The Double-slide Method: An Improved Method for Collecting Organisms and for Successional Studies in Aquatic Environments

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Introduction

Artificial substrata have been used by many authors for ecological studies in aquatic environments. Pieces of glass have been commonly placed on the bottoms of rivers and lakes for these purposes since they can be used later for microscopical studies without undue disturbance. These kinds of experimental surfaces have been criticized since they are not "natural" (and, consequently, they would not reflect actual ecological phenomena; Margalef, 1974). Opaque substrata, such as rocks, have been abandoned in favor of glass because of the more practical characteristics of the latter.

It seems that Hentschell (1916) was the first who used the glass substratum method (for a historical account of the first studies with this method, see Butcher, 1932). Recently, Margalef (1974) used the system of hanging one or more slides with a cord anchored in rocks of rivers.

Capillary methods have also been used for aquatic ecological studies, especially for collecting organisms (Perfiliev, 1969).

Methods and Site Description

The method that we developed in Monteverde combined the artificial substrate and capillary methods. The device, which we call the double-slide, consists of two microscope slides separated by two very thin cords of nylon at each end. The nylon cords not only create a thin space between the glass slides but also were used to anchor the double-slide to rocks or logs. In this way we obtained not only a double surface for colonization by aquatic organisms but also additional organisms retained by capillary between the two slides.

Two sites along the same river were studied. The first was about 200 m downstream, the second about 25 m upstream, from the Monteverde Lechería. This Lechería produces a daily effluent of residues with high amounts of salt, moderate amounts of lactose, and low amounts of proteins and nitrates. The total volume of residues per day is about 6000 liters, producing a milky mixture in the river water.

The double-slides were hung from logs which were anchored with rocks. The slides were perpendicular to the stream flow, and were held at an intermediate depth by the log floats. Twenty one double-slides were used: 10 above the Lecheria and 11 downstream from that site. Five of each were hung in fast flowing water and the other five in slow moving water. The relative depth of all slides was the same. The last double-slide was placed on the bottom at the exit of a small phreatic water source (spring) which flowed into the main stream.

The double-slides were set on July 25, 1981, and the dates when the samples were taken from the water are shown in Table II.

Comparative Studies

In order to determine the effectiveness of our method, we used it in similar places to where studies on the effect of the dairy effluent on stream biology were done two years before (Cover et al., 1979). During those previous studies, several extensive methods of collecting were used: water column infauna was sampled with a seine net (approximately 1.5 x 3 m); epifauna by sampling surface infauna on stream bed rocks; infauna by passing stream bottom sediment through seiving screens; and scrutiny of leaf litter samples for surface organisms. Since we can consider that the river was extensively sampled with these different methods, the comparison of their results with our results should yield an indication of how effective our method is.

The results obtained by Cover et al. (1979) are shown in Table I. Our results are shown in Tables II and III. The same diversity index (Shannon-Wiener) was used in both experiments.

Results

Our method seems to be very effective. We obtained similar values for the diversity indices (and in some cases, even larger values) and approximately the same kinds of organisms as were obtained two years before using more extensive and diverse methods (Cover et al., 1979).

Our results also show that the faunal composition in adjacent slow and fast flowing portions of the river is quite different. The diversity was always higher in slow-moving waters than in fast-moving ones. Also, there is a significant correlation between taxa and the place and/or speed of the stream.

Surprisingly, no algae were found fixed to the surfaces of the double-slides. Since algae are by far the most frequent organisms collected on experimental surfaces in temperate climates, probably algae in some tropical streams have very different abundances and/or importances. We know very little about tropical streams. More research is needed in order to understand better the ecological differences between temperate and tropical freshwaters.

We did not find any organisms on the double-slide laid on the stream bottom at the spring. Therefore, the contribution of the spring to the total stream biomass must be minimal with the possible exception of bacteria.

Although the faunal composition of the double-slides set in the same place changes through time, more research is needed in order to get a more precise idea about succession of organisms in these waters.

The organisms captured during our research seem very peculiar. Because of the lack of taxonomic studies on aquatic invertebrates in Central America, we have sent several specimens to specialists in order to have them identified.

Conclusions

The double-slide method is an improved method of sampling stream invertebrates, which combines the experimental substratum and capillary techniques. The indices of diversity and the qualitative list of organisms captured with the double slides demonstrate that this method is a useful one in comparison with other methods of collecting freshwater invertebrates. Our results indicate that the composition of the stream

community depends upon the speed of the stream. More comparative studies using the double-slide method in well-known environments are encouraged in order to determine the advantages and limitations of the method. Also, short and long term studies using this method at the same site should give us relevant information about the composition and succession of organisms in tropical freshwaters.

