

Note

Passive transport of Eastern Elliptio (*Elliptio complanata*) by freshwater turtles in New England

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Abstract

Dispersal of freshwater mussels (order Unionida) is primarily as glochidia on the fins and gills of host fish. Adult mussels are more sessile, generally moving short distances (<2 m/week) along lake and river beds. Between 2007 and 2016, we observed seven instances of adult Eastern Elliptio (*Elliptio complanata*) and one instance of a fingernail clam (*Sphaerium* sp.) attached to the feet of freshwater turtles in streams and ponds of New England, United States. Observations included five instances of mussels attached to Wood Turtles (*Glyptemys insculpta*) in Maine and Massachusetts, one instance of a mussel attached to the fingernail of an Eastern Painted Turtle (*Chrysemys picta*) in Massachusetts, one instance of a mussel attached to a Snapping Turtle (*Chelydra serpentina*) in Massachusetts, and one instance of a fingernail clam attached to the fingernail of an Eastern Painted Turtle in Massachusetts. We suggest that Eastern Elliptio may be susceptible to transport by freshwater turtles foraging in mussel beds and that transport of adult mussels by freshwater turtles could result in otherwise atypical long-distance, upstream, or overland dispersal between waterbodies.

Key words: Eastern Elliptio; *Elliptio complanata*; freshwater mussel; Wood Turtle; *Glyptemys insculpta*; Eastern Painted Turtle; *Chrysemys picta*; Snapping Turtle; *Chelydra serpentina*; fingernail clam; Sphaeriidae; *Sphaerium* sp.; dispersal

Eastern Elliptio (*Elliptio complanata*), which is among the more abundant and widespread freshwater mussels (Unionida) of northeastern North America, is a generalist species reportedly capable of parasitizing over 20 fish species from nine families (reviewed by Lellis *et al.* 2013). Dispersal of freshwater mussels occurs primarily through glochidial (i.e., larval) attachment and transport on host fishes (Balfour and Smock 1995; Terui and Miyazaki 2015). Movement of adult freshwater mussels via crawling may be associated with spawning aggregations (Amyot and Downing 1997), changes in water levels (Newton *et al.* 2015), or other environmental changes (Schwalb and Pusch 2007). However, movements of adult mussels, including Eastern Elliptio, are generally short

(<2 m/week) and are not thought to be of significant value for long-distance dispersal (Balfour and Smock 1995; Schwalb and Pusch 2007; Terui and Miyazaki 2015). Here, we provide evidence of three species of freshwater turtle passively transporting adult Eastern Elliptio attached to their claws or feet. We also present one occurrence of a turtle transporting a fingernail clam (*Sphaerium* sp.), adding to other reports of this phenomenon on amphibians (Engel *et al.* 2008; Wood *et al.* 2008; Kappes and Haase 2012).

We observed seven instances of Eastern Elliptio, and one instance of a fingernail clam (*Sphaerium* sp.) attached to the claws and feet of wild, freshwater turtles. Five of these observations were made during Wood Turtle (*Glyptemys insculpta*) studies involv-

ing more than 15 000 visual and nonvisual detections of 1765 Wood Turtles (Jones 2009; Jones *et al.* 2018). On 4 October 2007, we radio-located adult male Wood Turtle #333 (straight carapace length [SCL] 184.4 mm; mass 912 g) in Franklin County, Massachusetts. An adult Eastern *Elliptio* was firmly attached to the turtle's hind right foot. At the time of observation, the turtle was walking on the river bottom. On 12 September 2013, we located male Wood Turtle #98-13 (SCL 200.0 mm; mass 1181 g) during a standardized visual survey (Jones *et al.* 2018) in Somerset County, Maine. The turtle was submerged on the stream bottom and an adult Eastern *Elliptio* was firmly attached to the turtle's hind foot. On 13 September 2013 during a timed survey in Somerset County, we located Wood Turtle male #126 (SCL 201.0 mm; mass 1271 g) walking quickly upstream on the river bottom. An adult Eastern *Elliptio* was attached firmly to a fingernail on his hind left foot (Figure 1a). On 13 October 2013, we again located male #126, the same Wood Turtle observed on 13 September, during a timed survey. The turtle was 444 m upstream of his earlier location on 13 September and, again, had an Eastern *Elliptio* firmly attached, this time to his front left foot (Figure 1b). We determined from photographs that the mussel was a different individual. At the time of capture, the turtle was submerged on the river bottom. In none of the preceding cases did the mussel appear to impede movement of the turtle. On 19 September 2015, during another standardized Wood Turtle survey in Somerset County, we located an adult female Wood Turtle (#452) basking on a clay riverbank with an adult Eastern *Elliptio* attached to her front foot (Figure 1c).

