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Sampling neotropical young and small fishes in their microhabitats: An improvement of the quatrefoil light-trap

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With 4 figures and 1 table in the text

Abstract

An improved version of the quatrefoil light trap was tested in a tributary of the Sinnamary River, French Guiana, South America, at the beginning of the rainy season. The entire trap was simplified to lower the cost and increase the reliability of the entire system in harsh field work conditions. The major improvement was an inexpensive electronic light-switch that automatically lighted the lamp at dusk and turned it off at down allowing deployment of numerous traps over large distances. Most of the 648 individuals caught in the 76 samples were Characiformes larvae, juveniles, and small adults. Some Clupeiformes, Siluriformes, Cyprinodontiformes, Syngnathiformes and Perciformes were also caught but no Gymnotiformes were represented in the samples. Light traps appear useful to sample in their microhabitat neotropical young and small fishes of several taxonomic groups.

Introduction

The light trap described herein was developed to sample young and small freshwater fish species in French Guiana, South America. The early life history of most of the South American fish species still remains largely unknown. Identically, the ecology of small fish stays poorly documented, although they constitute a large proportion of the fish communities in this area (MILLER 1979, WEITZMAN & VARI 1988).

Sampling with light has been used to catch freshwater invertebrates (DOMMANGET 1991), small invertebrates and vertebrates in lakes (FABER 1981), larval fish in temperate streams (FLOYD et al. 1984 b) and lakes (GREGORY & POWLES 1985, HAMMER 1983), ichthyoplankton in nearshore tropical environments (DENNIS et al. 1991), coral reef fish larvae (DOHERTY 1987), and even zooplankton under the Antarctic ice (KAWAGUCHI et al. 1986).

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The aim of this present work was to present a cost efficient light trap suited to be used in a large number of neotropical environmental conditions. Additionally, the results presented here give a first insight of the sampling capabilities of the apparatus.

Material and methods

The light trap (Fig. 1) is a simplified version of the model developed by FLOYD et al. (1984a). Top and bottom 200 × 200 mm Plexiglas plates are not grooved and the three-quarters of a circle 40 cm long, 8 cm O.D. tubes are directly cimented on them. Four

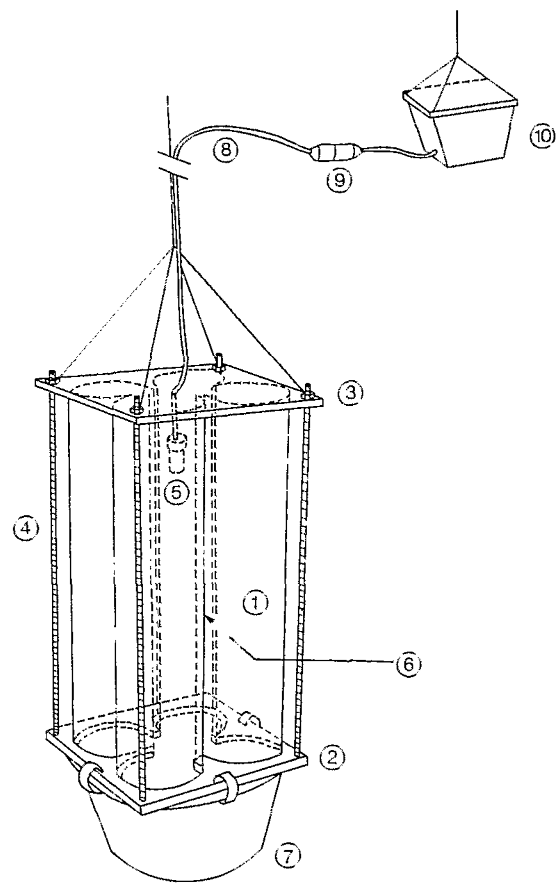

Fig. 1. Schematic representation of the improved version of the quatrefoil trap. **1.** Three-quarters of a circle 8 cm O.D. Plexiglas tubes. **2.** and **3.** Bottom and top 200 × 200 × 5 mm Plexiglas plates. **4.** Threaded metal rods (6 mm diameter) bolted to top and bottom Plexiglas plates. **5.** Lamp bulb encased in a sealed 40 ml polypropylene vial. **6.** Entry slot (4 mm width). **8.** Two wires connection cable. **9.** Waterproof connection. **10.** Battery and electronic circuitry encased in a weather-resistant clear plastic box.

