Gulf of Mexico Science

Volume 11
Number 2 *Number 2*

Article 8

12-1990

Lower Temperature Tolerance of Snook, *Centropomus undecimalis*

Robert G. Howells
Texas Parks and Wildlife Department

Albin J. Sonski
Texas Parks and Wildlife Department

Paul L. Shafland
Florida Game and Freshwater Fish Commission

Brian D. Hilton
Florida Game and Freshwater Fish Commission

DOI: 10.18785/negs.1102.08

Northeast Gulf Science Vol. 11, No. 2 December 1990 p. 155-158

Short papers and notes

LOWER TEMPERATURE TOLERANCE OF SNOOK, *Centropomus undecimalis*

Snook (*Centropomus undecimalis*) are important coastal game fish. They occur from Pamlico Sound, North Carolina to Rio de Janeiro, Brazil, including the Gulf of Mexico (Rivas 1986). However, North American distribution is generally restricted to coastal waters of Florida south of Tampa and to Texas south of Galveston (Walls 1975; Hoese and Moore 1977).

Snook are known to be cold sensitive (Storey and Gudger 1936; Storey 1937; Marshall 1958) with water temperature probably being the most significant factor limiting northern distribution (Marshall 1958; Ager *et al.* 1976). Cold weather related fish kills have been reported in natural snook stocks as well as among snook stocked in freshwater lakes (Storey and Gudger 1936; Moore 1976; Chapman 1982). Springer and Woodburn (1960) reported finding three dead snook (length unstated) at 13.0°C and Gilmore *et al.* (1978) observed adult snook swimming lethargically at temperatures from 6.7 to 9.0°C, both in Florida waters. Moore (1976) reported mortality among snook (lengths unstated) in Texas waters at 4.5°C. During late December 1989 an estimated 250 adult snook >61 cm TL were observed dead in Lake Okeechobee, Florida, when recorded temperatures dropped to a minimum of 9.5°C (*pers. comm.*, D. Fox, Florida Game and Fresh Water Fish Commission). This same cold front also caused additional mortalities in Texas including one snook found in the Colorado River, eight (45-80 cm TL) at Port Aransas where water temperatures were as low as 0°C (*pers. comm.*, T. King, Texas Parks and Wildlife Department), and nine other adults in ponds at the John Wilson Marine Fish Hatchery, Corpus Christi where water temperature reached 0.7°C (*pers. comm.*, R. Vega, Texas Parks and Wildlife Department).

The first laboratory cold tolerance study was presented by Shafland and Foote (1983) for six 4-month-old juveniles (125-145 mm TL) tested in fresh water. These snook ceased feeding, lost equilibrium, and died at mean temperatures of 14.2°C, 12.7°C, and 12.5°C, respectively. We report three additional low temperature tolerance studies on juvenile and subadult snook.

METHODS

Eighteen subadult snook were collected in coastal waters at South Padre Island and Port Isabel, Texas in September 1983, and were transported to Heart of the Hills Research Station (HOH), Ingram, Texas. There they were acclimated to fresh water over a 38-hour period, then stocked in two 1,800-l circular. fiberglass tanks.

Early juveniles (40 days old) were obtained from saltwater ponds (19-21 ppt) at the Perry R. Bass Marine Research Station (PBMRS), Palacios, Texas in July 1985. These juveniles had been reared from naturally ripened eggs and sperm, striped-spawned from adult Florida snook by Florida Department of Natural Resources personnel. One group from PBMRS (Group I) was transported to HOH for testing in salt water (19 ppt) and a second group (Group II) was sent to the Florida Game and Fresh Water Fish Commission (FGFC) for testing in freshwater.

Snook were acclimated for 10 or more days, then water temperatures were decreased 1°C/day in all tests. The 1°C/day rate of temperature decrease was selected to simulate natural fall temperature declines, to permit comparison to previous data from Shafland

and Foote (1983), and to follow an unofficial standard used in many cold tolerance studies. Temperatures were controlled using thermostatically adjustable water chillers and heaters that were checked two or more times daily. Periodic siphoning removed accumulated wastes. Control fish in all tests (2-5 per test) were treated identically to the test fish except that water temperatures were maintained at the acclimation temperatures of 15°C or 25°C.

