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Effect of Electroshock Voltage and Wave Form on Mortality of Incubating Walleye Eggs

Abstract

Commonly used electrofishing wave forms and voltages were tested to determine if they could be used to kill walleye eggs as part of walleye-control projects. Eggs were exposed to Pulsed DC (direct current), AC (alternating current), or Smooth DC (SDC) current from an electroshocker at outputs of 0.98, 2 6, or 5.9 v/cm, respectively, for 10 seconds. Different batches of eggs were exposed once to each of the treatments on days 1-7 post-fertilization. Eggs exposed to SDC were affected by electroshock for the first 2-3 days post-fertilization. During this period, 65-86 percent of the exposed eggs died compared to 42.6 percent of the controls.

Key words: walleye, electroshock, eggs.

Introduction

Electrofishing, a commonly used fish census technique, causes varying degrees of physical trauma to fish (Schreck *et al.* 1976, Sharber and Carothers 1988, Dalbey *et al.*1996, Snyder 1995). Electroshock can also cause mortality of trout eggs during the sensitive period of development (Dwyer *et al.* 1993). Currently, Montana Fish, Wildlife and Parks is evaluating means to control an illegally introduced walleye (*Stizostedion vitreum)* population in Canyon Ferry Reservoir. Because walleye exhibit fidelity to spawning grounds (Olson *et al.* 1978; Colby *et al.* 1979; Craig 1987), electroshock of eggs deposited in spawning areas may be a means to control recruitment.

Our objective was to define the effects of electroshock on mortality rates of walleye eggs using pulsed DC, AC, or smooth DC. We tested the hypothesis that there is no effect of electroshock on walleye egg mortality.

Materials and Methods

Freshly fertilized eggs collected from wild fish were received from Montana Fish, Wildlife and Park's Miles City Fish Hatchery. One tablespoon of eggs, about 1700 was measured into each of 84 10.2 x 10.2 cm wire screen baskets and placed into Heath® Incubator trays. The eggs in the baskets were exposed to one of three treatments: pulsed DC (PDC), alternating current (AC), or Smooth DC (SDC). Baskets of eggs to be treated were removed from the incubator, gently poured from the wire screen basket into a nylon basket in the exposure tank, exposed to the current from an electroshocker for 10 seconds, and returned to the incubator. Different groups of eggs were exposed to the treatments on each day from fertilization to hatch. The controls were either handled or not handled (C-H and C-NH). The handled controls were moved from the incubator and

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placed into the exposure chamber in the same manner as the treated eggs but no electric current was applied; the non-handled controls were not moved from the incubator until termination of the experiment. The measured output of the shocker was 0.98, 2.6, or 5.9 v/cm, for PDC, AC, and SDC, respectively (Table 1). All treatments were in triplicate.

A 208 X 55 X 49 cm Living Stream^{R} fiberglass tank was used as an exposure chamber. The electrodes were 47.0 X 55.9 cm pieces of sheet metal secured near each end of the chamber. Electrodes were 104.1 cm apart and parallel; the surface of the electrodes covered the entire cross sectional area of the tank. The electroshocker control box was connected to this configuration, producing a homogeneous electrical field.

The output of the electroshocker control box was monitored and electrode characteristics recorded in addition to water conductivity and temperature. The output average was

Table 1. *Electroshock characteristics as measured by an oscilloscope and a voltage meter by treatment (PDC = pulsed dc, AC = alternating current, and SDC = smooth dc).*

	Treatment		
Parameter	PDC	AC	SDC
	60 hz		
Mean voltage[a]	255	255	500
Peak voltage[b]	310	360	500
Voltage gradient[c]	0.98	2.6	5.9
Amps[d]	1.9	1.5	2.5

[a] Measured with an in-line voltage meter.
[b] Measured with an oscilloscope directly at the electrodes.
[c] Voltage gradient (vg) measured with a vg probe and the digital volt meter in v/cm. This is an average measurement.
[d] As measured by the amperage meter on the electroshocker control box.

Table 2. *Mean percent walleye electroshock egg mortality rates by day and treatment.*

	Treatment									
Day	PDC[a]		AC[b]		SDC[c]		C-NH[d]		C-H[e]	
1	40.7	(9.5)[f]			86.0	(12.2)	41.6	(2.6)		
2	50.4	(5.1)	42.1	(2.8)	73.6	(10.7)			42.6	(2.1)
3	38.9	(7.2)	42.5	(2.2)	64.9	(13.0)	39.6	(4.6)		
4	42.9	(2.1)	42.9	(2.7)	52.1	(5.9)			48.9	(5.3)
5	49.1	(5.4)	42.7	(1.2)	44.7	(2.9)	39.2	(4.6)		
6	45.0	(3.6)	50.9	(12.3)	40.2	(3.5)			44.9	(2.3)
7	40.0	(3.3)	42.7	(2.0)	38.8	(5.2)	39.3	(0.6)		

[a] pulsed direct current
[b] alternating current
[c] smooth direct current
[d] control (not handled)
[e] control (handled)
[f] standard deviations are shown in parentheses

measured with a digital volt meter and peak voltages were measured with an oscilloscope. Current was also recorded from the meter on the control box. The average voltage gradient in the water was measured with a digital volt meter.

The tests were terminated after seven days when the eggs were eyed and near hatching. Eggs were preserved in 10 percent formalin and evaluated by counting the living and dead eggs. Percent mortality was determined and recorded for each treatment.

The data were analyzed using the NCSS 6.08 one-way ANOVA (Hintze 1995).

Results and Discussion

Only the eggs exposed to SDC during the first 2-3 days post-fertilization, were killed at the voltages used in this test (Table 2). Mean percent mortality of the eggs exposed to the SDC treatment were 86.0, 73.6, 64.9, and 52.1 percent on days 1, 2, 3, and 4 post fertilization. Mortality of the eggs exposed to SDC on days 1, 2, and 3 were significantly higher (alpha = 0.05) than the 42.6 percent mean mortality of the eggs from the handled control treatments on day 2. Smooth DC caused more mortality to cutthroat trout eggs than 30 or 60 Hz pulsed DC at similar voltage levels (Dwyer and Erdahl 1995). Perhaps the higher voltage alone is the main cause for the increased mortality of walleye eggs as was demonstrated with cutthroat trout eggs (Dwyer *et al.* 1993).

Percent mortality of the eggs exposed to the 60 Hz pulsed DC and the AC treatments did not differ significantly from the handled control (C-H) treatment. Mortality ranged from 38.9 - 50.4 percent and 42.1 - 50.9 percent in the PDC and AC treatments, respectively, and 42.6 - 48.9 percent in the handled controls..

Use of electroshock to reduce walleye egg survival in large water bodies such as Canyon Ferry Reservoir may not be feasible because of the considerable effort needed to shock spawning areas repeatedly during brief periods when eggs are sensitive to electroshock. If there is potential for this technique, it will probably require using higher voltage equipment and dragging electrodes on the bottom, putting the electric field where the eggs are and avoiding non-target fish such as trout.

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