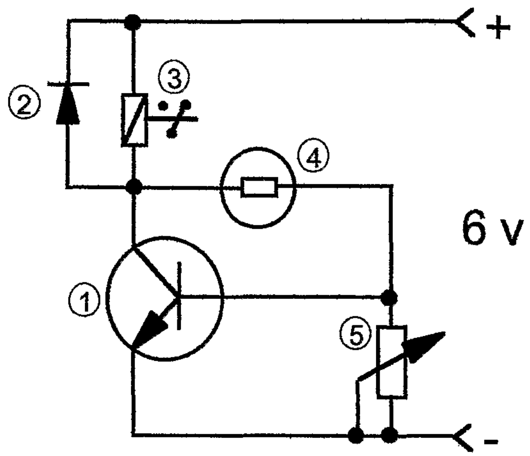

Fig. 2. Circuitry of the electronic light-switch. **1:** Transistor 2N222, **2:** Diode 1N4148, **3:** Electromagnetic switch 6V/100 Ohms, 4: Photoresistance LDR05, **5:** Adjustable resistance 4.7 Kohms.

threaded metal rods are bolted at each corner of the plates to protect and solidify the trap. The width of the entry slot is increased to 4 mm allowing larvae and small fish to enter the trap. The collection pan is made from a 20 cm diameter plastic bowl which bottom has been replaced by sealed 500 μm Nitex. This bowl is held to the bottom plate by four 2 cm diameter plastic clips. The 6V/500 mA lamp bulb is placed in a sealed 40 ml polypropylene vial equipped with a 3 m outer conductor. No light distribution device is used. Power is provided by a 6V/10 Ah sealed lead acid type rechargeable battery. The major improvement consists in an electronic light-switch (Fig. 2) that lights the lamp at dusk and turns it off at dawn. This system allows automatically to switch on and off the lamps of several traps at the same moment whatever the distances between them are. Moreover it increases the life-duration of the battery by turning off the lamp even if recovery is delayed. The battery and the electronic system are encased in a weather-resistant clear plastic box with a 0.5 m outer conductor. This system is linked to the trap by a waterproof connection. Total cost of the entire system remains under US$ 100 (1992).

Sampling took place in the Vénus Creek (5° 11′ N, 52° 58′ W), a tributary of the Sinnamary River (French Guiana, South America). From November 1992 to January 1993, i.e. at the beginning of the rainy season, five to nine traps were deployed during each of the ten nights of sampling (two nights in November, four in December and four in January). The traps were set between 0 and 2 m depth over a ca. 2 km distance in the Creek. The total depth of the microhabitats varied between 0.5 and 3 m, temperature ranged from 23.1 to 27.0 °C, pH from 4.5 to 5.6, conductivity from 22.4 to 33.1 $\mu S \cdot cm^{-1}$, and oxygen from 4.4 to 6.4 $mg \cdot l^{-1}$. Bottom substrate consisted mainly of mud covered with dead leaves and dead wood. Depending on water level, the traps were occasionally set in immersed terrestrial vegetation.

All fish were counted and measured (standard length) to the nearest 0.1 mm for larvae, and 1 mm for larger individuals. Identifications were made according to Le Bail et al. (1983 a and b), Le Bail et al. (1984), Rojas-Beltran (1984), Géry (1977), and Ponton (unpubl. data).

Results

A total of 648 individuals belonging to 32 taxa and six orders were obtained from the 76 samples (Table 1). *Hyphessobrycon* sp. aff. *sovichthys* and *Pristella maxillaris* juveniles and adults were the most abundant and contributed to 31.2 and 21.4 % of the total respectively. Fish larvae totalized 91 individuals (14.0 %) classified in seven different taxa.