Specimen origin, total length, acclimation temperature, salinity, and the number of snook tested in each trial are given in Table 1. All snook were feeding well and appeared healthy prior to decreasing water temperatures. Temperatures at which snook decreased and ceased feeding, lost equilibrium, and died were recorded. At the conclusion of each test, all the snook were measured and examined for parasites and diseases.

Subadult (265-380 mm TL) and Group I juvenile (36-48 mm TL) snook were tested in 1,800-l circular, fiberglass tanks with biofilters. Subadults were tested in fresh water and juveniles were tested in salt water (19 ppt). Juveniles were restricted to 19-l perforated, plastic buckets (12 fish/bucket) placed inside the 1,800-l tanks. Nitrite levels were checked daily. Subadult snook were fed live goldfish (*Carassius auratus*) *ad libitum*. This group of juveniles was fed frozen brine shrimp (*Artemia salina*) *ad libitum*, except for the first two days when they received live zooplankton and mosquitofish (*Gambusia affinis*).

Group II juveniles were tested in the semi-closed system described by Shafland and Pestrak (1982) which included six 190-l freshwater-filled aquaria stocked with 1-2 fish each, a 1,700-l cold water reservoir, and a 190-l collection and return box. Cold water was gravity-fed to each aquarium where temperature was maintained by individual thermo-regulator controls. About 10% of the temperature control system volume was replaced daily. These fish were fed a known number of mosquitofish, and the ammonia nitrogen and pH levels were measured weekly.

RESULTS

Subadults acclimated to 15°C lost equilibrium at 7-8°C and those acclimated to 25°C lost equilibrium at 8-9°C. Specimen color darkened and swimming behavior changed just prior to loss of equilibrium. Subadults swam lethargically then settled quietly to the bottom in an upright position approximately 2 hours prior to loss of equilibrium. Upon removal to the 15°C recovery tank, all test fish revived except one that died 6 hours later.

Group I juveniles lost equilibrium and died at 9°C. They fed vigorously to 14°C; however, only a few individuals fed sparingly between 11 and 14°C, and none fed at colder temperatures (Table 1). Color darkened several hours before loss of equilibrium and juveniles became lethargic, but rarely settled to the bottom until after loss of equilibrium. Several disoriented juveniles attempted to swim in midwater or at the surface for over 4 hours before death, although in most cases the loss of equilibrium period was typically brief (10-30 min).

Individual lower lethal temperatures ranged from 10 to 11°C for Group II juveniles. They markedly reduced feeding at 18-20°C and stopped feeding at 11-14°C (Table 1). Snook had some difficulty maintaining their position in the water column and occasionally bumped into tank walls at temperatures 1-2°C above lethal. Total loss of equilibrium only occurred for the few hours prior to death.

All control fish remained healthy and continued to feed throughout the study period. No parasites or physical anomalies were apparent in any snook.

https://aquila.usm.edu/goms/vol11/iss2/8
DOI: 10.18785/negs.1102.08

Nitrite nitrogen levels ranged between 0.00 and 0.02 ppm in the subadult and Group I test, and ammonia nitrogen ranged between 0.00 and 0.08 ppm and pH ranged between 6.5 and 7.7 in the Group II test. Water chemistry monitoring during long-term tank maintenance of snook and other euryhaline fishes suggests that these nitrogen and pH levels were well within tolerable limits.

DISCUSSION

The minimum lower lethal temperatures for juvenile Florida snook in two independent trials ranged from 9°C for tests in salt water (19 ppt) to 10°C for trials in fresh water. These temperatures are lower than the 12°C minimum lethal temperature reported by Shafland and Foote (1983) for somewhat larger fish tested in fresh water (Table 1).

Laboratory-identified lower lethal temperatures for Texas and Florida snook tested under a variety of conditions in this study range of <7 to 11°C. This range includes temperature data from cold-stressed subadult snook which recovered from temperatures as low as 7°C. This range in lower lethal temperatures suggests one or more of the parameters (*e.g.*, stock origin, salinity, fish size, food) that differed between these independent trials may have contributed the observed differences. Although these data provide to a better understanding of the cold tolerance of snook, more definitive temperature tolerance evaluations are needed.

ACKNOWLEDGMENTS

We would like to thank Mr. William Peck of San Antonio, Texas for his help in fish capture. Thanks also to the Florida Department of Natural Resources, Florida Game and Fresh Water Fish Commission and Texas Parks and Wildlife Department

Table 1. Cold tolerance of juvenile (36-145 mm TL) and subadult (265-380 mm TL) snook (*Centropomus undecimalis*), including previous data of Shafland and Foote (1983). Rate of temperature decrease was 1°C/day in all tests. Response temperature mean (°C), ± standard deviation, and range (in parenthesis) are given.

