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Identification of a Fish Host of the Inflated Heelsplitte Potamilus inflatus (Bivalvia: Unionidae) with a Descriptior Its Glochidium

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ABSTRACT.—A survey of the fishes of the Black Warrior River was undertaken to determin fish host(s) of the federally threatened inflated heelsplitter, *Potamilus inflatus*. Seven hur dred-twenty individual fishes representing 30 species were examined; mussel glochidia wer found on 10 individual fishes representing nine species. *Potamilus inflatus* glochidia wer only found infesting one freshwater drum (*Aplodinotus grunniens*), which is concordant witl previous findings for the genus *Potamilus*. The morphology of *P. inflatus* glochidia is de scribed and compared to *P. purpuratus*.

INTRODUCTION

Potamilus inflatus is a federally threatened mussel that inhabits large rivers in the s eastern United States (U.S. Fish and Wildlife Service, 1992). The historical range *inflatus* has decreased markedly in the last decade prompting concern over the con tion status of this organism. Historically, the inflated heelsplitter was known from the and Tangipahoa rivers in Louisiana, the Pearl and Tombigbee rivers in Mississippi, an Black Warrior, Coosa and Tombigbee rivers in Alabama (Hurd, 1974; Stern, 1976; Har 1988). Presently it is limited to the lower and middle reaches of the Amite and Pearl in Louisiana and in the Black Warrior River between the Demopolis Lock and Da stream to the Oliver Lock and Dam in Alabama (U.S. Fish and Wildlife Service, 1 Little is known about the natural history of *P. inflatus*; however, such information is c to effective conservation and species management.

Reproduction of mussels in the family Unionidae differs from other bivalves. Befo tilization the eggs pass into the suprabranchial chamber and then into the water tul the gills where they are fertilized (Pennak, 1989). The developing embryos are retain the marsupium, a modified portion of the gill (Thorpe and Covich, 1991). Members genus *Potamilus* are long-term breeders; the eggs are fertilized in the summer an embryos are not released for almost a year (Heard and Guckert, 1970). A critical st the development of all unionid mussels is the attachment of the glochidium larvae suitable fish host. After attachment to a host, the glochidium is encysted as the tis the fish grows to cover it (Pennak, 1989). During this stage the juvenile mussels of

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species develop their adult shell and anatomy (Surber, 1912, 1913, 1915; Cummings *et* 1990) that will enable them to begin life as a filter-feeding member of the benthic co munity. While all species of unionids do not appear to be host-specific, the genus *Potami* parasitizes the freshwater drum (*Aplodinotus grunniens*) almost exclusively (Surber, 19 Wilson, 1916; Cummings *et al.*, 1990). A single exception was reported by Surber (19 who found glochidia of *P. ohiensis* on white crappie (*Pomoxis annularis*).

The objective of this study was to identify the fish host(s) of *Potamilus inflatus*. Su information may prove useful in management and recovery of the species, as unionids dependent upon their fish hosts during a critical period of their natural history. Two spec of *Potamilus* (*P. inflatus* and *P. purpuratus*) are present in the Black Warrior River. described glochidia of *Potamilus* can be distinguished from those of other unionids by th axe-head shape (Hoggarth, 1988). However, the glochidium of *P. inflatus* have not be previously described. In order to facilitate the identification of these taxa, we describe glochidium of *P. inflatus* and compare it to the glochidium of *P. purpuratus*.

METHODS

Ten collections of fishes were made twice a week between 27 June and 28 July 1995 the Black Warrior river at 12 Mile Rock, (river mile 327.3), Tuscaloosa Co., Alabama single collection was made at Choctaw Bend, Greene Co., Alabama, below the Warrior D (between river mile 262 and 261) on 14 July 1995. These sites were selected because th portions of the river were known to contain populations of *Potamilus inflatus* (William *al.*, 1992). Several collection methods were employed including gill netting, seining a hook and line. Fishes were preserved in a solution of 10% formalin and examined glochidia on the fins and gills with a dissecting microscope. Gills harboring glochidia w isolated and placed in a solution of 70% ethanol for later identification using a compou microscope. Glochidia were identified based on their morphology as described in the lowing section. Common and scientific names of fishes follow Robins *et al.* (1991). Previ surveys by one of us (PH) indicated that glochidia release occurred between June and J A preliminary survey on 27 June 1995 of adult *P. inflatus* at 12 Mile Rock indicated t female *P. inflatus* were releasing glochidia. This was determined by opening the val slightly by hand and visually inspecting the marsupium. Several of the female mussels amined had partially discharged water tubes, indicating they were in the process of releas glochidia. To increase the likelihood of collecting fish infested with *P. inflatus* glochi we concentrated our efforts in this area. No attempt was made to identify the other g chidia found during this study, other than to confirm they were not *P. inflatus*.