Standard lengths of the catches varied from 3.5 to 42 mm with one outlier at 90.0 mm corresponding to a Syngnathidae (Fig. 3). The size distribution showed two distinct modes, one corresponding to the larval stages and the other to juveniles and small adults. The number of fish per trap caught in a night varied from 0 to 59, and the mode was between 1 and 5 (Fig. 4 a). Up to eight taxa were recorded in the traps (Fig. 4 b).

Discussion

Few reliable techniques have been developed to sample young and small fishes of neotropical freshwaters in their microhabitats. The sampling efficiency of rotenone usually remains very low for small fishes due to their lower rate of flotation, their lower visibility during retrieval, and the predation by larger individuals (Bayley & Austen 1990). Sensitivity to this ichthyocide varies greatly among fish species and introduces uncontrolled bias in the samples (Hocutt et al. 1973). Moreover, rotenone remains more adapted to sample fish communities in meso- than micro-habitats. Active samplers (tow- and push-nets) have to be replaced by passive ones in physically obstructed environments (Gregory & Powles 1988). However, pull-up traps (Higer & Kolipinski 1967, Kushlan 1974), drop traps (Kahl 1963), and throw traps (Kush-

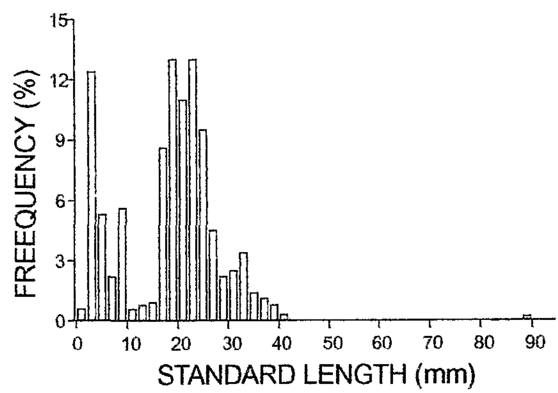

Fig. 3. Size distribution (standard length mm) of all the fish caught in the light-traps from November 1992 to January 1993 (N = 639). Note: The 90 mm SL individual corresponds to the Syngnathidae.

Table 1. Fish species caught in the Vénus Creek with light-traps Nov. 92–Jan. 93. Systematic positions after GÉRY (1977) and NELSON (1984).

Scientific name	Total number captured	Standard length (mm)		
		Mean	Min	Max
Clupeiformes				
Engraulididae				
Engraulidinae sp1	4	16.5	15.0	18.0
Engraulidinae sp2	1	12.9	–	–
Characiformes				
Lebiasanidae				
Pyrrhulininae				
Nannostomus beckfordi GÜNTHER, 1872	2	27.0	27.0	27.0
Characidae				
Characidae sp1	3	10.6	9.5	11.6
Characidae sp2	1	25.0	–	–
Characidiinae				
Characidium sp. gr. *fasciatum*	5	31.0	29.0	33.0
Serrasalminae				
Myleus ternetzi (NORMAN, 1929)	1	25.0	–	–
Myleus sp.[1]	2	11.2	11.1	11.3
Tetragonopterinae				
Bryconops sp.	8	23.5	18.0	30.0
Hemigrammus ocellifer (STEINDACHNER, 1882)	18	29.2	25.0	35.0
Hemigrammus unilineatus (GILL, 1858)	2	21.8	12.7	31.0
Hyphessobrycon sp. aff. *sovichtys*	202	24.4	18.0	30.0
Moenkhausia collettii (STEINDACHNER, 1882)	55	34.9	28.0	42.0
Moenkhausia comma EIGENMANN, 1908	3	34.3	28.0	40.0
Moenkhausia hemigramoides GÉRY, 1966	4	34.0	28.0	39.0
Moenkhausia oligolepis (GÜNTHER, 1864)	13	12.9	8.0	21.0
Moenkhausia sp. aff. *surinamensis*	1	34.0	–	–
Pristella maxillaris (ULREY, 1894)	139	20.0	7.8	28.0
Pseudopristella simulata GÉRY, 1960	16	25.7	22.0	32.0
Siluriformes				
Loricariidae				
Loricariidae sp.	2	10.0	8.0	12.0
Cyprinodontiformes				
Poeciliidae				
Tomeurinae				
Tomeurus gracilis EIGENMANN, 1909	3	17.5	9.4	22.0
Syngnathiformes				
Syngnathidae				
Syngnathinae				
Syngnathinae sp.1	1	90.0	–	–
Perciformes				
Eleotrididae				
Dormitator macrophtalmus PUYO, 1944	1	11.4	–	–
Eleotris sp.	69	9.5	7.5	24.0
Gobiidae				
Gobiidae sp.	1	19.0	–	–
Fish larvae[2]				
larvae sp1	3	5.4	5.4	5.4
larvae sp2	1	7.4	–	–
larvae sp3	5	3.9	3.5	4.5
larvae sp4	6	4.6	3.5	5.2
larvae sp5	1	5.2	–	–
larvae sp6	70	5.4	5.0	5.9
larvae sp7	1	4.3	–	–
undetermined larvae	4	–	–	–

