

SPAWNING IN THE EASTERN SAND DARTER, AMMOCRYPTA PELLUCIDA (PISCES: PERCIDAE), WITH COMMENTS ON THE PHYLOGENY OF AMMOCRYPTA AND RELATED TAXA

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ABSTRACT

The spawning behavior of *Ammocrypta pellucida* was studied in order to provide a better understanding of the life history of *Ammocrypta* and the evolution of spawning behaviors in darters. In this study *A. pellucida* spawned in aquaria in 1987 and 1988. Spawning was not observed in 1987 but eggs and larvae were recovered. In 1988 twelve spawning episodes were observed and eggs were recovered. Spawning occurred in pairs, or less frequently with two males and one female. Eggs were buried singly in the sand.

INTRODUCTION

Spawning has not been described for any of the seven species of *Ammocrypta*, although spawning descriptions have been published for 73 species of *Etheostoma* and *Percina* (Page and Simon 1988). A study of the spawning behavior of *Ammocrypta pellucida* was conducted in order to better understand the evolution of breeding behaviors in darters, and to provide valuable life history information for this species.

MATERIAL AND METHODS

Five collections of *A. pellucida* were made from 2 June - 29 July 1987 in the Tippecanoe River at Talma, Fulton County, Indiana. Seine hauls were made in all

available habitats in a 0.4 km section of the river. The number, sex, and reproductive state of the sand darters were noted, along with the physical characteristics of the habitat where they were taken.

Five specimens of both sexes of *A. pellucida* were brought back to the Illinois Natural History Survey for aquarium observations. From 2-28 June a total of 11 *A. pellucida* were placed in a 151-liter tank. Water was 30 cm deep, and a filter placed on the side of the tank generated visible current. The substrate ranged from medium-sized gravel to fine sand. The average substrate depth was 5 cm. Mussel shells, plants, and large rocks were placed in the tank as spawning substrate choices. In December 1987 the fish were transferred to a 37.8-liter tank with a bubble filter. The substrate and spawning choices were the same as before.

RESULTS AND DISCUSSION

In the Tippecanoe River, sand darters were most abundant in swiftly flowing water approximately 30 cm deep, over a substrate of approximately 80% sand and 20% gravel. These areas were usually the deepest, swiftest runs. During intensive sampling on 26 July 23 male and 4 female *A. pellucida* were captured, suggesting that males had congregated in the area sampled, or that males outnumber females in the population. During our sampling period, males and females could be distinguished by the presence of dark pigmentation on the pelvic fins of the males and the distended abdomens of the females. Water temperatures during field observations ranged from 17-26C.

In 1987, spawning was not observed but eggs and larvae were found in the tank. Eggs were first found on 29 June 1987. Sixty-six eggs were found buried in the mixed sand and gravel substrate and were dispersed over an area 10 x 16 cm. Fertilized eggs were translucent, spherical, and slightly adhesive. Mean egg diameter was 1.4 mm (range 1.1-1.7 mm, n=24, SD=0.15). The tank was searched daily from 29 June to late July, 1987. Eggs and larvae were found from 29 June to 16 July 1987 at approximately 4-5 day intervals.

Spawning was first observed in *A. pellucida* on 7 April 1988 at 2100 hr. One female and four males were on the substrate surface. The males pursued the female around the tank, often resting their pelvic fins and chin on her back. When the female was ready to spawn, she moved to a sand and gravel area in the corner of the tank and sat motionless. In 9 of 12 spawning episodes she was mounted by a male who positioned himself directly on top of her. Egg deposition occurred when the pair vibrated, burying their tails and caudal peduncles in the substrate. In the remaining three spawning episodes witnessed, the pair was joined by a second male who positioned himself on one side of the female and vibrated with the pair. Eggs were buried singly in the substrate.

Spawning lasted from 7 April to about 10 June 1988 and occurred both day and night, at water temperatures of 20.5-23C. It is probable that a female spawns many times during the season. During the breeding season males develop dark pigmentation on the first three to four outer rays of the pelvic fins and small tubercles on the ventral surface of the first few outer pelvic rays. It is apparent by their positions and the posture of the male and female during spawning, that these tubercles act to hold or stimulate the female during spawning.

Given the burying lifestyle of this species, its spawning strategy of egg burying is not surprising. The spawning substrates used by darters with other spawning

methods, such as plants, boulders, and flat rocks, often are unavailable in the immediate environment of sand darters, and spawning migrations are rare in darters (Page 1985). It is likely that egg survivorship is high in the well-oxygenated substrate where *Ammocrypta* live and bury eggs. This strategy is similar to that of many other darters in the genera *Percina* and *Etheostoma*, such as *P. carprodes*, *E. caeruleum*, and *E. stigmaeum* (Winn 1958), which also bury their eggs in well-oxygenated substrate (Page 1985).

The occurrence in *A. Pellucida* of 'sneaker males', or males which attempt to join a spawning pair also is not surprising since it has been reported for other darters with similar spawning strategies, for example *E. caeruleum* (Reeves 1907), *Percina pantherina* (James, et al. 1988) and *Etheostoma rufilineatum* (Stiles 1988). Sneaking will most likely be found to be common as more detailed work is done on spawning strategies in darters.

