Swimming Speed Performance of the Longear Sunfish

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INTRODUCTION

Protection of small streams and their associated fauna are of major importance to land management agencies such as the U. S. Forest Service. Small streams provide habitat for endemic species in the Ouachita drainage such as the paleback darer (Etheostoma pallididorsum) as well as other more distributionally widespread species (Robison and Buchanan 1988). Some of the species that occur in small streams, while found in other areas as well,, are nevertheless important components of the stream's ecosystem.

Modification of streams can come in a variety of forms ranging from channel alterations to land use practices affecting stream runoff. Channel restrictions such as culverts can increase current velocities and reduce stream bottom roughness causing difficulty for small fishes moving upstream. Theoretically this could eliminate ephemeral spawning grounds as well as recruitment into ephemeral drainages when conditions were more favorable for fishes. The velocities which small fishes can endure and for what periods of time are of special concern in determining impacts of structural stream alterations such as culverts.

A number of studies have been performed on the swimming abilities of larger fishes (eg. Thomas and Donahoo 1977; Buckley et al. 1985). Apparatus used in each of these studies appeared unsuitable for determining swimming speeds of small fishes . Much of the literature on small fishes related to swimming abilities often involve selection of habitats in an artificial stream by fishes rather than assessing ability of the fish to successfully negotiate a current of known velocity (eg. Matthews et al. 1990). In this study we determine the endurance of the longear sunfish (Lepomis megalotis) to select current velocities from low velocities to velocities which produce complete failure by the fish to negotiate.

MATERIALS AND METHODS

Layher and Ralston (1995) found significant differences between swimming performance of small fishes collected by seining and those collected by electrofishing. Consequently all fishes used in this study were collected by seining which was assumed to have no negative impact on the fishes swimming ability. Several collections of fishes were made in the Ouachita River and tributaries. These collections provided specimens which were housed in a controlled environment where oxygen and temperature were held relatively constant. Temperatures varied from 17. 9 to 20.1 c and dissolved oxygen ranged between 6.0 and 7.0 mg/l.

Ralston and Layher (1997) described an ichthyonatometer, a device designed to allow the determination of either fish swimming endurance at a select velocity or the point at which a fish can no longer traverse the current. This device was used in this study. The device produces velocities from 0 to over 100 cm/sec. Five different velocities were used to assess the endurance of longear sunfish: 16, 19, 22, 33, and 39 cm/sec.

Prior to placing fish in the ichthyonatometer, water temperature in the tank of origin was compared to that in the swimming chamber reservoir to ensure no significant temperature difference. Fish were inspected upon removal from their aquarium for signs of disease or fungus. No fish were used that displayed any signs of ill health or incomplete caudal fins. Fish were allowed to acclimate to low flow levels in the chamber before velocity was gradually increased to the desired level. Upon reaching the test velocity, time was recorded to the nearest second until the fish was exhausted or fourteen minutes had been successfully negotiated. Eighty-nine longear shiners were tested in the apparatus. Fish were tested one at a time to avoid potential effects of flow alteration in the chamber. Percent failure at two minute intervals for each test velocity were calculated.

RESULTS and DISCUSSION

Longear sunfish were able to endure velocities up to 19 cm/sec for two minutes. The success rate dropped to 91 percent at 22 cm/sec and fell to 88 percent at 33 cm/sec. Forty-three percent could traverse velocities of 39 cm/sec for a two minute time interval (Table 1).

Increasing the time of exposure to current velocities caused reduced success. Only 44 percent of the fishes tested could successfully negotiate velocities of 33 cm/sec and all fish were unsuccessful during a four minute time period at 39 cm/sec.

Exposing fish to velocities for six minutes resulted in 100 percent failure at 39 cm/sec and 19 percent success at 53 cm/sec. Success rose to 91 percent at 22 cm/sec with total success at 16 and 19 cm/sec for the six minute time period.

No fishes could negotiate current velocities in excess of 22 cm/sec for time periods of 10 minutes or greater. Longear sunfish appear to exhibit points at which success drastically falls in relation to increasing time periods at any given velocity (Fig. 1). These was no significant difference in size of fish used between trials ($F=0.871$; $P>F=0.484$) (Table II).

Results of these endurance trials suggest that longear sunfish cannot traverse high velocities. No apparent positioning behavior was noted by these fish. Data presented could be used to estimate fish passage success around barriers if velocities are known.

