

Spawning in *Semotilus corporalis* (Fallfish) (Pisces: Cyprinidae)

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ABSTRACT

Two reproductive behavioral characters of *Semotilus corporalis* (spawning clasp and spawning location on the upstream slope of the pit of a pit/ridge pebble nest) are consistent with those in other *Semotilus* species, supporting the monophyly of the genus. During the latter stages of nest construction, *S. corporalis* collects pebbles from the nearby substrate and deposits them on the pit/ridge nest to form a mound of pebbles, a behavior unique to the species.

INTRODUCTION

There are conflicting reports regarding the spawning behavior of *S. corporalis* (fallfish). Ross and Reed (1978) stated that *S. corporalis*, unlike other *Semotilus* species, spawn communally over a nest. They were unable to identify isolated spawning between individual pairs of fish. Earlier, however, Greeley and Bishop (1933) indicated that female *S. corporalis*, held in a brief spawning clasp by a breeding male at the downstream end of the ridge of a pit/ridge pebble nest, were tossed upward with such force that their snouts often broke the surface with a splash. Raney (1969), apparently paraphrasing Greeley and Bishop, used a similar description of the spawning clasp and where in the water column it occurred in a popular account of the breeding behavior of *S. corporalis*. Maurakis et al. (1990), after finding that eggs of *S. corporalis* were concentrated in downstream pits of early-stage pit/ridge nests, hypothesized that, like other species of *Semotilus*, *S. corporalis* spawned in the pit as reported by Greeley and Bishop (1933). Here we present evidence from field observation and frame by frame analysis of video tapes that not only does *S. corporalis* spawn in the pit of a pit/ridge pebble nest, but has spawning techniques not unlike those of other *Semotilus* species.

METHODS

Spawning was observed in Genito Creek (James River drainage), Co. Rt. 642, 2 km N of St. Rt. 6, 22 km W of Richmond, Goochland Co., Virginia, in waters of 16.2 C, 9 May 1991; and in Mill River (Connecticut River drainage), 1.6 km S of Amherst, Hampshire Co., Massachusetts, water temperature of 17.9 C, 15 May 1991.

Descriptions of nest-construction and associated behaviors are based on field observations, and video tapes recorded above the surface of the water with television cameras equipped with polarizing filters to minimize reflected light. Zoom macro lenses on cameras allowed the field of vision to be manually adjusted and focused for close-up and wide-angle views. Ten hours of videotapes, replayed frame by frame to identify spawning behaviors, were compared with field notes and literature accounts.

RESULTS

A tuberculate, breeding *S. corporalis* (in full breeding color) constructed a well-defined pit/ridge pebble nest in less than 38 hrs in Genito Creek (no nest at 1830 hrs EDT, water temperature 14.2 C, 7 April 1991; nest present and active at 0815 hrs EDT, water temperature 16.2 C, 9 April 1991). An equal-sized tuberculate male (highly colored) and two tuberculate subordinate male *S. corporalis* (with subdued coloration) were also at the nest site. The nesting male excavated pebbles from the rear of the pit, and occasionally from the nearby streambed, depositing them on the upstream slope of the pit where eggs were later collected. During latter stages of nest construction, the nest-building male collected pebbles of sizes like those reported for the species by Maurakis et al. (1990) with his jaws primarily from the streambed and deposited them over the pit/ridge nest to form a mound of pebbles. This continued for two days until we stopped the activity and searched for eggs. Previously, we observed mound-building by *S. corporalis* males that continued for at least four days.

When a female moved into the spawning pit from a downstream position, the nesting male and sometimes a subordinate male aligned alongside the female. The trio, with the female between the males, moved forward to the upstream slope of the pit. Both males bent their caudal peduncles over the back of the female. The larger size, and resultant force, of the caudal peduncle of the nest-building male displaced that of the subordinate male from the back of the female. Then the larger male, with his pectoral fin under the breast of the female and his caudal peduncle over her back, forced her head up and tail down resulting in a spawning clasp. The clasp was like that observed in Mill River where a female was clasped by a single male *S. corporalis* at the upstream slope of the pit of a pit/ridge pebble nest. The male in this position encircled the vertically oriented female during the spawning clasp, similar to the clasps in *Semotilus atromaculatus* (Reighard, 1910); *S. atromaculatus*, *Semotilus lumbee*, and *Semotilus* sp. (Woolcott and Maurakis, 1988; Maurakis and Woolcott, 1990); and *Semotilus thoreauianus* (manuscript). The female, with mouth agape, was released from the clasp and drifted momentarily upside down before she regained equilibrium downstream of the pit.

DISCUSSION

The male *S. corporalis* in the latter stages of nest construction, following spawning, collects pebbles from the nearby streambed and deposits them over the pit/ridge nest to form a mound of pebbles, a behavior unique to the species. This may enhance the survival of developing eggs in the interstices of a nest. During the mound-building period the male chases all fishes, including male and female *S. corporalis*, from the nest site. The aggressive behaviors minimize predation of the buried fertilized eggs during the period required for hatching. Laboratory reared eggs of *S. corporalis*, as well as those of other *Semotilus* species, did not hatch as yolk-sac larvae before seven days of development took place (pers. obs.). The yolk-sac larvae, negatively phototactic, remained motionless during development, responding only to mechanical agitation by swimming until the stimulus was stopped. This suggests that yolk-sac larvae are procumbent while undergoing development in the interstices of a nest, unless disturbed. The swimming response of larvae may be a behavior that enhances their chances of survival as some

cyprinids and catostomids physically move pebbles in a nest as they forage for food. Also, changes in interstitial aeration may stimulate larvae to move to interstices farther upstream in the nest. We have collected large numbers of late-staged, yolk-sac larvae near the upstream base of mounds when nests were covered with silt.

Reed (1971) stated that fertilized eggs were always in a pocket within the nest and at a level of the original stream substrate. Like Reed, we collected the non-adhesive and non-cohesive fertilized eggs of *S. corporalis* in discrete areas, either on the upstream slope of the pit in a small pit/ridge nest or in the downstream base of a mature mound pebble nest (Maurakis et al., 1990).

Two reproductive characters of *S. corporalis*, spawning clasp and spawning location on the upstream slope of the pit where it joins the ridge, are behavioral synapomorphies that support the monophyly of the genus. The behaviors do not occur in the species of the other two pebble nest-building cyprinid genera, *Exoglossum* and *Nocomis* (Maurakis et al., 1991a; 1991b).

We agree with Greeley and Bishop (1933) and Raney (1969) regarding the spawning clasp and where it occurs in *S. corporalis*. Frame by frame analyses of the videotapes corroborate the descriptions of Atkins (cited in Kendall and Goldsboro, 1908) that "... by and by a female came swiftly along, and right over ed (ed in his diagram is identified as the crest of the upstream slope of the pit) was seen struggling in an erect position; the male was close to her, but nothing more could be made out." We interpret the description of the erect position of the female to correspond to the vertical position of the females that we saw during the spawning clasp.

Unlike Ross and Reed (1978), we have never seen nor filmed the communal spawning rush of *S. corporalis* over nests. We believe the "rush" is the forward swimming movement of the nesting male (and sometimes subordinate males) toward the female in the pit as she positions her self on the upstream portion of the spawning pit where she is subsequently clasped by the male.

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