

**SURVIVAL OF LABORATORY-HELD TEXAS  
AND SOUTH CAROLINA RED DRUM FINGERLINGS  
EXPOSED TO EXTREME TEXAS WINTER TEMPERATURES**

by

**Lynne S. Procarione**



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**Texas Parks and Wildlife Department  
Fisheries Division  
4200 Smith School Road  
Austin, Texas 78744**

## ABSTRACT

Texas and South Carolina red drum (Sciaenops ocellatus) fingerlings (40 - 57 mm total length) were compared to evaluate survival during laboratory-simulated winter temperature conditions. Red drum from each geographic population were spawned in fall 1987; fry were reared in separate outdoor earthen ponds. At harvest, fingerlings were transferred to indoor recirculating tanks. Fish were exposed to a water temperature regime similar to that observed along the mid-Texas coast during winter 1983-1984. Survival at study termination was similar between Texas ( $52.0 \pm 32.4\%$ ) and South Carolina ( $76.0 \pm 32.8\%$ ) fish. The results imply that South Carolina red drum do not offer the advantage of increased cold tolerance over that of Texas red drum.

## INTRODUCTION

Red drum (Sciaenops ocellatus) is an important sport fish on the Gulf of Mexico and Atlantic coasts of the United States (Matlock 1984). The development of controlled spawning techniques (Arnold et al. 1977), hatchery scale fingerling production (Colura et al. 1976, McCarty et al. 1986), and the overfishing of Texas red drum populations (Matlock 1983) has resulted in implementation of coastal and inland red drum stocking programs in Texas (Dailey and Matlock 1987).

Red drum from different geographic locations may possess different traits which make them more or less suited to the goals of a particular stocking program. Gulf coast red drum suffer periodic winter kills due to low water temperatures (Gunter 1941, Gunter and Hildebrand 1951, McEachron et al. 1984); the more northerly distributed Atlantic coast red drum may be less susceptible to low water temperatures (Bearden 1967). The Texas Parks and Wildlife Department (TPWD) currently maintains adult red drum from the Atlantic (South Carolina) and Gulf of Mexico (Texas) coasts in controlled tank systems at the Gulf Coast Conservation Association/Central Power and Light/TPWD Marine Development Center (MDC) at Corpus Christi, Texas.

Efforts were initiated by the TPWD to identify potentially cold-tolerant red drum which could contribute to stocking programs used for population enhancement in Texas. The study objective was to evaluate survival of Texas and South Carolina red drum subjected to low temperature conditions similar to those that existed along the mid-Texas coast during winter 1983.

## MATERIALS AND METHODS

The study was conducted at the TPWD Perry R. Bass Marine Fisheries Research Station (MFRS), Palacios, Texas, from September 1987 to January 1988. Texas and South Carolina red drum spawned 19-20 September at MDC were cultured in separate 0.1-ha ponds at MFRS from 22 September to 19 October following the general methods of McCarty et al. (1986). Commercial trout crumble was offered daily at 6.0 kg/ha, beginning 2 weeks post-stocking.

At harvest (19 October), approximately 4,000 randomly selected Texas and South Carolina red drum fingerlings were transferred from the 0.1-ha ponds to separate 4,000-liter indoor recirculating tanks and held for 2 months to acclimate to tank conditions. Tanks were equipped with water chillers, ultraviolet water sterilizers and biofilters, and held at a mean ( $\pm$  SD) temperature of  $19.6 \pm 1.6$  C and an average salinity of 20 o/oo. Fish were fed a mixture of trout crumble, frozen brine shrimp and staple flake food ad libitum four times daily.

On 13 November, 25 randomly selected fish (40 - 57 mm total length (TL)) from each group were transferred to the experimental system. The system consisted of a 4,000-liter recirculating tank (equipped as described previously) containing ten 22.7-liter plastic experimental units (buckets).

Holes were cut in the bottoms and sides of each bucket to allow complete water circulation; all holes were covered with 3-mm mesh plastic netting. Buckets were positioned around the inner edge of the tank with the upper rim approximately 10-cm above the water surface. Five fish were placed in each bucket. Temperature and salinity were held at  $20.7 \pm 0.7$  C and 20 o/oo, respectively, during an initial 3-day acclimation period, and fish were replaced as mortalities occurred.

From 16 November 1987 through 1 January 1988, water temperature was raised or lowered to simulate conditions that existed along the Texas coast (Freeport harbor) from 16 December 1983 - 31 January 1984 (Figure 1). Water temperature data were obtained from the National Oceanic and Atmospheric Association (Steve Lyles, personal communication). Fish were fed twice daily as previously described. Water temperature was recorded three to five times daily, salinity was recorded once daily, and dissolved oxygen was measured periodically. Ammonia and pH were measured three times weekly. Mortalities were recorded three times daily.

All statistical tests were performed using the Statistical Analysis System (SAS Institute 1985);  $P = 0.05$ . Mean values ( $\pm$  SD) were calculated for each variable tested. A Chi-square goodness of fit test was used to determine if there were differences in survival between the two groups.

## RESULTS

Survival was similar ( $X^2 = 3.17$ ,  $P > 0.075$ ) between Texas and South Carolina red drum, and averaged  $52.0 \pm 32.4\%$  and  $76.0 \pm 32.8\%$ , respectively. The lowest water temperature encountered during the simulation was 2.8 C (Figure 1). Most mortalities (68%) occurred 3-10 days after the low temperatures were encountered. Mean ( $\pm$  SD) TL at study termination was  $45.3 \pm 4.2$  mm and  $44.7 \pm 3.1$  mm for Texas and South Carolina fish, respectively.

