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Spawning Behavior in *Nocomis asper* (Actinopterygii: Cyprinidae)

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ABSTRACT

Spawning behavior in *Nocomis asper* is described from direct observations and review of videotapes made in Jenkins Creek (Arkansas River drainage), Missouri in 1997. Spawning behavior in *N. asper* where a single male excavates pits and spawns with females on the upstream slope of his nest is like that described for *Nocomis biguttatus*. Nest associates (i.e., species that congregate and may spawn in a nest but do not contribute to its construction) of *N. asper* were *Campostoma anomalum*, *Dionda nubila*, *Luxilus cardinalis*, *Notropis rubellus*, and *Phoxinus erythrogaster*.

INTRODUCTION

Nocomis asper, endemic to streams of the interior highlands of North America, is one of seven species of *Nocomis* in which males of the species use their jaws to construct gravel nests for spawning in spring (Lachner and Jenkins, 1971). Spawning behavior has been described for populations of a close relative, *Nocomis biguttatus*, by Vives (1990) and Maurakis et al. (1991), but not for *N. asper*. This paper describes spawning behavior in *N. asper* and compares it with that in *N. biguttatus*.

MATERIALS AND METHODS

Observations and videorecordings of fishes at nests of *N. asper* were made in Jenkins Creek (tributary of Spring River, Arkansas River drainage) on Outer Road, 4.8 km W of Rt. 37, Jasper Co., Missouri, from 1130-1500 hrs CDT, 8 May 1997. Underwater videorecordings were made with a Sony VX 1000 digital camera/recorder, equipped with a built-in 100 watt light source, and mounted in a Sting Ray waterproof housing. The camera, manually manipulated or set in a fixed position on the substrate, was positioned 30-51 cm from the nest. Stream width was 10 m, water depth at the nest was 50 cm, and maximum visibility was 2.4 m. One hour of activities of fishes recorded on film were reviewed at normal speed, in slow motion, and frame by frame to identify specific behaviors of female and male *N. asper* following methods in Maurakis and Woolcott (1995). Six chronological categories that reflected the sequence of male-female interactions characteristic of a successful spawn, following Sabaj (1992) and Maurakis and Woolcott (1993), were used to resolve reproductive activities of male and female *N. asper*: *interim* (behavior of male between spawns), *approach* (behavior of female directed towards interim male), *alignment* (behavior affecting orientation of a spawning pair over substrate), *run* (initiated by a female, synchronized movement of aligned pair over substrate), *clasp* (spawning act, i.e., momentary flexure of male's body about that of female at end of her *run*), and *dissociation* (behaviors of male and female affecting their separation immediately

following the clasp). Behaviors other than those associated with the spawning sequence were considered disruptive of a successful spawn.

A satellite male is one that deceptively mimics females and pairs simultaneously with true females and parental males, Gross, 1984.

RESULTS

The nest (where videorecordings were made) was constructed in slow to moderate current in a 40 m long pool where bedrock was the major component of the substrate. The nest was less than 1 m from shore, and 5 m upstream of a gravel island. A week prior to spawning, the male *N. asper* was observed excavating a saucer-shaped concavity, characteristic of the first stage of nest construction typical of nest-building behavior by males in other species of *Nocomis* (e.g. *Nocomis leptocephalus*, *Nocomis micropogon*, and *Nocomis raneyi*). Within a week, mound-building was completed, and a spawning pit excavated on the upstream slope of the nest where a single male *N. asper* spawned with females. After spawning, the male covered the pit with gravel collected from surrounding substrates. He then excavated and spawned in pits aside and upstream of the original pit. The closest nest (near the opposite shore, and adjacent to the upstream portion of the gravel island) constructed by another male *N. asper* was approximately 8 m from the nest where videorecordings were made. No satellite male *N. asper* hovered over or just downstream of the nest. No combat behavior was observed between the interim male and intruder male *N. asper*.

Nest associate species (those that congregate and may spawn over a nest but do not contribute to its construction) were *Campostoma anomalum*, *Dionda nubila*, *Luxilus cardinalis*, *Notropis rubellus*, and *Phoxinus erythrogaster*.

Spawning analysis:

Interim: The interim male *N. asper* engaged in mound-building, pit digging, pit fanning, and pit posturing interim behaviors like those described for breeding male *N. biguttatus* and *N. leptocephalus* by Maurakis et al. (1991) and for *N. leptocephalus* by Sabaj (1992).

Approach: Female *N. asper*, hovering over the rear of the nest, individually approached the spawning pit from downstream. A successful approach occurred when a female moved into the spawning pit beneath the postured male. On several occasions after a female and male dissociated, a female immediately turned and approached the pit again. Females also approached the pit when the spawning male was not present.

Alignment: After entering the pit and posturing herself beneath the tail of the male, a female moved forward to his extended pelvic fins until her snout was either directly below or slightly ahead of his pectoral girdle. With her body aligned parallel to the long axis of the pit, she pressed the ventral surface of her body to the substrate of the pit, and either immediately began her run, or momentarily remained in this position. In response, the male tilted his body sagitally toward the female.

