Life-Cycle Completion of the Freshwater Clam *Lasmigona compressa* (Bivalvia : Unionidae) in an Experimental Host, *Lebistes reticulatus*

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THERE ARE ONLY A FEW WORKS on the known hosts of North American freshwater bivalves of the family Unionidae, and in most cases the host is a freshwater fish (the occurrence of *Simpsoniconcha ambigua* on the mudpuppy, *Necturus*, is an exception), although in a few cases, such as with *Strophitus undulatus, Anodonta imbecilis* and *Obliquaria reflexa,* there may be no fish host and development proceeds directly (FULLER, 1974).

Lists of fish hosts of the various bivalves are scattered widely in the literature, but are summarized in LEFEVRE & CURTIS (1912) and especially in FULLER (1974). Hosts of the clam investigated in this study, *Lasmigona compressa* (Lea, 1829), are not mentioned in these studies, nor does the present work deal with the normal hosts for this species. The purpose of this paper is to call attention to a system of glochidial infection and metamorphosis which is easy to study in the laboratory, since the clam is abundant in its range. The experimental fish host is the easily obtained pet guppy fish, *Lebistes reticulatus,* and the whole life cycle (*i.e.*, maturation of the larval clam) takes less than 2 weeks. Since attachment of larval hooked glochidia occurs on the fins and not on the gills, the infection can be easily observed with a dissecting microscope. The fins infested with glochidia can be easily removed for more detailed examination at any time during development by simple excision.

Adult *Lasmigona compressa* were collected from the Huron River, in Washtenaw County, Michigan, in August, 1978. These clams were maintained in a 72 L capacity aquarium with river vegetation. The clams were given Tetramin flakes of fish food with the expectation that they would feed upon this; previous experience in this laboratory had shown that various clams do well on this diet for 6 months and longer.

Female clams of this species were found to pass glochidia – as well as orange colored ova – into the water in December, for a period of one week. Free glochidia were taken from the bottom of the aquarium with a long pipette rather than being dissected out of the gills as performed by other workers (LEFEVRE & CURTIS, 1912), for it was found that glochidia removed by dissection were noninfective. The glochidia are 320 μm × 260 μm when closed, and each hook (one per valve) is 90 μm long. The hooks are studded with rather sharp little spines, 7 μm in diameter, 3 per row for much of the hook's length. About 100 glochidia were placed into each shallow Petri plate with water, and male and female guppies were allowed to swim in this for a period of 2-5 minutes, during which they were continuously examined under a dissecting microscope. This interval of time was sufficient to allow an average of 10 glochidia to attach to each fish. A heavier infection was thought to be undesirable because of the small size of these fish. Similarly, goldfish of 5 cm length were also exposed to glochidia in separate containers. Usually, 10 fish of each species were used per experiment.

The goldfish were found to attract glochidia, causing the latter to attach to the fins, but the infections were not successful; these larval clams fell off or were shed in 2 days and died.

The first infections of guppies were successful in the sense that glochidia attached well to all the fins. But after the infected guppies were isolated and kept in aerated tap-water, every one of 10 fish developed fungus infections at the sites of attachment and the glochidia died and fell off in 4 - 6 days. Not a single larva metamorphosed under these conditions. Uninfected fish kept in the same water remained completely healthy and free of fungus.

A separate group of guppies was then infected, but place into aerated tap-water into which Furazone (Dyna-Pet, Campbell, Calif.) was dissolved at the concentration recommended for fish by this company to discourage bacterial and fungal growth. Under these conditions, glochidia remained attached to all the guppies, and the former underwent successful metamorphosis. The criterion for metamorphosis is only generally defined, but involves the young clam falling off or detaching itself from the fish fin after showing some adult features, especially the development of a large, muscular foot with which the young clam now crawls. Gills are also visible at this time. No significant growth was seen during this period. The time for completion of metamorphosis under these laboratory conditions, at room temperature (20° C) was 10 - 12 days with almost 100% success.

When the glochidia finally detached from their hosts, they were placed into aerated tap-water, containing the small freshwater diatom, *Navicula pelliculosa*. The glochidia kept in this water inside a 50 mL glass-stoppered flask lived thus and grew for 2 weeks, after which the experiments were terminated. During this time, a new growth-margin developed on each clam shell, amounting to an added new width of 46 μm. This new growth area was characterized by a smooth surface, unlike the original glochidial shell surface, which is coarse, and studded with large calcium carbonate crystals.

A few simple experiments were conducted on the newly shed glochidia, which apparently live only one or two days unless they find a suitable fish host. Under normal, quiet conditions, the glochidia lie with the 2 valves spread widely apart, ventral side upward; these animals are normally motionless.

Several guppies were ground up in a Waring blender, and the supernatant of this fluid was added dropwise to a dish containing quiescent glochidia. One drop of such fish fluid in 20 mL of water was enough to cause most glochidia to snap a few times, after which some stayed closed for several minutes. In 10 minutes all these glochidia were open again.

The amino acid, L-glutamic acid, was then dropped as crystals into these containers, near the glochidia. Again, a positive response was elicited, as shown by the snapping or snapping-shut of these larvae. Heard & Hendrix (1964) found that 20 amino acids, but not the 3 basic amino acids, arginine, histidine and lysine, elicited glochidial response in the clams which they tested.

Finally, the responsiveness of glochidia to physical stimulation was tested. A very fine, etched piece of tungsten wire was used to touch various areas of the glochidium, to see if pure mechanical stimulation is enough to elicit contraction, *i.e.*, attachment behavior, and if so, to see which part of the glochidium is most sensitive. It was found that the glochidia are indeed sensitive to mechanical stimulation, without prior chemical sensitization. The most sensitive part of the glochidium was in a swelling near the hinge line, where a larval thread has been shown to originate in other glochidia (see Wood, 1974).

It is possible that glochidia of other species could also infect the guppy under similar laboratory conditions. Such a system as this one, with *Lasmigona compressa* and the guppy, followed by feeding with *Navicula pelliculosa,* offers much promise for more detailed studies of fish susceptibility, hardiness to heavy infections, for possible class demonstrations of the life cycle of freshwater clams, and especially in elucidating details of how clams metamorphose on freshwater fish. Such studies are all the more important since it is likely that this early larval life and immediate post-metamorphosis may be the most critical period in the life-cycle of freshwater clams. If such larval and young clams are more sensitive to aquatic pollution of various kinds than are adult clams, then this would explain why so many endangered areas of rivers have adult clams only and lack any (recruitment of) young. More detailed studies along these lines could be of great help in re-establishing clams into recently cleaned up rivers and ponds using some method of commercial or laboratory rearing of the young.

Voucher specimens of *Lasmigona compressa* and the infected fish have been deposited in the collections of The University of Michigan, Museum of Zoology.

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