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USE OF A SUDDEN TEMPERATURE DECREASE TO REDUCE THE EXCITABILITY OF CHANNEL CATFISH DURING HANDLING

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HARVESTING AND SUBSEQUENTLY HANDLING fishes at water temperatures of approximately 80°F or greater often results in mechanical damage, physiological stress, and mortality. Yet the sale of channel catfish to be used in pay-fishing, and the sale of bait minnows, requires harvesting and handling in midsummer. Harry [*1*] reported using "thermal shock" to reduce mortality of golden shiners *(Notemigonus crysoleucas)* when they are harvested and handled at high temperatures. He advocated moving fish from the warmwater pond directly to 60°F water on the harvest truck. However, he pointed out that when moving fish from the hauling tank to holding tanks with higher temperatures, it is necessary to temper the fish at a rate not greater than 10°F per hour.

We have examined the effects on channel catfish *(Ictalurus punctatus)* of the instantaneous temperature change of 80° to 60°F(26.6° to 15.5°C), maintained for periods of 1 to 8 hours, followed by instantaneous return of the fish to 80°F water. The objectives were to determine if the channel catfish would tolerate these instantaneous temperature changes, and if this procedure could be used to reduce excitability, with a resulting reduction of physiological stress and mechanical damage.

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MATERIALS AND METHODS

Three procedures were used to evaluate the effects of sudden temperature change. In the first procedure, yearling channel catfish (18.0 to 170 grams, mean 60.5) were acclimated to aquarium conditions at 80°F (±3°). The fish were then moved by dip nets to adjacent tanks containing 60°F water (±2°), held there for 1 to 8 hours, and returned without acclimating to 80°F water. To demonstrate the effects of handling, fish were also moved from 80° to 80°F water. The effects of the temperature change were evaluated by observing for evidence of abnormal behavior and mortality for a period of 10 days after the fish were transferred.

The second procedure consisted of measuring oxygen consumption of fish transferred from 80° to 60°F water, as compared to that of fish transferred from 80° to 80°F water. Oxygen consumption was measured with a constant head respirometer, using 8 experimental fish and 8 control fish (35.0 grams, ±1.5). Oxygen consumption was determined at 10-minute intervals for 8 hours. The mean values of consumption for the two treatments were compared, using a modified two-way analysis of variance [*2*].

The third procedure consisted of actual hauling trials ranging in length from 1 to 4 hours. Fish were seined from a pond and transported in a fiberglass hauling tank mounted on a pickup truck. Water temperatures of the ponds from which the fish were harvested ranged from 83° to 86°F. By using ice, the water temperature of the hauling tank was maintained 20°F below the temperature of the pond from which the fish were taken. After being hauled, the fish were placed either in aquariums or in clear-

water ponds free of other fish. Mortality occurring during a 10-day period after hauling was recorded.

RESULTS

When fish were transferred from 80° to 60°F water and held from 1 to 8 hours, no mortality attributable to the transfer occurred during the 10-day observation period following (table 1). Both experimental and control fish fed the day following the transfer, with one exception. One lot of experimental fish exposed to 60°F for 6 hours did not feed until the second day following transfer back to the warm water. The experimental fish exhibited a fairly predictable behavior pattern. Following introduction into the 60°F water, the fish swam slowly around the aquarium for about 5 minutes, then settled to the bottom and lay still for 45 to 60 minutes, after which they became more active, alternately swimming slowly and lying still for the duration of the exposure to the 60°F water. Activity tended to increase with the length of time the fish were held at 60°F, but they were always less active and less excitable than the control fish. Less than 5 minutes after they were returned to 80°F water, the experimental fish commenced to exhibit behavior identical to that of the control fish.

Table 1.—Mortality of channel catfish exposed to the sudden temperature change from 80° to 60°F followed by immediate return to 80°F

Hours held at 60° F	Number of fish	Mortality (numbers)
1	60	0
2	70	0
4	75	0
6	113	1
8	240	2
8 (control)	151	1

Fish transferred from 80° to 50°F or cooler water exhibited an initially violent reaction for the first few minutes. They convulsed violently and attempted to leap out of the water. Some swam upside down or on their sides, then sank to the bottom and lay on their sides or backs. The majority of the fish lost their equilibrium. After extended exposure to the low temperature, a few fish regained their equilibrium, but all remained lying on the bottom and exhibited no activity (table 2). When returned to 80°F water, the fish remained motionless on the bottom for 5 to 20 minutes before resuming activity. Of the 40 fish that died following the 1-hour exposure to 40°F water, 38 never resumed activity following exposure (table 2). They were apparently killed immediately by the temperature change. One fish died 5 days after the experiment, and another died 9 days afterwards.