A single female *Potamilus inflatus* was collected during the preliminary survey on 27 Ju and maintained in an aquarium with river water and sediment until it had released glochidia. Glochidia were recovered from the substrate with an eye-dropper. *Potamilus p puratus* glochidia were obtained from a preserved female specimen collected on 30 Ju 1993 from the Cahaba River, Bibb Co., Alabama. Measurements of 10 glochidia of ea species were made with an ocular micrometer. Glochidia height is defined as the great distance between the dorsal and ventral margins; dorsal length is defined as the great length between the anterior and posterior edges along the dorsal margin, and ventral len is defined as the greatest distance between the anterior and posterior edges along ventral margin. Glochidia were prepared for scanning electron microscopy (SEM) follow procedures outlined in Hoggarth (1988). The features identified using SEM were sub quently used to identify glochidia encysted in gill tissues. Gill tissue containing glochi was prepared by partial clearing in a solution of 10% trypsin and sodium borate. T prepared tissue was examined and the glochidia identified using a compound microsco

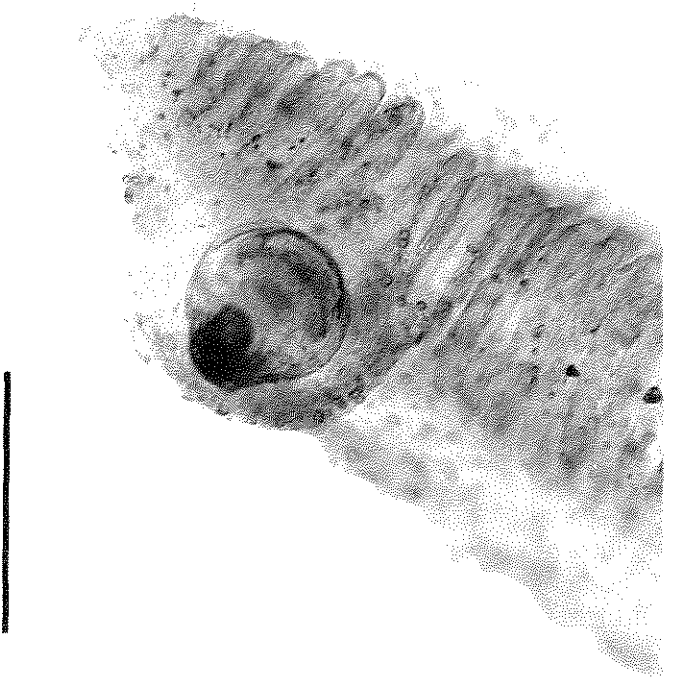

FIG. 1.—Light micrograph of *Potamilus inflatus* larvae encysted in gill filament of *Aplodinotus gru niens*. Bar = 0.20 mm

RESULTS

A total of 720 fishes representing 30 species were collected and examined for glochidi infestation (Table 1). The number of fish species examined represented 61% of tho reported by Mettee *et al.* (1989) between the Oliver Lock and Dam and the Warrior Lo and Dam. Ten of the 720 specimens were infested with glochidia and one of the 37 spe mens of *Aplodinotus grunniens* (collected 10 July 1995) was infested with 12 glochidia ide tified as *Potamilus inflatus*. All glochidia were attached to or encysted in the gills; no gl chidia were observed on the fins of any fishes examined (Fig. 1).

Description of glochidia.—The glochidia of *Potamilus purpuratus* and *P. inflatus* were read distinguishable from each other. The glochidia of *P. inflatus* are small, with a mean height 0.188 mm (SD = 0.01 mm, range = 0.180–0.234 mm) and axe-head shaped (Fig. 2a,b). Tl dorsal margin is straight, with a mean length of 0.070 mm (SD = 0.008 mm, range = 0.05 0.081) and the ventral margin is curved with a mean length of 0.125 mm (SD = 0.020, ran = 0.081–0.126 mm) Large lanceolate hooks are present on the anterior and posterior edges

TABLE 1.—List of fishes[1] reported from the Black Warrior River between the William Bacon Ol Lock and Dam and the Armisted I. Selden Lock and Dam (Mettee *et al.*, 1989) with numbers of e species examined for this survey