[1] probably *Myleus ternetzi* (NORMAN, 1929). [2] mostly Characiformes larvae.

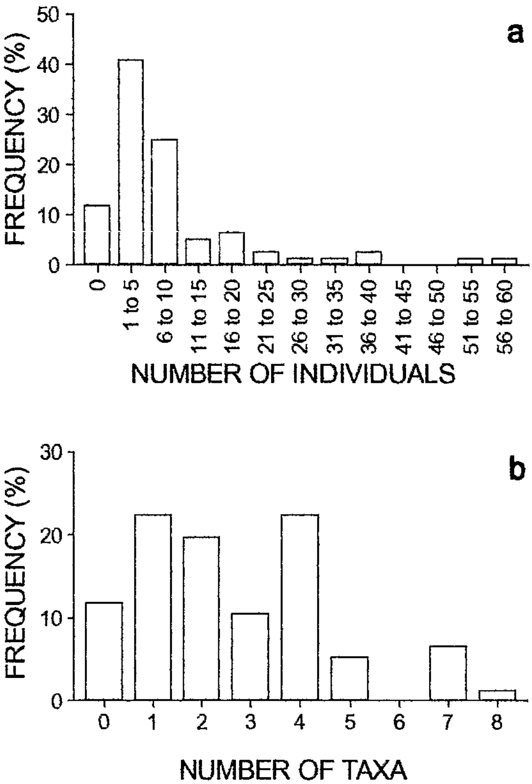

Fig. 4. Frequency distribution of (a) the number of fish and (b) the number of taxa caught per sample (N = 76).

LAN 1981) remain more addressed to large lenitic weedy areas that small tributaries encumbered by dead trees.

Light sampling appears to be a useful technique despite its selectivity for taxonomic composition and size (for a complete discussion see DENNIS et al. 1991, DOHERTY 1987, GREGORY & POWLES 1988, among other). No Gymnotiformes and few Siluriformes were caught by light traps in Vénus Creek although large adults (LAUZANNE & TITO, pers. comm., ORSTOM, Cayenne) and juveniles (PONTON, unpubl. data) of these groups have been obtained in large quantities respectively with rotenone and drift nets. Nevertheless, the light traps were useful to detect early reproduction of different taxa as indicated by the occurrence of Characoid larvae, young Engraulididae, Characidae (*Pristella maxillaris*), Serrasalmidae (*Myleus* sp.), Loricaridae, Poecilidae (*Tomeurus gracilis*), and Eleotridae (*Eleotris* sp.). At least for these taxa, the reproduction and emergence of offspring seem synchronized with the beginning of the short rainy season. Light traps, which have been shown to be quite effective in determining the chronology and distribution of larval fish in temperate lakes (GREGORY & POWLES 1988), seem also useful to explore the same field of research in neotropical areas.

In conclusion, the reliability and effectiveness of this version of the quatrefoil trap and its electronic light-switch was demonstrated along three months of trial. The system proved to be useful to sample fish larvae and older small fishes of neotropical freshwaters in their microhabitats. The low price of the entire apparatus, its null-maintenance needs, and the electronic light-switch allow to increase easily the number of traps set in the field whatever the duration for deployment and recovery are.

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