Differences between Electrofished and Seined Golden Shiners
as Related to Swimming Performance

By

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INTRODUCTION

Electrofishing is considered a standard method of capturing fishes for a variety of studies (Reynolds 1983). Indeed it may be superior in some environments when compared to other methods of collection (Layher and Maughen 1985). Efforts have been made to standardize techniques and improve on this method of sampling fishes (Burkhardt and Gutreuter 1995). Benthic species in shallow rivers may be missed in samples by gear types such as seins.

Numerous authors have reported on electrofishing injury and mortality, especially as it relates to collection of game fishes (Horak and Klein 1967; McMicheal 1993; Mesa and Schreck 1989; Reach 1962; Schreck et al. 1976; Sharber et al. 1994; Spencer 1967; Taube 1992; Whaley et al. 1978; and Zalewski and Cowx 1990). Of lesser concern until recently, is the impact of this sampling technique on small fishes.

If injuries occur to small fishes, use of electrofishing to sample threatened or endangered populations may be a concern. Sampling riffles in stream systems, especially where such habitats are rare would also be of concern. Areas where recruitment potential from up or downstream habitats is likely would be of less concern to the researcher.

Mortalities of small fishes were often noted by the authors of this paper when electrofishing was utilized as a capture method. Less intense use of electricity, short bursts of power as opposed to continuous shocking, seemed to produce less mortalities.

Long-term effects of electrofishing on small fishes are unknown. However, if they occur or make fishes less fit or mobile to cope with environmental conditions, mortality could be theorized to occur from factors such as increased predation; inability to forage, or lack of the ability to negotiate currents in stream environments.

A study was designed to compare swimming performance of golden shiners (Notemigonous crysoleucas) that were collected by electrofishing to golden shiners which had not been electrofished.

MATERIALS AND METHODS

Apparatus

An apparatus was built to enable the determination of swimming speeds of small fishes. The apparatus was similar to that used by Matthews (1985) but was modified to obtain variable current velocities. The system consists of a submersible pump with an 18-inch riser 1.5 inches in diameter. This discharges through a diverter valve and a main flow valve. Bushings in pipe size ultimately divert flow through a three-inch clear PVC pipe. A petcock at one stage allows air to bleed from the tubing. An access plug located at the end of the clear pipe allows fish entry and exit to the system. A strainer at each end prevents fish from moving downstream or upstream out of view. Flows are diverted back into an aquarium equipped with temperature control; the same location as the water source.

A guide was placed in alignment with the valve handle to calibrate and allow velocity computation. The guide was marked in degrees so positions of the handle could be recorded during trials.

Flow through the clear pipe was determined by allowing the pump to run at a particular setting for a known period of time. Water volume per unit time was divided by area of the pipe cross section to obtain velocity. The process was repeated five times at five settings. With settings regressed against velocities one could enter the setting from the valve handle guide into the regression equation to obtain velocity at any desired time. Velocities produced by the apparatus in this study ranged from 11.124 cm/sec to 72.890 cm/sec. The apparatus, named an ichthyonatometer, has been fully described (Ralston and Layher 1997).

Fish collection and experiments

Fish were collected from the upper Ouachita River at three localities using a back-pack electrofishing unit. High mortalities were encountered and fish were again collected using short bursts of power.

Four 20-gallon aquaria with carbon filters were used to maintain fishes in the laboratory. Individual fishes were placed into the testing apparatus; then allowed to acclimate to a low velocity. After acclimation was achieved, velocity was increased slightly. The fish was again acclimated for approximately two minutes.

Eventually a point was reached at which the fish encountered some difficulty maintaining position. This point is referred to simply as "difficulty". Velocity was again increased until the fish was swept through the tube with no recovery upstream. This point was termed "cannot hold."

Golden shiners from the University of Arkansas at Pine Bluff's experimental fish hatchery were also tested. These fish had been cultured in ponds at that facility. Fish were collected by seining. After a three day acclimation period, these fish were used to determine swimming speeds.

RESULTS and DISCUSSION

Eleven golden shiners from the Ouachita River were collected by electrofishing and used in swimming performance tests. Specimens ranged from 50-110 mm in total length (Table I). Difficulty and cannot hold velocities ranged between 40 and 50 cm/sec and 50 and 60 cm/sec, respectively, regardless of length. (Fig. 1 and 2). No significant relations were found when velocity measurements were regressed against fish length.

Forty-six golden shiners were collected from the University of Arkansas at Pine Bluff's fish hatchery by seining and subjected to swimming speed tests (Table II). Fishes from this group showed strong relations of fish total length to velocities at both the difficulty and cannot hold measure. (Figure 3 and 4). When velocities were regressed against fish length significant relations were found (equations 1 and 2):

1). Difficulty (cm/sec) = 17.16 + 4.08 (fish length in cm); (R^2=0.707)

and

2). Cannot Hold (cm/sec)=21.13 + 4.10 (fish length in cm); (R^2=0.706)

These data provide evidence that golden shiners collected by electrofishing exhibit poorer swimming performance that those collected by seining especially for larger individuals tested. Larger fish could maintain positions between 60 and 70 cm/sec from the seined group. It would appear that smaller size groups of golden shiners collected by either group perform similarly, while larger electrofished specimens perform at about the same level as their smaller cohorts. The results of this study are surprising in that the fish from the culture station had never been subjected to strong water currents, yet performed better than fishes collected from the upper Ouachita River, a mountainous stream.

The use of electrofishing small fishes may need to be carefully studied to assess potential impacts to organisms that are a part of unique journal compositions or considered threatened and endangered. Electrofishing however, remains one of the best collection methods available to researchers investigating streams with heterogenous substrate types, logs or other obstacles which render other gear types inefficient.

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Table I. Mean Difficulty (DF) velocities (cm/sec), cannot hold (CH) velocities (cm/sec), and total lengths (cm) of golden shiners used in swimming performance tests from the Ouachita River by length group.

Group	IV	Length	DF	CH
5	3	5.60	45.76	50.57
6	2	6.15	40.20	45.81
7	3	7.60	45.81	51.29
8	1	8.70	45.81	51.29
9	1	9.20	45.81	51.29
10	1	10.50	36.86	40.29