrate.

(2) D-frame (30 cm diameter, 1-mm mesh) net. D-frame net samples are collected by dragging the net along the substrate at a 90º angle for 1 m. In our study, a 0.3 m^2 area will be sampled and the quantitative value of the sampler will be assessed by comparison to the corers.

(3) Modified Ogeechee corer (8.5 cm diameter). This sampler has a serrated blade on the bottom to cut through vegetation and a valve on the top of the corer that creates a vacuum. This small corer should effectively sample small, sedentary organisms but may not capture rare or mobile taxa. The corer is considered quantitative, but it does not sample the entire water column.

(4) Hess sampler. This sampler has a 33.0 cm diameter round frame with a 363 μm mesh collection net. The sampler is driven into the substrate, and the area inside the frame is stirred and the slurry is pushed into the collection net. This sampler may quantitatively sample both the water column and the substrate. It is in many respects a very large corer; however, it should contain less mud and organic debris than the corers.

We are assessing the samplers in three wetlands. The first of these wetlands is a floodplain wetland (University of Georgia Whitehall Forest, Clarke County, GA) that has extensive stands of grasses and shrubs that cover approximately 85% of the wetland. The second wetland is near the first but is a beaver modified oxbow that is sparsely vegetated (15% plant cover. The third wetland is associated with Sandy Creek in the Oconee National Forest, Greene County, GA. This wetland is a floodplain that has been heavily modified by beaver activity, and is now permanently flooded. This wetland is heavily vegetated with herbaceous grasses covering approximately 85%.

Figure 1. Sampling devices used (clockwise from top left): large corer, D-frame sweep net, Hess sampler, Ogeechee corer.

In each wetland five sampling stations were chosen at random locations within the portion of the wetland where water levels normally were < 1 m. This depth restriction is required because the tubular samplers (large corer and Hess) can only be used in shallows. The order of collection (1st, 2nd, 3rd or 4th) and cardinal direction from the center of the sampling station (N, E, S, or W) was randomly assigned for each sampler. Samples were taken from the summer 2003 and spring 2004 in the two sites in Whitehall Forest, and early and late summer 2005 from the Oconee National Forest wetland. Samples were preserved using 95% ethanol and returned to the lab for sorting and identification. Invertebrates will be identified to family. We will extrapolate all samples to invertebrates per m^2. Time taken to sort each sample in the laboratory was recorded for the initial sampling dates because time investment will be a criterion to assess efficacy.

Analyses

To compare the abundances of invertebrates collected by the samplers, we will use three-way ANOVA (sampler X Sampling station X date). Overall invertebrate abundance levels will be assessed first, and then densities of specific taxa. To compare the taxa richness captured by the samplers, we will pool the data from all of the sampling stations within each wetland and run a two-way ANOVA testing the effects of sampler and date. Separate analyses will be run for each wetland. Finally, we will contrast the samplers by processing time using a one-way ANOVA.

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