## DISCUSSION

Red drum population enhancement in inland and coastal waters depends in part on the species' ability to tolerate low temperatures in production ponds and shallow estuarine bays. In addition to genetic control of thermal tolerance, a fish's response to low temperature is influenced in part by its previous thermal history (i.e. acclimation state), the rate of temperature decline, and the length of time exposed to the low temperature (Fry 1971).

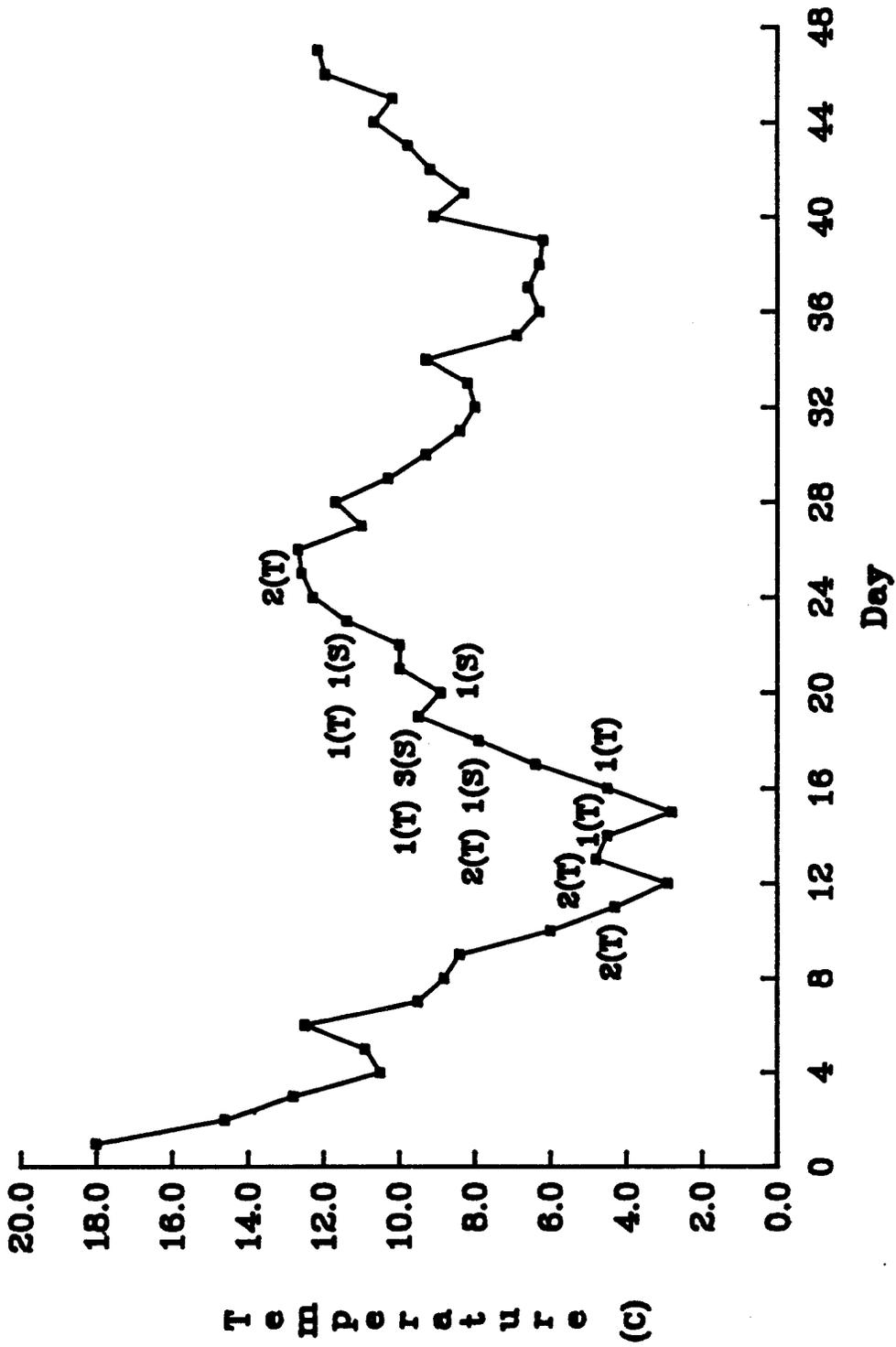
Fish kills due to low bay water temperatures have been reported periodically along the Texas coast (Simmons and Breuer 1962, McEachron et al. 1984), but the estimated temperatures at which red drum have been killed vary. Mass mortality of red drum was observed along the Texas coast during an early winter cold front in 1940 when water temperatures dropped to 3.8 C (Gunter 1941). An equally severe cold front in 1951 was estimated to have had less drastic effects on sciaenid populations, possibly due to its being the third front of the season as opposed to the first (Gunter and Hildebrand 1951).

Moore (1976) reported the lower lethal temperature of red drum to be between 4 and 7 C from observations along the Texas coast.

Our laboratory simulation of the 1983-1984 low temperature event along the Texas coast suggests that fingerling red drum from Texas and South Carolina will survive exposure to water temperatures as low as 2.8 C. However, our laboratory fish may have survived under conditions that would have been lethal to fish in a natural environment: during periods of extreme temperatures, our fish were lethargic, only semi-mobile, and at times had completely lost equilibrium, but recovered as temperatures increased. A fish which loses equilibrium in nature would be unlikely to survive.

As neither geographic population exhibited a clear advantage in laboratory survival during extreme low temperature conditions, no recommendation to stock one group in preference to the other can be made at this time.

Figure 1. Daily temperature series and mortalities for winter simulation comparing Texas and South Carolina red drum fingerlings. Numbers accompanying temperature line refer to numbers of South Carolina (S) and Texas (T) red drum fingerlings found dead that day.



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