					Mean temperature			
Source	Specimen origin	Salinity (‰)	Length (mm TL)	N	Acclimation	Feeding cessation	LOE[a]	Death
Present study	FL	19	36-48	24	25	12[b] (11-13)	9.0 ± 0.0 (9-9)	9 ± 0.0 (9-9)
Present study	FL	<0.1	87-123	8	25	12.4 ± 0.9 (11-14)	10.3 ± 0.5 (10-13)	10.3 ± 0.5 (10-11)
Shafland and Foote (1983)	FL	<0.1	125-145	6	25	14.2 ± 2.1 (12-18)	12.7 ± 0.8 (12-14)	12.5 ± 0.8 (12-14)
Present study	TX	<0.1	265-366	7	25	–[c]	8.9 ± 0.4 (8-9)	–[c]
Present study	TX	<0.1	266-380	7	15	–[c]	7.6 ± 0.5 (7-8)	–[c]

[a] LOE = Loss of equilibrium.

[b] Juveniles (36-48 mm TL) in the present study were tested in groups and it was not possible to determine at what temperature a given individual ceased feeding, therefore calculation of mean and standard deviation was not possible; median and range are given.

[c] Subadult snook were not monitored during feeding and testing was terminated when equilibrium was lost but before death.

staff members who assisted with the research and review of the manuscript.

LITERATURE CITED

Ager, L.A., D.E. Hammond, and F. Ware. 1976. Artificial spawning of snook. Proc. Ann. Conf. S.E. Assoc. Fish Wildl. Agencies 30:158-166.

Chapman, P. 1982. Study I: Artificial culture of snook. Final report for the sport fish introductions project. Florida Game and Fresh Water Fish Commission, Tallahassee, FL.

Gilmore, R.G., L.H. Bullock, and F.H. Berry. 1978. Hypothermal mortality in marine fishes of south-central Florida, January 1977. Northeast Gulf Sci. 2(2): 77-97.

Hoese, D.H., and R.H. Moore. 1977. Fishes of the Gulf of Mexico, Texas, Louisiana, and adjacent waters. Texas A&M Univ. Press, College Station, TX.

Marshall, A.R. 1958. A survey of the snook fishery of Florida, with studies of the biology of the principal species, *Centropomus undecimalis* (Bloch). Fl. St. Board of Conserv. Tech. Ser. 22: 1-39.

Moore, R.H. 1976. Observations on fishes killed by cold at Port Aransas, Texas, 11-12 January 1973. The Southwestern Natur. 20(4):461-466.

Rivas, L.R. 1986. Systematic review of the Perciform fishes of the genus *Centropomus*. Copeia 1986(3):578-611.

Shafland, P.L., and K.J. Foote. 1983. A lower lethal temperature for fingerling snook, *Centropomus undecimalis*. North-east Gulf Sci. 6(2):175-177.

Shafland, P.L., and J.M. Pestrak. 1982. Lower lethal temperatures for fourteen non-native fishes in Florida. Env. Bio. Fish. 7(2):149-156.

Springer, V.G., and K.D. Woodburn. 1960. An ecological study of the fishes of the Tampa Bay area. Fl. St. Board Conserv. Prof. Pap. Ser. 1:1-104.

Storey, M. 1937. The relation between normal range and mortality of fishes due to cold at Sanibel Island, Florida. Ecol. 18(1):640-643.

Storey, M., and E.W. Gudger. 1936. Mortality of fishes due to cold at Sanibel Island, Florida, 1886-1936. Ecol. 17(4): 640-648.

Walls, J.G. 1975. Fishes of the northern Gulf of Mexico. TFH Publ. Inc., Neptune City, N.J.

Robert G. Howells and Albin J. Sonski, Texas Parks and Wildlife Department, Heart of the Hills Research Station, Ingram, Texas 78025. Paul L. Shafland and Brian D. Hilton, Florida Game and Freshwater Fish Commission, Non-Native Fish Research Lab, Boca Raton, Florida 33431. Present Address: (A.J.S.) State of Connecticut, 120 Old Hatchery Road, Kennsington, Connecticut 06332.