Literature cited

Butcher, R. W. 1932. Studies in the ecology of rivers. II. The microflora of rivers with special reference to the algae on the river bed. Ann. Bot. 46(186): 813-862.

Butcher, R. W. 1940. Studies on the ecology of rivers. VI. The algal growth in certain highly calcareous streams. J. Ecol. 33: 268-283.

Ivlev, V. S. 1933. Ein versuch zur experimentallen erfurschung der okologie der wasserbioconosen. Arch. Hydrobiol. 25: 177-191.

Margalef, R. 1974. Ecologia. Ed. Omega, Barcelona.

Pentalow, F. T. K., R. W. Butcher, and J. Grindley. 1938. An investigation of the effects of milk wastes on the Bristol Avon. Fish Invest. Series 1, 4(1).

Table I. Upstream from the Lecheria.

Water Column

2 Libellulidae (Odonata)
2 Stonefly larvae
2 tadpoles
1 freshwater crab

7 ind/4 spp H = 1.3518

Epifauna

103 chironomid tubes
27 chimney Trichopters
3 small sack Trichoptera
1 large case Trichoptera
2 Mayfly larvae
Light filamentous algae and diatom cover

137 ind/6 spp H = 0.6082

Infauna

201 amphipods
2 fly larvae
2 bivalves
3 Stonefly larvae
1 Mayfly larva

209 ind/5 spp H = 0.2130

Leaf Litter

No organisms

Physical parameters

pH 5.0
Temp 16.9°C
Depth 41.2 cm
Velocity 0.164 m/s
Light (rel scale) 1

Downstream from the Lecheria.

Water Column

72 nematodes
2 planaria
1 red chironomid
4 purple chironomids
4 chironomid pupae

83 ind/5 spp H = 0.5586

Epifauna

68 planaria
417 purple chironomids
1 red chironomid
1 bivalve
1 water mite
1 fly pupa
1 white leech
2 nematodes
1 arthropod

493 ind/9 spp H = 0.5126

Infauna

113 white leeches
8 bivalves
2 purple chironomids
3 red chironomids
1 Trichopteran
1 planaria
1 fish larva

129 ind/7 spp H = 0.5535

Leaf Litter

Numerous leeches
water mites
free-living dipteran larvae

Physical parameters

pH (before whey) 5.0
Temp 17.2°C
Depth 23 cm
Velocity 0.153 m/s
Light 2

Table II. Organisms collected upstream and downstream the Lecheria, in different dates and water speed (F=fast; S=slow). (Each rectangle=1 double-slide).

Date	Water Speed	Downstream	Upstream
7/27/	F	10 chironomid larvae 1 oligochata larva 11 ind./2 ssp H=0.44	
	S	1 mollusk (adult) 1 mollusk (larva) 3 planaria larvae 20 ciliata 25 ind./3 ssp H=0.92	
7/29/81	F 1)	12 chironomids (almost adult) 12 ind./1 sp. H=0	10 gelatinous substances with amphibian eggs 1 planaria (adult) 1 chironomid larva 13 "ind."*/3 ssp. H=1
	2)	5 chironomid (adult) 1 hairy arthropod (?) 6 ind./2 ssp. H=0.2	13 gelatinous substances with amphibian eggs 1 chironomid larva 1 chironomid adult 15 "ind."*/3 ssp. H=1
	S 1)	1 red chironomid (adult) 4 chironomid larvae 5 ind./2 ssp. H=0.7	5 ciliata 5 ind./1 ssp H=0
		14 oligochaeta larvae 10 ciliata 4 mollusks (different sizes) 1 arthropod larva 1 planaria larva 30 ind./5 ssp. H=1.76	1 red chironomid 1 ind./1 sp. H=0
8/22/81	F	40 oligochaeta larvae 1 planaria adult 41 ind./2 ssp. H=0.22	
	S	1 mollusk 1 platyhelminthe 1 chironomid adult 1 oligochaeta larva 4 ind./4 ssp. H=2	

Water of phreatic origin - no organism was observed

* Each gelatinous substance with amphibian eggs was considered an "individual".

Table III.

Taxon	DSF	DSS	USF	USS	Total
Gelatinous substances with amphibian eggs	-	-	23	-	23
Ciliata	-	30	-	5	35
Chrionomid larvae	27	4	3	-	34
Chironomid adults/near adults	13	-	1	-	14
Chironomid (red)	-	1	-	1	2
Oligochaeta larvae	1	14	-	-	15
Molluscs	6	-	-	-	6
Planaria larvae	-	4	-	-	4
Planaria adults	-	-	1	-	1

DSF = downstream, fast; DSS = downstream, slow; USF = upstream, fast; USS = upstream, slow.