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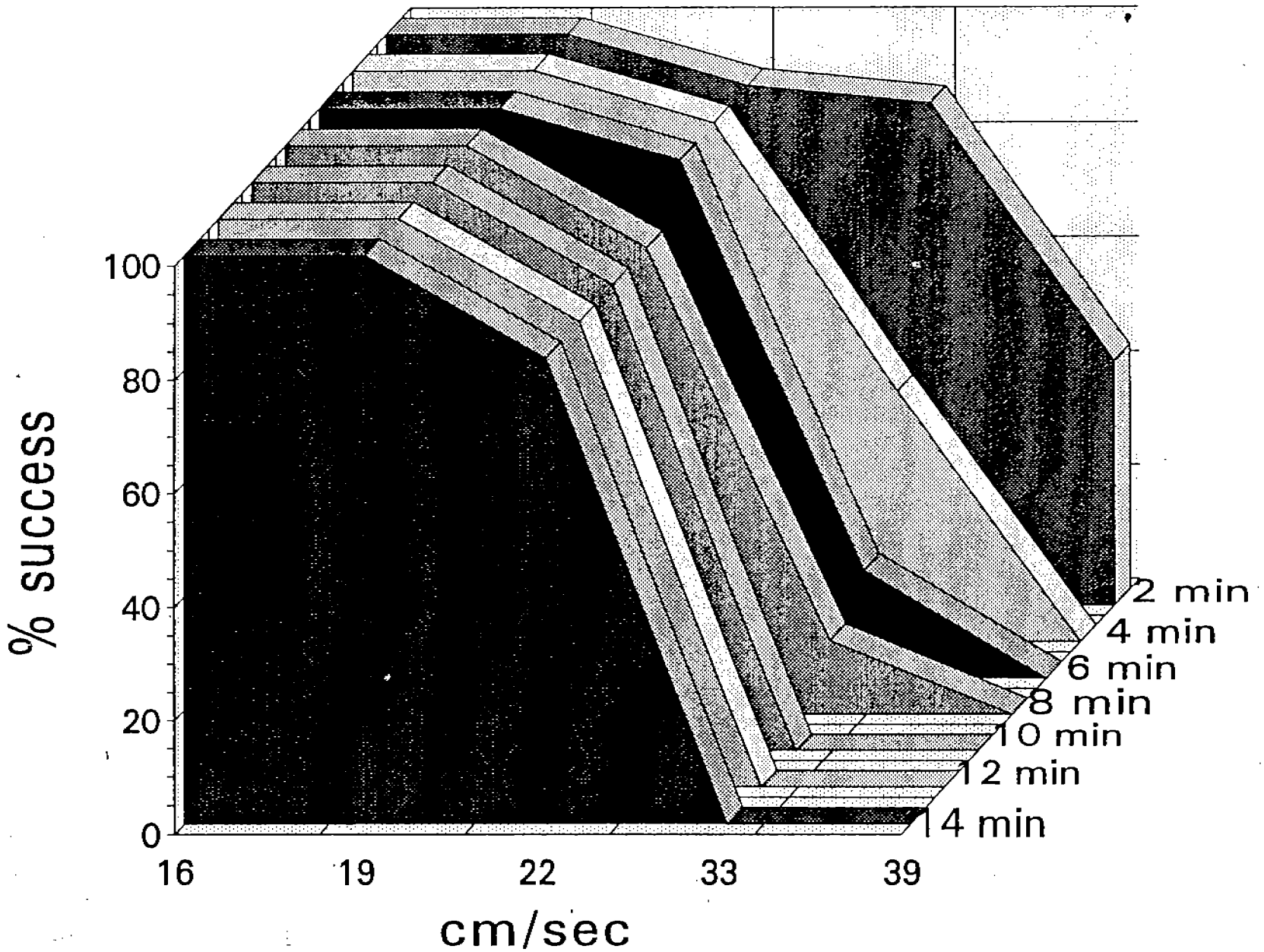
Table I. Percent success of longear sunfish for various velocities (cm/sec) at two minute intervals.

Time	16	19	22	33	39
2	100	100	91	88	43
4	100	100	91	44	00
6	100	100	91	19	00
8	100	100	82	13	00
10	100	100	82	00	00
12	100	100	82	00	00
14	100	100	82	00	00
n=	29	19	11	16	14

Table II. Total length (mm) statistics for longear sunfish used in swimming speed trials at various velocities (cm/sec). Analysis of variance revealed no significant difference between groups: F=0.871; P>F=0.484.

	Velocities				
	16	19	22	33	39
Minimum	50.0	59.0	59.0	56.0	57.0
Maximum	136.0	136.0	136.0	132.0	135.0
Mean	88.7	94.7	93.9	81.6	88.9
Variance	442.3	423.3	686.4	434.0	640.9
Standard deviation	21.0	20.5	26.2	20.8	25.3

Figure I. Relation of velocity and time to swimming performance of longear sunfish.


% SUCCESS LONGEAR SUNFISH
% success
100
80
60
40
20
0
16
19
22
33
39
cm/sec
2 min
4 min
6 min
8 min
10 min
12 min
14 min