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TESTS ON TROUT MORTALITY FROM A BATTERY-POWERED STREAM SHOCKER[1]

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On 4 June 1969, we tested the latest model of stream electrofishing unit, designed by Mr. Clinton H. Harris. This unit is powered by two 12-volt auto batteries; these plus the control unit can be carried in a light boat. The objective of the test was to determine whether this new unit caused significant mortality of trout when subjected to an amount of current typical of ordinary stream electrofishing.

Mr. Harris gave us further information on the characteristics and capacity of this new shocker, in a letter of 10 August to G. P. Cooper, quoted in part as follows:

> The pulses produced by the subject shocker are rectangular in form with a duration of approximately 1.6 milliseconds and a repetition rate of approximately 45 pulses per second.
>
> In the "High" setting, the maximum available voltage is 300 volts and the maximum available current is 4 amperes.
>
> In the "Low" setting, the maximum available voltage is 150 volts and the maximum available current is 4 amperes.
>
> In any given situation, the voltage and current is a function of the resistance across the electrodes. The output is

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[1]Contribution from Dingell-Johnson F-30-R, Michigan.

current-limited so that the shocker adjusts itself to the operating situation within the limits of the maximum available voltage and current.

I very much appreciate the work that Messrs. Shetter, Alexander, and Allison did in investigating any possible mortality arising from the use of this type of shocker. We can now go ahead and ask Ed Schultz to build these units for Department use without fear of mortality resulting from their use in the field.

During tests described below, the control unit was operated at the "Low" setting, with the maximum available voltage of 150 volts and maximum available current of 4 amps (see above).

Other pertinent physical-chemical data on the East Branch are given in a report by Urshel and Hooper (1961).[2] Samples taken by them just above the hatchery ponds, on 2 September 1961, gave the following analyses: on-site temperatures at 2:30 PM, air 68 F, water 54 F; dissolved oxygen 9 ppm; CO_2 0 ppm; methyl orange alkalinity 155, Ph-th 6.0 ppm; pH 8.2; conductivity 256 μmho (Micro-ohms) at 18 C.

Test fish and methods

The test site was the natural channel of the East Branch of the Au Sable River immediately below Pond 9 of the experimental ponds of the Grayling Fisheries Research Station. The water temperature during the testing stayed within the range of 52 to 54 F.

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[2] Urshel, Naylord F., and Frank F. Hooper. 1961. Analysis of hatchery water samples. Inst. Fish. Res., Mich. Dep. Conserv., Rep. 1634, 17 p. (electroprinted).

Rainbow trout (Salmo gairdneri) of two size ranges were obtained from stocks of fish on hand at the Grayling Station. In one lot of about 500 trout, the fish ranged from 5.5 to 12.4 inches; the 100 fish in the other lot were 11 to 24 inches in length.

The shocker, consisting of two 12-volt batteries and a current-control unit, was carried in a 6-foot flat-bottom boat. The negative electrode was a sheet of copper, 28 inches by 6 feet, attached to the bottom of the boat. The positive electrode was a piece of copper tubing 1 inch diameter by 10 inches long.

The shocker boat was anchored in the stream channel (East Branch) so that it would not swing with the current. The positive electrode (copper tubing) was mounted vertically, attached firmly to a stake driven into the stream bottom, just 10 feet downstream from the downstream end of the boat. In other words, the electrodes were 10 feet apart. Water depth between the two electrodes was 20 inches. A precise point for exposure of fish to the current field was established (and marked by a post anchored to the stream bottom); this "point of exposure" was 2 feet from the positive electrode, and 8 feet from the negative electrode on the bottom of the boat.

All fish to be exposed to electrical current were held in a scap net and submerged 3 inches below the water surface (thus 17 inches above the bottom) at the established "exposure point" 2 feet from the positive electrode. Some fish were given a shock for 5 seconds, some for 10, some for 20, and some (Controls) received no shock at all; the

Controls were handled in the scap net, same as the other fish, and held at the exposure point for 10 seconds (but without turning on the current). Of the smaller test fish (5.5 to 12.4 inches), 80 fish were given the 5-second treatment, 80 the 10-second, 80 the 20-second, and there were 80 controls (total 320 fish). Of the larger fish (11 to 24 inches), there were 25 fish in each of the four treatment lots.

