A New Widespread Morphological Deformity in Freshwater Mussels from New York

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Abstract - I describe a new, characteristic shell deformity in unionid mussels from several sites in southern New York. The posterior end of the shell is strikingly shortened and distorted in these deformed mussels. Because these misshapen mussels have been seen only in streams with heavily agricultural or residential watersheds and only after 1990, they may be caused by an agricultural or household chemical that has come into recent use.

The widespread pollution of fresh waters has increased the incidence of morphological and developmental deformities in freshwater animals. Indeed, the occurrence and frequency of such abnormalities is often used as an indicator of water pollution (e.g., Johnson et al. 1993, Lenat 1993, Meregalli et al. 2000, Vuori and Kukkonen 2002). Morphological abnormalities have sometimes been described in freshwater mussels (Unionidae), but typically have been attributed to mechanical damage or parasites rather than pollution (e.g., Baker 1928, Parmalee and Bogan 1998, Vermeij and Dudley 1985). Here, I describe a new, widespread deformity in freshwater mussels from southern New York that seems to be associated with agricultural and suburban watersheds.

Deformed mussels are readily recognized by their severely shortened posterior ends (Fig. 1). The posterior margin of the shell is irregular or ragged, the periostracal layers often are thick and distorted, and the 2 valves often do not fit together well at the posterior end of the shell, resulting in a marked gape. The deformation of the shell may be so severe that it is difficult to identify the species. I have not observed the soft tissues of animals affected by this deformity, but they presumably are distorted as well.

I saw this deformity at 5 widely separated sites in New York in 1992–2006. In the Ramapo River (Orange County), which drains a suburban watershed, I found deformed individuals of all 3 unionid species—*Elliptio complanata* (Lightfoot) (eastern elliptio), *Alasmidonta undulata* (Say) (triangle floater) and *Pyganodon cataracta* (Say) (eastern floater)—that live at this site. Similarly misshapen mussels also turned up in 4 streams whose watersheds are dominated by row-crop agriculture: Schoharie Creek (Schoharie County, *Lasmigona costata* (Rafinesque) [flutedshell]), 2 sites along Rutgers Creek (Orange County, *E. complanata*), 2 sites along Five Mile Creek (Steuben County, *Lasmigona compressa* (Lea) [creek heelsplitter]), and Webatuck Creek (Dutchess County, *E. complanata*). Unlike the situation in the Ramapo River, I did not see deformed individuals of all of the species present at these latter 4 sites. This deformity is thus geographically and phylogenetically widespread. Although I did not record the frequency of misshapen animals in affected populations, these shell anomalies were not rare, and involved >10% of the animals that I saw at some sites.

I have examined thousands of unionid specimens in museum collections that were collected from New York and other parts of the Northeast from 1820–1990, and have seen a few misshapen specimens, but none with the characteristic deformity shown in Figure 1. Further, although several authors (e.g., Baker 1928, Coker et al. 1921, Howells et al. 1996, Parmalee and Bogan 1998, Vermeij and Dudley 1985) have discussed or illustrated shell anomalies in unionids, only Figure 9D of Howells et al. (1996) even remotely resembles the specimens in Figure 1. All of this evidence suggests that this type of deformity may be of recent origin.

The cause of this deformity and its ultimate significance to unionid populations are unknown. However, the geographical and temporal distribution of the abnormality suggests that it might be caused by a chemical that has recently come into use in agricultural or residential areas. A wide variety of chemicals, including insecticides, herbicides, metals, organic contaminants, chlorine, and industrial, agricultural, and