We observed similar phenomena with Eastern Painted Turtles (*Chrysemys picta picta*) in Massachusetts. On 23 September 2014, while undertaking surveys for Northern Red-bellied Cooter (*Pseudemys rubriventris*), we observed an adult Painted Turtle with an Eastern *Elliptio* attached to its hind left foot. The turtle was basking on a log in a large pond in Plymouth County (Figure 1d). On 24 April 2008, we observed a fingernail clam (*Sphaerium* sp.) attached to the front left foot of a young Eastern Painted Turtle (Figure 1e) in a small stream in Berkshire County.

We also observed one instance of an Eastern *Elliptio* attached to the right hind foot of a Common Snapping Turtle (*Chelydra serpentina*) in Hampshire County, Massachusetts, during a freshwater mussel survey on 11 July 2016 (Figure 1f). The turtle was moving across the bottom of the brook at the time we captured it.

It is possible that mussels become attached to turtles that forage in mussel aggregations. On 11 June 2011, we observed an adult female Wood Turtle (#44

feeding on the broken remains of a dead mussel along a river bank in Somerset County, Maine.

This is not the first report of passive transport of mussels by freshwater turtles: Kew (1893) reported an Eastern *Elliptio* attached to the jaw of a Snapping Turtle in Wisconsin. Further, Eastern *Elliptio* was reported by Darwin (1882) attached to the middle toe of a duck from Danversport, Massachusetts, spurring Darwin's hypotheses on assisted colonization by aquatic fauna. Darwin (1882) and others (Engel *et al.* 2008; Wood *et al.* 2008; Kappes and Haase 2012) have reported occurrences of other freshwater bivalves (e.g., Sphaeriidae) transported over land on the toes of pond-breeding salamanders, aiding in the dispersal of the molluscs to nearby ponds. Eastern *Elliptio* can be a protandrous hermaphrodite capable of self-fertilization, which is likely to aid in colonization of new areas by a small founding population (Downing *et al.* 1989). However, unlike the Sphaeriidae, Eastern *Elliptio* still requires a fish host for glochidial transformation. Thus, it is feasible that short overland dispersal of adult mussels by turtles could aid in the colonization of new habitats if fish hosts are present in the new area.

Closure (adduction) of the bivalve shell is controlled by the anterior and posterior adductor muscles, used in locomotion as well as a protective response to light or physical stimuli (Waller *et al.* 1999). A turtle foot or claw that touches the mantle of a gaped mussel will elicit adduction and attachment. This same response is employed by a crowsfoot brail dredge, used to collect freshwater mussels for research and commercial harvest (Miller and Payne 1993; Williams *et al.* 1993; Sietman *et al.* 2011). Collection of mussels using a brail dredge is associated with 50% or higher mortality (Williams *et al.* 1993; Waller *et al.* 1999), but it is unclear whether mussels attached to turtles would exhibit similar rates of mortality. The high mortality rate on a brail dredge may be caused by shell and soft tissue damage from the dredging itself and also from the active removal of mussels from the brails. A thick-shelled mussel attached to a turtle foot would likely undergo far lower forces than those on a brail dredge and are likely to be detached via their own release. Nevertheless, there is potential for soft tissue injury (i.e., to the foot, viscera, or mantle) that could result in mortality.

Species-specific differences exist in tolerance to emersion (i.e., being out of water), and shell closure is used to protect freshwater mussels from desiccation during emersion (Waller *et al.* 1999; Gough *et al.* 2012). Eastern *Elliptio* is known to survive emersion for two or more days (P.D.H. pers. obs. during mussel salvage attempts following a dam removal in Pepperell, Massachusetts, 2015; S.L.J. pers. obs.



FIGURE 1. a. Adult Eastern *Elliptio complanata* firmly attached to the foot of an adult male Wood Turtle (*Glyptemys insculpta*; #126) in Somerset County, Maine, USA, on 13 September 2013. Photo: M.T. Jones. b. Adult Eastern *Elliptio* firmly attached to the front foot of the same Wood Turtle (#126) in Somerset County, on 13 October 2013. Photo: M.T. Jones. c. Adult Eastern *Elliptio* firmly attached to the foot of an adult female Wood Turtle (#452) in Somerset County, on 19 September 2015. Photo: M.T. Jones. d. Adult Eastern *Elliptio* firmly attached to the foot of an adult Eastern Painted Turtle (*Chrysemys picta*) in Plymouth County, Massachusetts, USA, on 23 September 2014. Photo: M.T. Jones. e. Fingernail clam (*Sphaerium* sp.) attached to the front foot of a young Eastern Painted Turtle in Berkshire County, Massachusetts, USA, on 24 April 2018. Photo: M.T. Jones. f. Adult Eastern *Elliptio* firmly attached to the foot of an adult Snapping Turtle (*Chelydra serpentina*) in Hampshire County, Massachusetts, USA, on 11 July 2016. Photo: S.L. Johnson.

during several canal drawdown surveys in Holyoke, Massachusetts). Given this emersion tolerance, Eastern *Elliptio* is likely to survive short-term emersion during turtle-facilitated transport if they release near shore or when a turtle goes back into the water.

