Journal of the Arkansas Academy of Science

Volume 20 Article 11

1966

Growth Rates at Various temperatures of the Orange-Throat Darter Etheostoma spectabile (Agassiz)

Boyce W. West
University of Arkansas, Fayetteville

GROWTH RATES AT VARIOUS TEMPERATURES OF THE ORANGE-THROAT DARTER **ETHEOSTOMA SPECTABILE** (AGASSIZ)

Boyce W. West
University of Arkansas

INTRODUCTION

This paper demonstrates the effect temperature has upon the growth rate of the orangethroat darter **Etheostoma spectabile** (Agassiz). There is a tremendous literature on the effect of temperature on the growth of fishes in their native habitat. Until recently very little had been done in the laboratory under rigidly controlled conditions. In the last score of years papers have begun to appear relating growth rates of fishes at various temperatures. Gibson and Hirst (1955), working with pre-adult guppies **Lebistes reticulatus** (Peters), found that the most rapid growth occurred at 23 and 25°C with less rapid growth at 20, 30, and 32°C. Kinne (1960), studying the eurythermal and euryhaline desert pupfish **Cyprinodon macularius** Baird and Girard, found that the growth rate was dependent upon both temperature and salinity and that the combination of the two factors was of supreme importance. Growth rate, in salinity 35 °/oo, decreased in this order: 30, 25, 35, 20, and 15°C. The effect of salinity was shown at 30°C where the growth rates decreased in this order of salinity: 35, 15, 55 °/oo, and fresh water. Strawn (1961) studied the growth of the largemouth bass, **Micropterus salmoides** (Lacepede), and found maximum growth to occur at 27.5 and 30.0°C, with less rapid growth at 25.0, 22.5, 20.0, and 17.5°C, decreasing in that order. The present study illustrates that the growth rate of the orangethroat darter may be accelerated or retarded through the control of temperature.

MATERIALS AND METHODS

Adult **Etheostoma spectabile** were collected from Clear Creek, upstream from county road crossing, ¼ mile SW of Johnson, Washington County, Arkansas (R 30 W T 17 N Sec. 21) on March 17, 1965. The fish were taken to the laboratory and the eggs and sperm were stripped into a pan by gently pressing on the ventral side of the fish with a backward motion from the pectoral fin to the vent (Strawn and Hubbs, 1956). All of the fertilized eggs were covered with aged tap water at 21.0°C overnight in the open pan. After hardening, the eggs were freed from the pan and placed in a submerged gallon jar with an airstone bubbling gently at 21.0°C until they hatched. Dead eggs, characterized by a dull milky color, were removed daily. The eggs began hatching on March 23, 1965. The larvae were measured for total length and placed in constant temperature tanks on March 26, 1965 when it appeared they were ready to begin feeding (the yolk-sac had been absorbed). Sixty individuals were placed in each tank. The

tanks were constructed of plywood and covered with polyester resin to make them waterproof. The inside dimensions of the tanks were as follows: 41 inches long by 26 inches wide by 14 inches deep. About three inches of washed sand covered two 12 inch by 23 inch under-gravel filters. The tanks were lighted by cool white fluorescent bulbs suspended above the tanks. The temperature was controlled by thermoregulators, sensitive to 0.01°C temperature changes, connected to transistorized relay units. Water was heated by using 150 watt submersible heaters connected to the relay units. Temperature was measured with thermometers calibrated to 0.1°C. Airstones were used to aerate and circulate the water and to aid in maintaining a constant temperature throughout the tank. The temperatures used were: 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 24.0, 25.0, 26.0, and 27.0°C. Single degree intervals at the upper end of the range were used because it was suspected that maximum growth would occur in this part of the range and this would better pinpoint the optimum temperature for maximum growth.

The fish were fed larvae of the brine-shrimp **Artemia salina** twice daily.

Samples of ten fish from each tank were caught each week by dragging an aquarium net through the middle of the tank. The fish were then measured for total length using dividers and a three inch piece of transparent plastic tubing fitted on a medicine dropper which functioned as a syringe for picking up the fish. The fish, clearly visible in the tubing, was measured to the nearest 0.1 millimeter. At the end of the sixth week all of the fish were preserved in 10 per cent formalin and measured.

