Southeastern Fishes Council Proceedings

Volume 1
Number 18 *Number 18 (December 1988)*

Article 2

12-1-1988

Pit-Ridge Nest Construction and Spawning Behaviors of *Semotilus lumbee* and *Semotilus thoreauianus*

William S. Woolcott

Eugene G. Murakis

Pit-Ridge Nest Construction and Spawning Behaviors of *Semotilus lumbee* and *Semotilus thoreauianus*

Southeastern Fishes Council
PROCEEDINGS
DEDICATED TO THE PRESERVATION OF SOUTHEASTERN FISHES

Number 18 December 1988

Pit-Ridge Nest Construction and Spawning Behaviors of *Semotilus lumbee* and *Semotilus thoreauianus*

William S. Woolcott
Biology Department
University of Richmond, Virginia 23173

and

Eugene G. Maurakis
Department of Biological Sciences
The George Washington University
Washington, D. C. 20052

Pit-ridge nest construction is unique to only the males of three species of chubs *(Semotilus atromaculatus, Semotilus lumbee and Semotilus thoreauianus)* (Maurakis and Loos, 1984; Maurakis and Kahnke, 1987). *Semotilus lumbee* (Sandhills Chub) and *S. thoreauianus* (Thoreau's Chub) have limited ranges on the periphery of the range of *S. atromaculatus* (Creek Chub), which occurs throughout eastern and central United States and southeastern Canada. *Semotilus lumbee* is restricted to headwaters of Coastal Plain streams of the Cape Fear, Little Peedee, and Peedee River drainages in the Carolina Sandhills in North Carolina and South Carolina (Snelson and Suttkus, 1978). *Semotilus thoreauianus* is in small streams above and below the Fall Line from the Savannah River drainage in northwestern South Carolina to the Pearl River drainage in southeastern Louisiana (Johnston and Ramsey, 1985).

Our observations of the breeding behavior of *S. atromaculatus* conform to those depicted in Reighard (1910) and Ross (1976; 1977a,b). Using data from direct field observations and video recordings, we describe the habitats and activities associated with nest construction and the spawning behaviors of *S. lumbee* and *S. thoreauianus*, both sibling species of *S. atromaculatus*.

Materials and Methods

Stream width and depth, and dimensions of nests were measured with a meter stick; water current (m/sec) with a Marsh-McBirney meter; and water temperature with an alcohol Celsius thermometer. Fishes were collected with a pulsed DC backpack electroshocker. Nest construction and reproductive behaviors were photographed in color with three types of cameras (35 mm; industrial grade Panasonic video camera; and a Sony television camera).

Results and Discussion

Semotilus lumbee and *S. thoreauianus* constructed pit-ridge nests in gravel reaches of 1st and 2nd order creeks similar to those of *S. atromaculatus* (Table 1). Nests were located in tails of pools, either in midstream or nearshore, with a nearby cryptic refuge (e.g. undercut bank). In both species, the nest began as a pit built by a single dominant male. After the male spawned with a female, it excavated pebbles from the downstream end of the pit and placed them over the eggs deposited in the upstream end of the pit. Thus, as spawning proceeded, a ridge of deposited material was formed which increased in length and continually displaced the pit downstream. Pit size remained relatively constant even though the rear margin of the pit was subjected to continual downstream excavation. Fine sand, dislodged during the digging, formed the downstream rim of the pit.

Dimensions of the ridge and pit varied with size of the male, duration of spawning, and stream characteristics (Table 1). The structure of the nest caused eddies to be formed within the pit perimeter, which enabled the non-adhesive eggs to sink into the gravel of the pit. For example, an active nest of *S. thoreauianus* in a creek (flow = 0.023 m^3/sec) exhibited the following velocities: 7.7 cm/sec above and below the nest; 10.6 cm/sec at the posterior end of the ridge; 2 cm/sec at the front of the pit; and 5.7 cm/sec at the rear of the pit.

