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A Lower Lethal Temperature for Fingerling Snook, *Centropomus undecimalis*

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Snook (*Centropomus undecimalis*) are a marine/estuarine, tropical-subtropical gamefish which have a strong affinity for fresh water. Nearly all references to snook consider low water temperature as a factor limiting their distribution. Estimated lower lethal temperatures in current use are based on field observations (Storey and Gudger 1936; Storey 1937; Marshall 1958; Gilmore *et al.* 1978). This note is the first report of laboratory identified lower lethal temperatures for snook. These data were, in turn, used to estimate the potential inland range of snook in Florida.

METHODS

Eight 4-month-old snook (125-145 mm TL; 18-26 g) reared from artificially fertilized eggs (Shafland and Koehl 1979) were transferred from a freshwater rearing pond to a 3400 ℓ temperature control system (1 November 1977) which had been adjusted to the temperature of the pond (24°C). The temperature control system consisted of a cold water reservoir, eight 190 ℓ aquaria with individual temperature controls (± 0.1°C) and a collection and return box. Air-lifts provided even mixing of fresh water within aquaria.

Snook were acclimated in the system for eight days at 24°C. Starting on day nine, temperature was decreased in six of the aquaria at a constant rate of 1°C/day. Two aquaria were maintained as controls at 24°C throughout the study. Daily monitoring included: counting the remaining forage organisms (*Gambusia affinis*), calculating the number consumed and replacing those eaten during the previous 24 hours; observing the snook for behavioral changes associated with each decrease in temperature; and exchanging approximately 10% of the system's water volume and siphoning feces from each aquaria. Experimental fish were weighed, measured and examined for parasites and disease at the conclusion of the study.

Using these methods, a sample size of five or more will yield the true mean lower lethal temperature (± 1°C) for snook 95% of the time. This value is based on the maximum standard deviation (S = 0.9) for lethal temperatures reported for 14 tropical fishes previously tested (Shafland and Pestrak 1982), 95% confidence and an 1°C acceptable error of the mean ($1.96\ \sigma_x$ = 1°C; $\sigma_x = S/(n-1)^{1/2}$, where σ_x = standard error of the mean, S = standard deviation and n = sample size).

RESULTS

Mean (n = 6) temperatures at which snook: stopped feeding completely was 14.2°C (S = 2.1; R = 12-18°C); lost equilibrium was 12.7°C (S = 0.81; R = 12-14°C); and died was 12.5°C (S = 0.84; R = 12-14°C). Of the experimental fish, one died at 14°C, another at 13°C and four at 12°C. Control fish remained healthy and continued to feed throughout the study period.

Four of the six experimental fish fed at temperatures ⩽ 2°C above their subsequent lethal temperature. In general, snook became less active but neither lost equilibrium nor laid on the bottom for extended periods of time prior to dying.

No parasites or physical anomalies were apparent on the experimental fish. Control fish continued feeding and appeared healthy throughout the study.

DISCUSSION

Storey and Gudger's (1936) survey of temperature induced mortalities at Sanibel Island, Florida, from 1886-1934 emphasized the temperature restricted range of snook. They concluded minimum safe water temperature for snook was 15.6°C. Marshall (1958) placed the nominal northern limits of snook in Florida at Volusia County on the east coast and Hernando County on the west coast. Concurring with Storey and Gudger, he suggested that a low mean monthly water temperature of 15.6°C serves as a range determinant for snook in Florida. Similarly, Springer and Woodburn (1960) reported finding three dead snook in a bayou when the water temperature dropped to 13°C. These field observations were supported by the present study in which juvenile snook began dying at 14°C.

The winter of 1976-1977 was one of the coldest on record in Florida and there are several reports of its effect on snook. Major temperature induced snook mortalities were reported between Cocoa and Daytona Beach (Sargent and Campbell 1977). F.F. Snelson, Jr. (University of Central Florida, personal communications) observed lethargic adult snook greater than 9.0 kg in coastal waters with a surface temperature of 8-9°C. Snelson and Bradley (1978) stated that many, if not most of these snook would probably recover as water temperatures warmed. Gilmore *et al.* (1978) reported adult snook swimming lethargically in water temperatures as low as 6.7°C and concluded that they die at temperatures approaching the lower end of a 6-13°C range.

These latter reports suggest adult snook may be more tolerant of cold water than are fingerlings. Differences between these and previously reported field observations (Storey and Gudger 1936; Marshall 1958; Springer and Woodburn 1960) on the cold water tolerance of snook is poorly understood.

It is impossible to construct general water temperature isotherms for large geographic areas due to various thermal modifiers (e.g. water depth, flow, wind force) that cause temperatures to vary within and between different types of nearby aquatic habitats. Air temperatures, however, have been used routinely to reliably delineate isotherms. Since mean monthly air and stream temperatures in Florida are similar (Anderson 1975), it is suggested that air temperatures be used to estimate general water temperature zones.

A subjective comparison of the lower lethal temperatures identified here and isotherms based on the mean monthly air temperatures for January (Thomas 1974; Wood and Fernald 1974; Shafland and Pestrak 1982), normally Florida's coldest month of the year (Bradley 1974), suggests fingerling snook will survive average inland Florida winters south of a line connecting St. Petersburg, Okeechobee City and Cape Canaveral. Fingerling snook may occasionally overwinter as far north as Gainesville, however, periodic survival beyond this point seems unlikely.

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