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RESISTANCE OF THREADFIN SHAD TO LOW TEMPERATURES

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ABSTRACT

Threadfin shad can be successfully maintained in aquaria for long periods on a diet of newly hatched brine shrimp. They quickly die at 5.0 and will survive the winter in a lake that does not go below 9.0°C.

INTRODUCTION

The Arkansas Game and Fish Commission and the University of Arkansas conducted a cooperative study (Federal Aid Project F-8-R-1 through 5) on the effects of stocking threadfin shad, *Dorosoma petenense* (Günther) in Lake Fort Smith, Crawford County, Arkansas. This lake, a city-water-supply impoundment, was surveyed for nearly two years, under the direction of Dr. Charles F. Cole, and then stocked with threadfin shad by the Arkansas Game and Fish Commission. They failed to survive the following winter and a study on their tolerance to low water temperatures was conducted in the laboratory to determine if they could be expected to survive the usual winter water temperatures recorded for Lake Fort Smith. Published observations (Parsons and Kinsey, 1954) and conversations with fisheries workers indicated that temperatures within the range of 5.0 to 9.0°C. would be pertinent to this study. **I wish to thank Dr. Charles F. Cole for the use of Table 1.**

METHODS AND RESULTS

To investigate the minimum survival temperatures of threadfin shad, approximately forty fish, that had been acclimated at 15.0°C. for over a month, were put in each of four tanks. The transfer of threadfin shad from one tank to another usually results in some deaths from injuries. Records of mortality were not kept until after injured fish had died and the temperature had been lowered to 11.0°C. Initial mortality was unusually high in the tank that was chosen to be lowered to 9.0° C. and was low in the other tanks. Fish for our experiments were raised at the Centerton and the Hot Springs state fish hatcheries. The stock originally came from southeastern Arkansas.

Loren G. Hill, a student supported by N.S.F. Grant 19342, fed newly hatched brine shrimp to the threadfin shad each morning and recorded the number dead, and Joe E. Coward, a student supported on Federal Aid Project F-8-R-5, fed them each night. Threadfin shad do well on a diet of newly hatched brine shrimp, but did not do well on dry fishfood. One threadfin shad was maintained in the laboratory for over a year and a half on a diet of brine shrimp. Small specimens do not feed on the bottom and although large threadfin shad will feed on the bottom, they are not predominantly bottom-feeders. A few gizzard shad were kept with the threadfin shad, and they spent much time feeding on the bottom.

Starting on October 29, 1961, the temperature of all four tanks was dropped from 15.0° to 14.0° C., and the temperatures were dropped one degree at the end of each week until temperatures of 9.0° C. for tank 1, 7.0° C. for tank 2, 6.0° C. for tank 3, and 5.0° C. for tank 4 were reached. An ultimate temperature of 8.0° C. was not used because of a shortage of tanks. Room temperatures had to be controlled manually and slight drops in temperature below the temperature to which the tanks were cooled occurred during cold spells.

The threadfin shad in the tank lowered to 5.0° C. all died during the next six days (Fig. 1). Some survived longer in the tank lowered to 6.0° C. and at 7.0° C. a few lived still longer (Fig. 1). Three shad were alive at the end of 106 days in 9.0° C. water. During Christmas

TABLE I

Summary of Minimum Intake Temperatures from Fort Smith Water Plant Records, 1938-60. November through April. 23 seasons.