Run: Initiated by a female, the run (about 2-3 cm) began when a female moved directly beneath and to the side of the male's tilted body. With body pressed to the substrate, the female quivered her tail and moved slightly upstream. The male responded by accompanying her forward motion with rapid tail beats. With the ventral portion of the female's body continuing to conform to the topography of the spawning pit, she moved forward to the upstream slope of the pit, gaped, and retroflexed (i.e.,

the immediate pitching of her head vertically into the water column and rolling the anterior portion of her body away from the male thus placing her dorsum in contact with his anterior flank). Females often made an approach, and run with retroflexure in the pit when the breeding male *N. asper* was not present.

Clasp: As the female retroflexed, the male initiated his clasp. Turning his head toward the female, he curved his posterior flank over her back and drove it into her side between her pectoral and pelvic girdles. His body (from head to caudal fin) contracted into a semicircle. At the height of the clasp (lasting up to one second), the male's vent was pressed to the dorsolateral surface of the female's caudal peduncle, as her vent remained in contact with the substrate on the upstream rim of the pit. Eggs were shed at this moment.

Dissociation: Dissociation occurred as the male's body relaxed after contraction during the clasp. He drifted downstream and resumed interim behavior. Simultaneously, the female continued to rise vertically into the water column, regained horizontal equilibrium, and either moved to the downstream portion of the nest or drifted just downstream of the male and initiated another approach.

DISCUSSION

We observed *N. asper* spawning in May, which is like that reported by Robison and Buchanan (1988) for the species in Arkansas. It is probable that spawning in *N. asper* occurs over several weeks into June (Pflieger, 1975), much like that of a closely related species, *N. biguttatus,* which spawns from May through early July, but predominately during a three-four week period from mid-May to mid-June (Vives, 1990).

Spawning behavior in *N. asper* is similar to that described for *N. biguttatus* by Maurakis et al. (1991) and Vives (1990). Behaviors of male and female *N. asper* in each of the six categories that led to a successful spawn are comparable to those described for *Nocomis leptocephalus* by Sabaj (1992) with one exception. Female *N. asper* frequently approached the pit, performed a run, and retroflexed in the spawning pit of a nest when the spawning male *N. asper* was not present.

On the upstream slope of the nest, a single male *N. asper* used his jaws to excavate a spawning pit, which he fanned with his anal fin. After spawning with individual females in the pit, he covered it with pebbles from surrounding substrates, and excavated another pit where he continued spawning behaviors (i.e., pit fanning and spawning). These behaviors are comparable to those in male *N. biguttatus*, where a single male occupies a nest (Vives, 1990; Maurakis et al., 1991) but unlike those in *N. leptocephalus* where several males may excavate their own spawning pits alongside that of the nest-building male, after sequentially establishing territories on the upstream slope of the nest (Maurakis et al., 1997).

Pflieger (1975) listed *D. nubila*, *L. cardinalis*, and *P. erythrogaster* as nest associate species of *N. asper* in Missouri. With our observations and videorecordings, two additional nest associate species of *N. asper* were identified: *C. anomalum* and *N. rubellus*.

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LITERATURE CITED

Gross, M. R. 1984. Sneakers, satellites, and parentals: polymorphic mating strategies in North American sunfishes. Zeitschrift fuer Tierpsychologie 60:1-26.

Lachner, E. A. and R. E. Jenkins. 1971. Systematics, distribution, and evolution of the *Nocomis biguttatus* species group (Family Cyprinidae: Pisces) with a description of a new species from the Ozark Upland. Smithsonian Contributions to Zoology. 91:1-28.

Maurakis, E. G. and W. S. Woolcott. 1993. Spawning behaviors in *Luxilus albeolus* and *Luxilus cerasinus* (Cyprinidae). Virginia Journal of Science. 44(3):275-278.

Maurakis, E. G. and W. S. Woolcott. 1995. Techniques of videotaping fishes from above the surface of the water. Southeastern Fishes Council Proceedings 31:4-5.

Maurakis, E. G., W. S. Woolcott, and M. H. Sabaj. 1991. Reproductive-behavioral phylogenetics of *Nocomis* species-groups. American Midland Naturalist 126:103-110.

Maurakis, E. G., W. S. Woolcott, and E. S. Perry. 1997. Descriptions of agonistic behaviors in two species of *Nocomis* (Pisces:Cyprinidae). Virginia Journal of Science. 48(3):195-202.

Pflieger, W. L. 1975. *The Fishes of Missouri.* Missouri Department of Conservation. Jefferson City, Missouri. 343 p.

Robison, H. W. and T. M. Buhanan. 1988. *Fishes of Arkansas*. University Arkansas Press. Fayetteville, Arkansas. 536 p.

Sabaj, M. H. 1992. Spawning clasps and gamete deposition in pebble nest-building minnows (Pisces: Cyprinidae). Unpubl. Masters Thesis, University of Richmond, Virginia. 85 p.

Vives, S. P. 1990. Nesting ecology and behavior of hornyhead chub *Nocomis biguttatus*, a keystone species in Allequash Creek, Wisconsin. American Midland Naturalist 124:46-56.