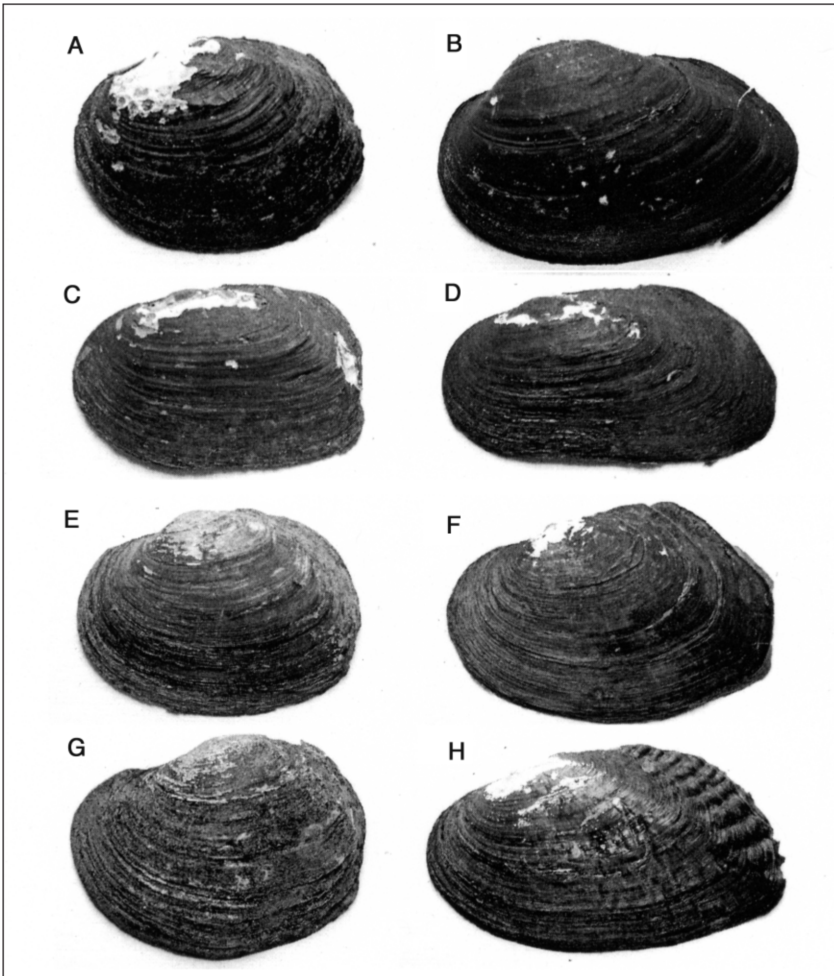

Figure 1. Deformed unionid mussels from New York, along with normal shells from nearby sites for comparison; actual shell lengths are given in parentheses. All specimens are oriented with the anterior to the left. A. *Alasmidonta undulata* (deformed, 34 mm), Ramapo River, Tuxedo Park, Orange County, NY; B. *A. undulata* (normal, 60 mm), Hackensack River, 1 km below Lake Louise, Rockland County, NY; C. *Elliptio complanata* (deformed, 48 mm), Rutgers Creek at Johnson, Orange County, NY; D. *E. complanata* (normal, 75 mm), Indian Kill 100 m above mouth, Staatsburg, Dutchess County, NY; E. *Lasmigona compressa* (deformed, 50 mm), Five Mile Creek above Kanona, Steuben County, NY; F. *L. compressa* (normal, 57 mm), Mud Creek west of Sonora, Steuben County, NY; G. *Lasmigona costata* (deformed, 81 mm), Schoharie Creek, Esperance, Schoharie County, NY; H. *L. costata* (normal, 76 mm), Mohawk River, Cohoes, Albany County, NY. All specimens are in the collection of the New York State Museum.

domestic effluents in general, are known to cause abnormalities in other freshwater animals (Johnson et al. 1993).

Alternatively, this deformity may be caused by a parasite. Coker et al. (1921) and Baker (1928) noted that parasitic infestations of unionids sometimes cause their shells to grow irregularly (although they suggest that the anterior part of the shell is usually distorted). If the shells shown in Figure 1 were distorted as a result of a parasitic infestation, however, it is difficult to understand why such shells were not found in the past in the Northeast.

I do not know whether this deformity affects functions such as feeding, reproduction, or respiration, nor if it might affect population size or viability. The extent, cause, and functional consequences of this deformity deserve further investigation.

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