Species	N	Glochidia	Species	N	Gloch
Lepisosteus oculatus	8	–	*Notropis atherinoides*	13	–
L. osseus	—		*N. candidus*	75	–
Amia calva	—		*N. edwardraneyi*	213	–
Alosa chrysochloris	17	–	*N. texanus*	1	–
Dorosoma cepedianum	49	–	*Opsopoeodus emiliae*	—	
D. petenense	59	–	*Pimephales vigilax*	47	–
Esox niger	—		*Carpiodes cyrpinus*	5	–
Cyprinella venusta	29	–	*C. velifer*	11	+
**Cyprinus carpio*	1	–	*Ictiobus bubalus*	2	–
Hybopsis winchelli	—		*Moxostoma erythrurum*	—	
Macrhybopsis storeriana	9	–	*M. poecilurum*	—	
Ictalurus furcatus	2	–	*Amieurus natalis*	—	
I. punctatus	17	+	*Lepomis macrochirus*	22	+
Pylodictus olivaris	—		*L. megalotis*	36	+
**Aphrododerus sayanus*	1	–	*L. microlophus*	21	+
Strongylura marina	5	–	*L. punctatus*	—	
Fundulus olivaceus	—		*Micropterus punctulatus*	20	+
Gambusia affinis	1	–	*M. salmoides*	1	–
Labidesthes sicculus	2	–	*Pomoxis annularis*	1	–
Morone chrysops	—		*P. nigromaculatus*	—	
**M. mississippiensis*	14	+	*Percina shumardi*	—	
M. chrysops × *saxatilis*	1	–	*P. vigil*	—	
			Aplodinotus grunniens	37	+

[1] List includes fishes caught at Choctaw Bend on 14 July 1995: *Cyprinella venusta* (5), *Notropis erinoides* (3), *N. edwardraneyi* (5), *Ictalurus punctatus* (1), *Labidesthes sicculus* (1), *Lepomis macroch* (1), *L. megalotis* (9), *L. microlophus* (4), *Micropterus punctulatus* (5), *M. salmoides* (1)

* Indicates fishes not reported by Mettee *et al.*, 1989

both valves. These hooks extend more antero-posteriorly in *P. inflatus* than in other congei (Hoggarth, 1988). Between these large hooks are a variable number (5–7) of smaller bifur hooks. Micropoints are present on the ventral edge of both valves, with some extending c the base of the smaller hooks. The micropoints are lanceolate and are loosely organized vertical rows and the valves are equal in size with no lateral valve gape.

The glochidia of *Potamilus purpuratus* are twice as large as *P. inflatus*, averaging 0.371 in height (SD = 0.001 mm, range = 0.360–0.378 mm) and are elongate and strap-like (2c,d). The dorsal margin is straight, mean length = 0.108 mm (SD = 0.015, range 0.072–0 mm) while the ventral margin is only slightly curved, mean length = 0.201 mm (SD = 0. range = 0.180–0.220). *Potamilus purpuratus* glochidia possess large lanceolate hooks on anterior and posterior margins of the valves, oriented at nearly a right angle to the ant posterior plane and lack the smaller bifurcate hooks found on *P. inflatus*. Micropoints are present on the ventral margins of both valves and are organized into vertical rows. The va are unequal ventrally with one side fitting within the other. A large lateral valve gape is pres

The *Potamilus inflatus* glochidia observed on the drum were well-encysted in the tissue of their host. All glochidia were located at or near the distal end of the gill filam