The test fish were stored in, and dipped from live crates. Because of the known tendencies for trout to segregate themselves somewhat by size groups when confined in live crates, the fish were dipped from the live crates in small lots (10, 6 or 7; see below) and the sequence of treatments was rotated among treatment times of 5 seconds, 10 seconds, 20 seconds, controls (followed by 10 seconds, 20 seconds, controls, 5 seconds; etc.). To get 80 fish exposed to the 5-second treatment, there were 8 lots of 10 fish each. The 10 fish were exposed, one fish at a time held in the scap net in the field; and this was repeated eight times for the 8 lots. The 8 lots treated at 5 seconds were interspersed with the 8 lots treated at 10 seconds, the 8 treated at 20, and the 8 controls (by rotation as indicated above).

In the case of the larger test fish, lots of 6, 6, 6 and 7 were dipped from the live crate; these 4 lots given a particular treatment (e.g., 5 sec) added up to 25 fish receiving each treatment. Here again the sequence of treatment time was rotated among the 4 lots and 4 treatments.

Two persons worked as a team in exposing the test fish to current. One person handled one fish at a time in the scap net, and held it at the designated exposure point between the two electrodes. A second person operated a switch in the electrical circuit, and timed each exposure by watching the sweep-second hand on a wrist watch. The treated fish were held in a pail of fresh water until the test lot of 10 (or 6) had been accumulated, and then transferred to a designated compartment of one of the hatchery raceways. Fish receiving different treatments were, of course, held in different compartments.

The test fish were held in the compartments from 4 June (treatment date) to 17 June 1969; they were fed the usual hatchery diet, and the compartments were examined daily for any mortalities.

Results

Among the large trout (11 to 24 inches), all were accounted for at the end of the experiment. There were no deaths among either the control lot, or the fish shocked for 5, 10 or 20 seconds.

Among the groups of smaller fish (5.5 to 12.4 inches), one control fish and one 5-second-shocked fish died between 10 June and 17 June. On 17 June, we discovered two mortalities among 10-second-shocked fish wedged between the screens and raceway walls.

The results for both size groups of fish are tabulated below:

	Treatment time			
	5 sec	10 sec	20 sec	No shock
Large fish				
Put in 6/4	25	25	25	25
Found 6/17	25	25	25	25
Average length (inches)	14.8	15.0	14.8	14.9
Small fish				
Put in 6/4	80	80	80	80
Died 6/4-6/17	1	0	0	1
Picked up dead 6/17	0	2	0	0
Unobserved mortality	1	0	1	1
Alive and measured 6/17	78	78	79	78
Average length (inches)	7.6	7.7	7.8	7.6

The observed mortalities were examined by Dr. L. N. Allison and he describes his observations as follows (letter, Allison to Shetter, 3 July 1969):

> The fish [four] that died in the electro-fishing work in the raceways were autopsied. When fresh, the skin and body cavity were examined for lesions that might be attributed to damage from electric shock. All were negative. The specimens were frozen at -20° F. until today, and sectioned grossly with a sharp knife. No lesions were found in the musculature or area of the spinal column. To sum up, I did not find any symptoms of damage by electric shock in any of these fish.

Discussion

All fish subjected to the various shock periods responded in such manner that they would have been satisfactorily stunned for capture. The exposures chosen represented minimum (5 sec) to excessive (20 sec) amounts of time for shocker operations in a stream. Obviously none of the large rainbow trout were adversely affected by the various shocking periods.

Among the test groups of smaller trout, even if we assume fish missing on 17 June to be mortalities resulting directly from electrofishing, a Chi-square test of the surviving:dead ratios indicates that there was not a statistically significant difference among the test groups on 17 June. The loss of one or two fish from these lots would be considered normal mortality rates for hatchery rearing stations.

We conclude from the above that, under the test conditions prevailing, the battery-powered electrofishing unit did not cause a significant mortality of trout.

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Report approved by G. P. Cooper

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