The genus *Ammocrypta* was regarded as a specialized derivative of *Percina* by Bailey and Gosline (1955), but recent studies suggest a common origin for *Etheostoma* and *Ammocrypta* (Page and Whitt 1973a, 1973b). Page and Whitt (1973a) suggested that *E. (Vaillantia) chlorosomum* is the sister taxon to *Ammocrypta*, and Page (1985) proposed the phylogenetic relationships among species of the subgenera *Boleosoma*, *loa*, *Vaillantia*, and *Doration* shown in Fig. 1A. Members of *Doration* are egg buriers, of *Vaillantia* are egg attachers, and of *loa* attach their eggs in clusters similarly to *Boleosoma*, which are egg clusterers and have parental care (Page 1985). Simons (1988) has proposed, based on osteological evidence, that *E. (loa) vitreum* is the sister taxon to *Ammocrypta*, with *Boleosoma* and *Vaillantia* as the sisters to this clade (Fig. 1B).

The hypothesis Fig. 1A, of Page (1985) parallels the progression in complexity of reproductive behaviors from egg burying in *Doration*, egg attaching in *Vaillantia*, attaching in clusters in *loa*, to egg clustering and parental care in *Boleosoma*. If *Ammocrypta* is added as the sister taxon to *Vaillantia* (Page and Whitt 1973a), egg burying is a reversal to the primitive state in *Ammocrypta*, or egg attaching arose independently in *Vaillantia* and *loa/Boleosoma*. The hypothesis of Simons (1988) with *Ammocrypta* as the sister taxon to *loa* (Fig. 1B), requires either independent origins for egg attaching/clustering in *Vaillantia*, *Boleosoma*, and *loa* (if *Doration* or any other egg-burying darters are considered to be the sister group), or a reversal to the primitive egg-burying behavior in *Ammocrypta*, with egg attaching first appearing in *Vaillantia*. More detailed genetic and osteological work will aid in determining the best hypothesis of relationships among these taxa.

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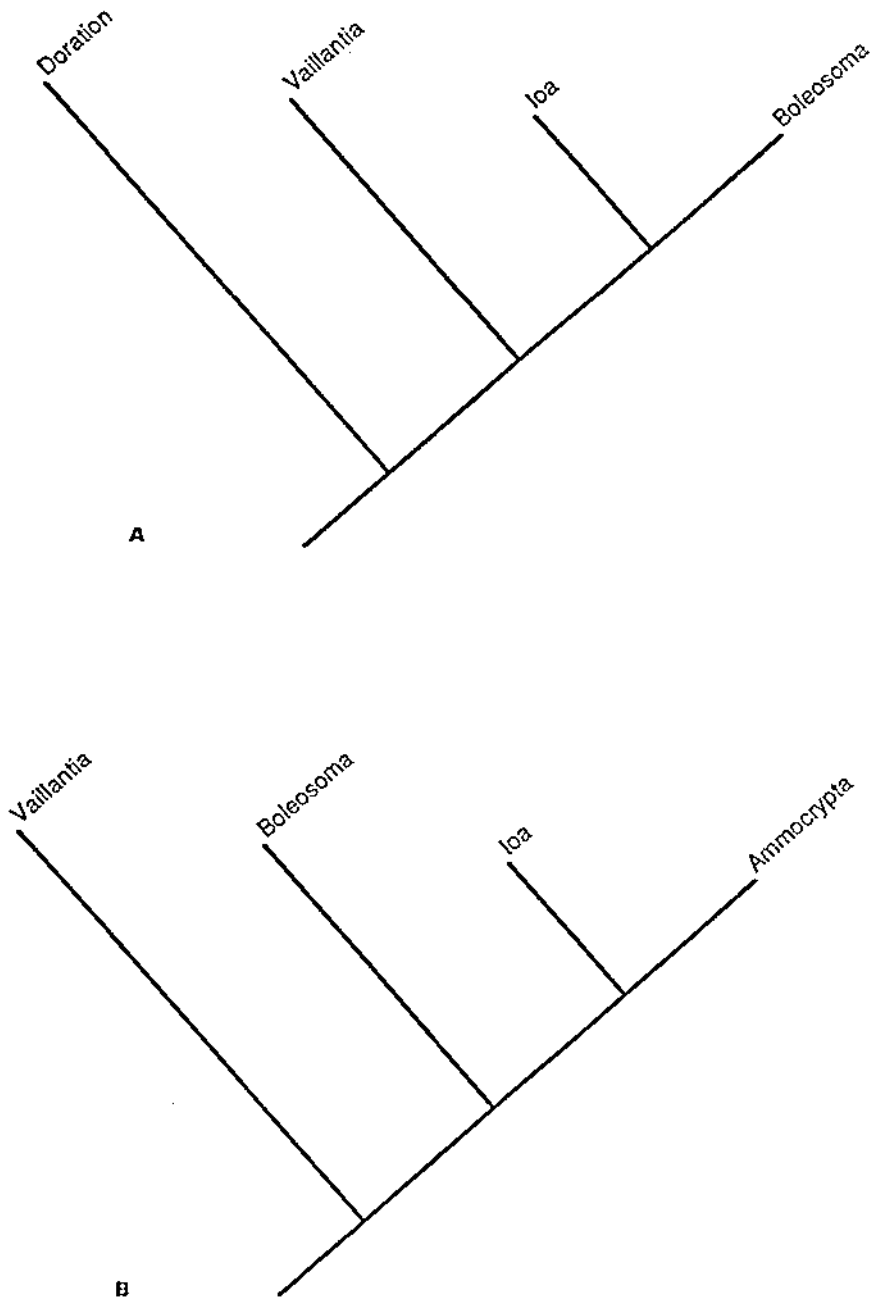


Figure 1. A. Hypothesized phylogenetic relationships of *Doration*, *Vaillantia*, *loa* and *Boleosoma* from Page (1985). B. Hypothesized relationships of *Vaillantia*, *Boleosoma*, *loa* and *Ammocrypta* from Simons (1988).