Table 2.—Mortality of channel catfish exposed to sudden temperature decreases from 80° to 50° F or less followed by immediate return to 80° F

Temperature Lowered to (°F)	Hours held at lowered temperature	Number of fish	Mortality (numbers)
50	1	52	0
45	1	52	0
45	2	52	0
40	1	145	40
Control	1	52	0

In the hauling experiment, no mortality occurred when the fish were subjected to a 20°F change in temperature and transported for 1 to 4 hours (table 3).

Table 3.—Mortality of channel catfish exposed to the sudden temperature decrease of 20° F in actual hauling trials followed by immediate return to the original temperature

Temperature change (°F)	Hours held at lowered temperature	Approximate number of fish	Mortality (numbers)
86–66	1.00	200	0
86–66	3.25	450	0
83–63	4.00	240	0
83–63	4.00	290	1

Oxygen consumption of the control fish was much higher than that of the experimental fish immediately after handling, and remained higher during the following 8-hour period (fig. 1). The difference between the two treatments was statistically significant at the 0.05 level. After being returned to 80°F water following an 8-hour exposure to 60°F water for the experimental fish and 80°F water for the controls, oxygen consumption by the fish was highly variable (fig. 2).

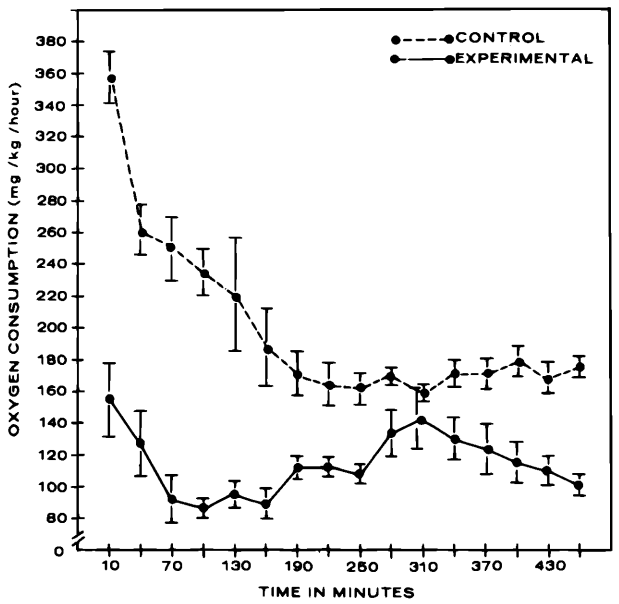

Figure 1.—Mean oxygen consumption of eight channel catfish transferred from 80° to 80°F water (control) vs. eight channel catfish transferred from 80° to 60°F water (experimental).

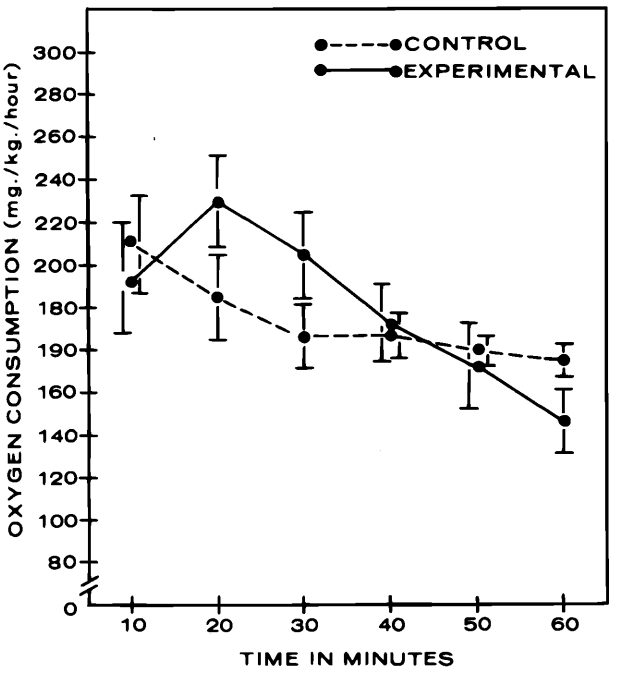

Figure 2.—Mean oxygen consumption of eight control and eight experimental channel catfish returned to 80°F water following 8-hour exposures to control (80°F) and experimental (60°F) temperatures.

CONCLUSIONS

The excitability of yearling channel catfish can be successfully controlled by instantaneous transfer of the fish from 80° to 60°F water. Following transfer, the fish can be held at the lower temperature for at least 8 hours and not exhibit noticeable effects when they are transferred back to the higher temperature. Tempering is not necessary when the fish are returned to 80°F water. This technique can be successfully applied to harvesting and handling channel catfish when pond water temperature is unfavorably high.

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