Dominant males of *S. lumbee* and *S. thoreauianus* were observed spawning during the day at minimum water temperatures of 13.9 C (25 April 1982) and 17.0 C (13 April 1986), respectively (Table 1). Cephalic tuberculation of *S. thoreauianus* is the same as that of *S. lumbee*, which is reported for the latter by Snelson and Suttkus (1978). Also, the coloration of breeding males of the two species was consistent with the description

given by Snelson and Suttkus for *S. lumbee* (dusky olivaceous body dorsum, rosy-orange side intensifying to orange toward the head, and pinkish-orange pectoral fin).

Spawning of the two species was similar. The dominant male took a position at the head of the pit. A female either drifted tail first over the upstream rim of the pit as described by Ross (1976) for *S. atromaculatus* or entered from the back side of the pit. Spawning took place when a female aligned parallel with the male. The male, with his pectoral fin under the breast of the female and his caudal peduncle over her back forces her head up and her tail down resulting in the spawning clasps as described by Reighard (1910) for *S. atromaculatus*. Smaller females were usually thrown toward the surface whereas larger ones were rolled to the side.

Whether engaged in pit excavation, ridge building, or spawning the dominant male stayed in or near the pit guarding the nest for extended periods. Agonistic displays in the form of parallel swims with other comparable sized adult males usually occurred upstream of the nest. The dominant male also made short aggressive lunges toward other species that were near the nest.

There are no known nest associates (i.e. species that use a nest for spawning but do not contribute to its formation) in streams inhabited by *S. lumbee*. We observed one nest associate (*Notropis rubricroceus)* over a *S. thoreauianus* nest. Other potential nest associates of *S. thoreauianus* are *Hybopsis rubrifrons* and species of *Notropis* and *Campostoma*.

Acknowledgements

Thanks are expressed to J. Goodin, J. Kahnke, M. King, J. Loos, and T. Orrell for their assistance with the field work, and to G. Grossman for his review of the manuscript. The studies were supported in part by a grant from the Richard Gwathmey and Caroline T. Gwathmey Memorial Trust, a University of Richmond Faculty Research Grant, a Student Research Grant from the George Washington University Chapter of Sigma Xi, and a loan of video equipment from Potomac Electric Power Company.

Literature Cited

Breder, C.M., Jr. and D.E. Rosen. 1966. *Modes of Reproduction in Fishes.* Natur. Hist. Press, N.Y.

Johnston, C.E. and J.S. Ramsey. 1985. Status of *Semotilus thoreauianus* Jordan, a creek chub of the southeastern United States. 65th Ann. Meet. Am. Soc. Ichthyologists and Herptologists, Prog. Abstr. Knoxville, TN: 81.

Maurakis, E.G. and J.J. Loos. 1984. Nest building and spawning of *Semotilus lumbee* (Pisces: Cyprindae). A.S.B. Bull. 31 (2): 34. and

— and J.B. Kahnke. 1987. Construction of spawning nests by two recently described or redescribed chub species from southeastern United States. A.S.B. Bull. 34 (2): 86.

Reighard, J. 1910. Methods of studying the habits of fishes, with an account of the breeding habits of the horned dace. Bull. U.S. Bureau Fish. 28: 1111-1136.

Ross, M.R. 1976. Nest-entry of female creek chubs (*Semotilus atromaculatus*) in different habitats. Copeia (2): 378-380.

Table 1. Physical characteristics associated with pit-ridge nests of *Semotilus lumbee*, *Semotilus thoreauianus* and *Semotilus atromaculatus.*

Parameter		*lumbee*	*thoreauianus*	*atromaculatus*
No. of streams		3	8	9
No. of nests		8	12	18
No. of males		3	3	16
Dominant Males (SL mm)		170-200	68-102	127-200
Stream width (m)		1.98-2.1	1.5-3.0	1-9
Flow (m3/sec)		0.16-0.18	0.023	
Current (cm/sec)		10-29	11-13	10-40
Water Temperature (C)		13.9-16.1	17-17.5	12.1-26.7 (1,2)
Nest Length (m)		0.9-1.6	0.5-1.1	0.7-2.25
Ridge	Height (cm)	12.7-18.3	3.5-10	5-7.6
	Width (cm)	30-61	12-30	25-30
	Length (cm)	50.8-120	5-70	30-460
Pit	Depth (cm)	6.3-8.2	4-9	5-20
	Width (cm)	25-40.6	19-30	20-31
	Length (cm)	35.6-38	20-40	20-61

1. Scott and Crossman (1973)
2. Breder and Rosen (1966)

— .1977a. Aggression as a social mechanism in the creek chub (*Semotilus atromaculatus*). Copeia (2): 393-397.