RESULTS AND DISCUSSION

The fish had a mean total length of 6.0 millimeters at the time of transfer to the experimental temperatures. Maximum growth rate occurred at 26.0°C with growth rate decreasing in this order: 26.0, 25.0, 24.0, 21.0, 27.0, 23.0, 19.0, 13.0, and 15.0°C (Figure 1). All of the fish at 17.0°C died on the tenth day of the experiment due to an accident. The rate of growth of the fish at higher temperatures became more rapid during the second week. This increase in growth rate may be due to either of two factors: (i) acclimation of the fish to the respective temperature, or (ii) increased temperature tolerance with increasing age. Hubbs and Armstrong (1962), have shown evidence that the latter is true for this species. Several of the measurements at the fifth week exceed the mean length of the fish at the sixth week, (Figure 1). Apparently this is due to the method of sampling the population. This method appears to be selective for the larger **E. spectabile.** The points at the sixth week include all of the fish from that respective tank, while at the fifth week only ten fish were measured.

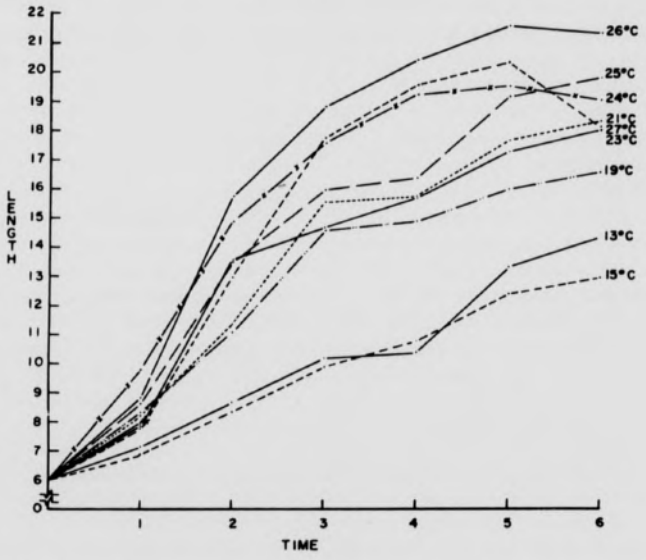

Figure 1. Growth curves of **Etheostoma spectabile.** Time in weeks is plotted against length in millimeters. Points at 1-5 represent mean lengths of ten fish. Points at 6 represent mean lengths of all fish in the tank.

It may be concluded from this data that the growth rate of **E. spectabile** is increased, with temperature as a variable, to 26.0°C. It may also be concluded that as the age of the fish increased, so did its temperature tolerance.

SUMMARY

The growth rate of **Etheostoma spectabile** (Agassiz) at various temperatures was studied. Larvae averaging 6.0 millimeters total length were placed in tanks regulated to the following temperatures: 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 24.0, 25.0, 26.0, and 27.0°C. The fish were measured weekly for six weeks and the data indicates the maximum rate of growth occurred at 26.0°C. There is some indication that the larger fish are more easily captured, thus adding a bias to small samples. There is evidence that with increasing age temperature tolerance is increased.

ACKNOWLEDGMENTS

I would like to thank the Department of Zoology at the University of Arkansas, and especially Dr. Kirk Strawn for the use of equipment and for invaluable help throughout the study.

LITERATURE CITED

Gibson, M. B., and B. Hirst. 1955. The effect of salinity and temperature on the pre-adult growth of guppies. Copeia 1955 (3):241-243

Hubbs, Clark, and Neal E. Armstrong. 1962. Developmental temperature tolerance of Texas and Arkansas-Missouri **Etheostoma spectabile** (Percidae, Osteichthyes). Ecology 43:742-744

Kinne, O. 1960. Growth, food intake, and food conversion in a euryplastic fish exposed to different temperatures and salinities. Physiol. Zool. 33:288-317

Strawn, K. 1961. Growth of largemouth bass fry at various temperatures. Trans. Amer. Fish. Soc. 90(3):334-335

Strawn, Kirk, and Clark Hubbs. 1956. Observations on stripping small fishes for experimental purposes. Copeia 1956 (2):114-116