(Underlines indicate yearly minimums which may extend over several months)

Year	Nov.	Dec.	Jan.	Feb.	March	April
1937-38	48°F	43	42	42	47	55
1938-39	46	41	41	40	42	52
1939-40	50	44	36	38	42	51
1940-41	50	45	44	42	42	50
1941-42	50	45	38	41	42	50
1942-43	52	45	39	40	41	53
1943-44	47	42	39	41	47	50
1944-45	53	42	38	40	45	55
1945-46	51	40	40	40	45	60
1946-47	50	47	42	40	40	49
1947-48	50	44	36	36	42	53
1948-49	47	43	42	40	46	54
1949-50	51	45	45	45	46	50
1950-51	49	41	38	36	47	52
1951-52	49	41	41	45	45	52
1952-53	47	40	40	43	45	53
1953-54	49	40	38	41	44	53
1954-55	52	43	41	41	45	49
1955-56	49	42	40	40	47	54
1956-57	51	47	41	42	47	50
1957-58	50	46	42	41	43	48
1958-59	52	45	40	41	46	52
1959-60	48	47	42	40	39	48
Range	46-53	40-47	36-45	36-45	39-47	48-60
Ave.	49.6	43.4	40.2	40.7	44.1	51.9
Percentage this month contains a yearly minimum.	0%	17%	70%	52%	13%	0%