—.1977b. Function of creek chub (*Semotilus atromaculatus*) nest-building. Ohio J. Sci. (1): 36-37.

Scott, W.B. and E.J. Crossman. 1973. *Freshwater Fishes of Canada*. Bull. 1984. Fish. Res. Bd. Can. Ottawa, Can.

Snelson, F.F. and R.D. Suttkus. 1978. A new species of *Semotilus* (Pisces: Cyprinidae) from the Carolinas. Bull. Alabama Mus. Nat. Hist. (3): 1-11.

A Need for Clarification of the Concept of Nest Building Among Cyprinid Minnows

William S. Woolcott
Biology Department
University of Richmond, Virginia 23173

and

Eugene G. Murakis
Department of Biological Sciences
The George Washington University
Washington, D.C. 20052

The complex reproductive behavior of constructing well-defined pebble or rock nests (i.e. pit, pit/ridge and pit/mound) by the overt movement of substrate material with the use of the jaws of adult male chubs before and after the spawning act is considered an advanced evolutionary trait (reference to *Nocomis*, Lachner and Jenkins, 1971). It is limited to the species of four North American cyprinid genera (*Campostoma, Exoglossum, Nocomis, and Semotilus*). Excluded from this concept are the behaviors of minnows that form depressions with their fins during the act of spawning, e.g. that of *Rhinichthys atratulus*; or, as described by Raney (1940), that of minnows that may rarely pick up small stones in their mouths before spawning, e.g. *Notropis cornutus*.

Because of the uniqueness of pebble nestbuilding behavior and consequently its evolutionary significance in Cyprinidae, misunderstanding leading to misinterpretation may result if authors fail to clearly define their meaning when referring to nest-building minnows. For example, from a translation on life history aspects of some Asian minnows by Nakamura (1969), Gosline (1978) reports "*Opsariichthys* and *Zacco* are nest-building cyprinids and in this respect, differ from most or all members of the cultrine stock." A thorough and precise translation of Nakamura (1969) failed to identify these fishes as nest builders. Actually, the English equivalent of nest is used only once (p. 242), but it is in reference to ovaries of ripe females rather than to spawning nests. There is a statement that might be construed as a reference to a use of a nest where breeding pairs of *Zacco temminckii* go to a "spawning spot." Further, Nakamura describes the migration of adult *Opsariichthys uncirostris* from Lake Biwa upstream into tributaries where they move into shallows to spawn over gravel or sand. He says that a cone-shaped concavity is made in the substrate as a result of the spawning activity of *O. uncirostris*. The elongated anal fin of the male makes "gravel into a scoop" that receives fertilized eggs. This type of nest is comparable to the depressions made by *R. atratulus* during the spawning act and is substantially different from the pebble nest of North American nest-building cyprinids.

Acknowledgments

We thank David C. Evans, Professor of Japanese History and his assistant, Junko Uzuhashi, of the University of Richmond for a punctilious translation of Nakamura's paper.

Literature Cited

Gosline, W.A. 1978. Unbranched dorsal fin-rays and subfamily classification in the fish family Cyprinidae. Occ. Pap. Mus. Zool. Univ. Mich. 684: 1-21.

Lachner, E.A. and R.E. Jenkins. 1971. Systematics, distribution and evolution of the chub genus *Nocomis* Girard (Pisces, Cyprinidae) of Eastern United States, with descriptions of new species. Smith. Contrib. Zool. 85: 1-97.

Nakamura, M. 1969. Cyprinid Fishes of Japan – Studies on the life history of cyprinid fishes of Japan (in Japanese). Res. Inst. Nat. Res. Tokyo. Special Publication 4.

Raney, E.C. 1940. The breeding behavior of the common shiner, *Notropis cornutus* (Mitchill). Zoologica. XXV (1): 1-14.