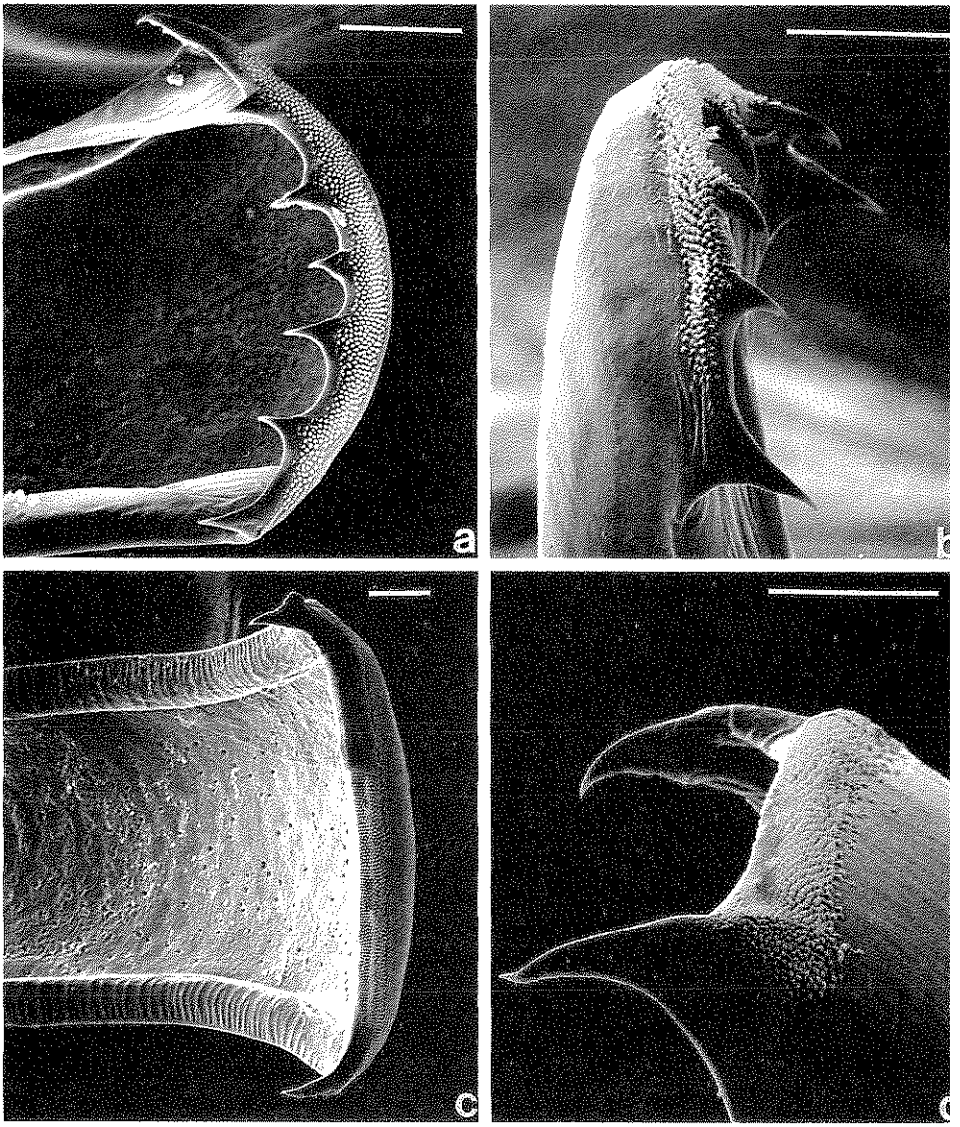

FIG. 2.—Scanning electron micrographs of glochidia larvae. 2a,b medial and lateral views larvae *Potamilus inflatus*. 2c,d medial and lateral views larvae of *Potamilus purpuratus*. Bar = 25 μm

The axe-head shape, large lanceolate hooks, and smaller hooks were present confirmin that these were *P. inflatus* glochidia. In addition, the adult valves were clearly visible, e tending beyond the margins of the glochidial valves (Fig. 1).

DISCUSSION

The presence of metamorphosing *Potamilus inflatus* glochidia encysted on a freshwat drum indicates that drum are a host for *P. inflatus*. Although female *P. inflatus* were activel

discharging glochidia when the study began, only one of 37 freshwater drum collec (2.7%) was infected with their glochidia. Low infection rates might be due to: (1) numbers of host fish encountering gravid female *P. inflatus*; (2) low numbers of gra female mussels or (3) the reflection of normal infestation rates for this species. Freshwa drum are widespread and relatively common in the Black Warrior River (Mettee *et* 1989); however, freshwater drum may have habitat preferences that preclude their enco tering *P. inflatus* and are therefore not locally abundant in stretches of the river inhabi by mussels. Swingle (1953) found a significant decrease in the abundance of freshwa drum following river impoundments, and hypothesized that flowing water was necessary reproduction of the fish. The Black Warrior River is impounded above and below section of the river where the gravid *P. inflatus* were found, and this stretch exhibited li flow. Changes in the river flow due to impoundment may explain the low infection ra observed: drum do not frequent areas with low flow and are therefore unlikely to encour the mussels and subsequently become infected.

Mean densities of *Potamilus inflatus* in the Black Warrior River are low, although at so sites surveyed they were the dominant species of mussel (Miller *et al.*, 1996). Values ran from 0.5 individuals/100 m^2 to 0.97 individuals/100 m^2 depending on which substrate t were found (Miller *et al.*, 1996). These densities might explain the low infestation ra found in this study. However, previously reported infestation rates for other species of *tamilus* are comparable to those found in this study. Surber (1913) indicated that only of the *Aplodinotus grunniens* in his survey were infested with the glochidia of *P. ohier* Weiss and Layzer (1995) studied glochidial infestations of the fishes of the Barren Ri Kentucky, and found that 3% (n = 73) of drum were infested with glochidia of *P. ala* In contrast, Cummings *et al.* (1990) documented a comparatively high infestation rate *P. capax*, where 75% of the *A. grunniens* collected were infected with glochidia of *P. cap* The low infestation rate of drum by *Potamilus glochidia* observed in this and other stu may be typical for this genus. Although Cummings *et al.* (1990) observed a much hig rate than we observed, we note that their sample size was small (n = 8) possibly bias the observed infestation rate. Further investigations into the reproductive biology of species are needed to determine what other factors may be influential in the low infestat rates observed in this and other studies.

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