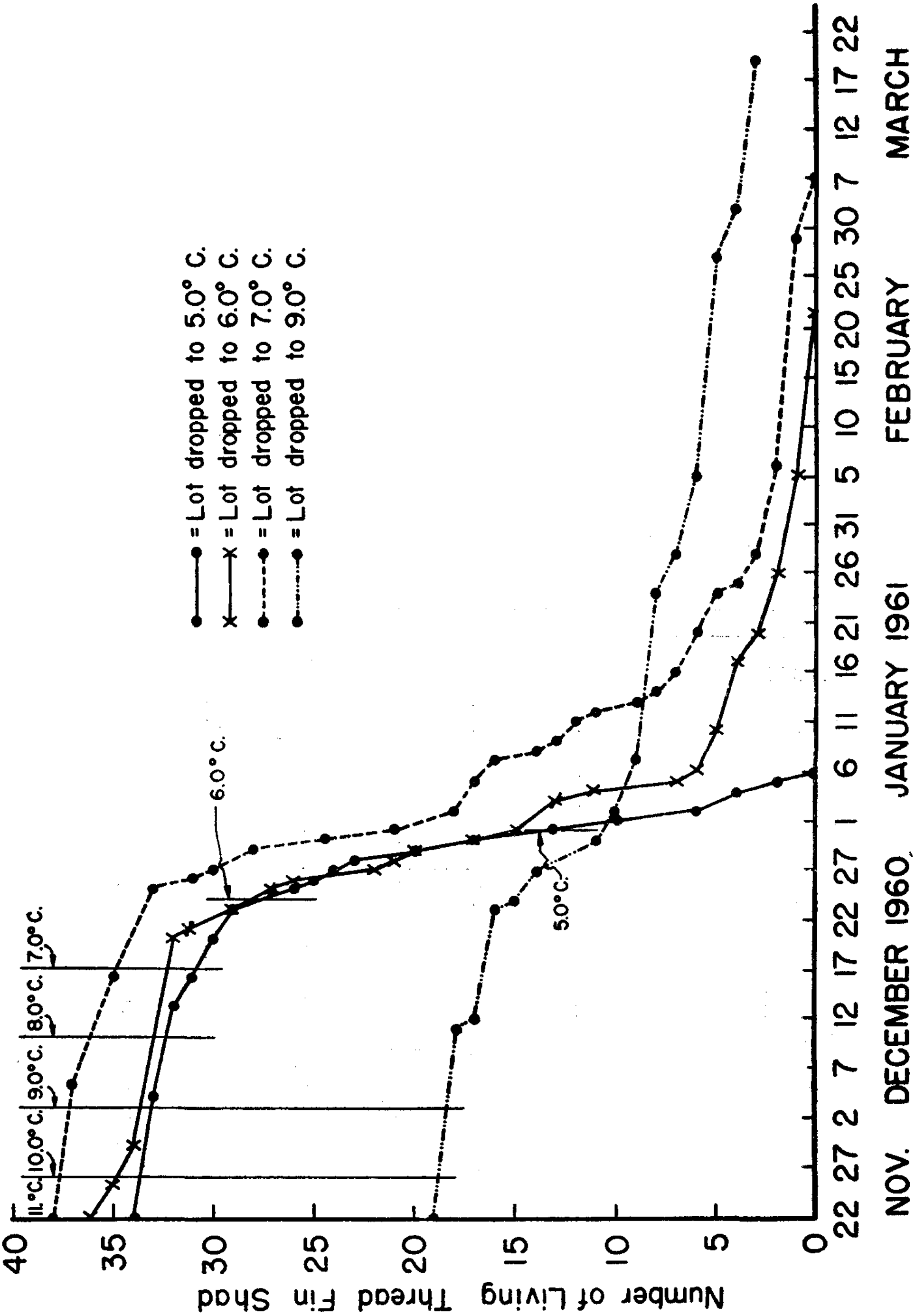

Figure 1. Survival of threadfin shad at various temperatures. All fish were acclimated at 15.0° C. and their temperatures were dropped 1.0° C. each week until the desired temperature levels were reached. The vertical lines, crossing the survival curves, indicate a drop in temperature.

vacation, the mortality rate in all lots increased sharply (Fig. 1). Both Loren G. Hill and the project leader were out of town for a little over a week, and the care of the threadfin shad was intrusted to Joe E. Coward. The reason for this great mortality is unknown.

Data obtained in the performance of these experiments indicate that a slow drop in temperature to 5.0° C. will eliminate threadfin shad from a lake. A sudden drop in temperature would be even more deadly because the threadfin shad would not have time to become acclimated to colder temperatures. Deaths of threadfin shad at 12.2 to 14.2° C. in the Colorado River at Austin, Texas (Hubbs, 1951), were probably caused by a sudden drop in temperature. For example, threadfin shad, acclimated at 15.0° C., live less than a day when suddenly put at 6.0° C. Some threadfin shad could survive limited periods at lake temperatures as low as 6.0 to 7.0° C. A breeding stock of threadfin shad will survive the winter in a lake that does not go below 9.0° C. provided the drop in temperature is slow enough for them to become acclimated to cold temperatures. However, they are sluggish at low temperatures and it is possible that predators would eliminate them from a lake because of their reduced swimming speed.

Lake Fort Smith usually becomes too cold in winter for threadfin shad to survive. During 23 winters (Table 1), the minimum water temperature fell below 5.0° C. (41.0° F.) during 16 and remained above 5.0° C. during 3. No evidence of overwintering by threadfin shad, stocked in Lake Fort Smith in the summers of 1959, 1960 and 1961, was obtained and a temperature kill of threadfin shad was observed during the late winter of 1959-1960 when temperature fell below 5.0° C.

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THE RELATIVE RESISTANCES OF SEVENTEEN SPECIES OF FISH TO PETROLEUM REFINERY EFFLUENTS AND A COMPARISON OF SOME POSSIBLE METHODS OF RANKING RESISTANCES [1, 2]

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ABSTRACT

Eighteen species of fish including a reference species, were subjected to toxicity bioassay using petroleum refinery effluent as a toxicant. Twenty-four-hour and 96-hour median tolerance limits were calculated using a straight-line graphical interpolation based on ten specimens per concentration with a replication. Collection, laboratory, and bioassay histories were recorded for each test species and a general suitability statement made for each.

Twenty-four-hour and 96-hour adjusted resistances obtained by the "Preadjusted-Abbreviated Doolittle" method were subjected to analysis of variance and to a modification of Duncan's new five percent multiple range test. Six methods were employed to adjust the relative resistance for differences in tests. The tests were ranked according to results obtained by each adjustment from most to least resistant. The "Interval" method was preferred over the other adjusted procedures on the

[1] Contribution 379 Zoology Department, Oklahoma State University.

[2] The project was supported by the National Institute of Health Research Grant WP-67(C2).

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