We suggest that Eastern *Elliptio* may be more susceptible than other more fragile-shelled mussel spe-

cies (i.e., *Pyganodon* sp., *Anodonta* sp.) to turtle facilitated transport because of its relative abundance in New England, shell strength, and the strength of its closure. The relative contribution of this activity to Eastern *Elliptio* dispersal and/or mortality is currently unclear, but presumed to be relatively low. Although we did not specifically track the number of

times freshwater turtles were observed without mussels attached to their feet, the phenomenon appears to be a regular occurrence, as we observed it in three distinct watersheds and in three freshwater turtle species.

Author Contributions

Supervision: M.T.J.; Writing – Original Draft Preparation: M.T.J., L.L.W., and P.D.H.; Writing – Review & Editing: M.T.J., L.L.W., P.D.H., D.T.Y., and S.L.J.; Conceptualization: M.T.J. and L.L.W.; Investigation: M.T.J., L.L.W., D.T.Y., and S.L.J.; Funding Acquisition: M.T.J. and L.L.W.; Validation: S.L.J. and P.D.H.; Resources: M.T.J., L.L.W., and P.D.H.

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Literature Cited

- Amyot, J.P., and J.A. Downing.** 1997. Seasonal variation in vertical and horizontal movement of the freshwater bivalve *Elliptio complanata* (Mollusca: Unionidae). *Freshwater Biology* 37: 345–354. <https://doi.org/10.1046/j.1365-2427.1997.00158.x>
- Balfour, D.L., and L.A. Smock.** 1995. Distribution, age structure, and movements of the freshwater mussel *Elliptio complanata* (Mollusca: Unionidae) in a headwater stream. *Journal of Freshwater Ecology* 10: 255–268. <https://doi.org/10.1080/02705060.1995.9663445>
- Darwin, C.** 1882. On the dispersal of freshwater bivalves. *Nature* 25: 529–530. <https://doi.org/10.1038/025529f0>
- Downing, J.A., J.P. Amyot, M. Pérusse, and Y. Rochon.** 1989. Visceral sex, hermaphroditism, and protandry in a population of the freshwater bivalve *Elliptio complanata*. *Journal of the North American Benthological Society* 8: 92–99. <https://doi.org/10.2307/1467405>
- Engel, E., K. Groh, R. Griffiths, L. Wood, and L. Schley.** 2008. Interactions between freshwater mussels and newts: a novel form of parasitism? *Amphibia-Reptilia* 29: 457–462. <https://doi.org/10.1163/156853808786230433>
- Gough, H.M., A.M. Gascho Landis, and J.A. Stoeckel.** 2012. Behaviour and physiology are linked in the responses of freshwater mussels to drought. *Freshwater Biology* 57: 2356–2366. <https://doi.org/10.1111/fwb.12015>
- Jones, M.T.** 2009. Spatial ecology, population structure, and conservation of the Wood Turtle, *Glyptemys insculpta*, in central New England. Ph.D. thesis, University of Massachusetts, Amherst, Massachusetts, USA. <https://doi.org/10.7275/hn42-4v25>
- Jones, M.T., H.P. Roberts, and L.L. Willey.** 2018. Conservation plan for the Wood Turtle (*Glyptemys insculpta*) in the northeastern United States. Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts, USA.
- Kappes, H., and P. Haase.** 2012. Slow, but steady: dispersal of freshwater molluscs. *Aquatic Sciences* 74: 1–14. <https://doi.org/10.1007/s00027-011-0187-6>
- Kew, H.W.** 1893. The Dispersal of Shells: an Inquiry into the Means of Dispersal Possessed by Fresh-water and Land Mollusca. Kegan Paul, Trench, Trübner, London, United Kingdom. <https://doi.org/10.5962/bhl.title.152720>
- Lellis, W.A., B. St. John White, J.C. Cole, C.S. Johnson, J.L. Devers, E. van Snik Gray, and H.S. Galbraith.** 2013. Newly documented host fishes for the eastern elliptio mussel *Elliptio complanata*. *Journal of Fish and Wildlife Management* 4: 75–85. <https://doi.org/10.3996/102012-jfwm-094>
- Miller, A.C., and B.S. Payne.** 1993. Qualitative versus quantitative sampling to evaluate population and community characteristics at a large-river mussel bed. *American Midland Naturalist* 130: 133–145. <https://doi.org/10.2307/2426282>
- Newton, T.J., S.J. Zigler, and B.R. Gray.** 2015. Mortality, movement and behaviour of native mussels during a planned water-level drawdown in the Upper Mississippi River. *Freshwater Biology* 60: 1–15. <https://doi.org/10.1111/fwb.12461>
- Schwalb, A.N., and M.T. Pusch.** 2007. Horizontal and vertical movements of unionid mussels in a lowland river. *Journal of the North American Benthological Society* 26: 261–272. [https://doi.org/10.1899/0887-3593\(2007\)26\[261:havmou\]2.0.co;2](https://doi.org/10.1899/0887-3593(2007)26[261:havmou]2.0.co;2)
- Sietman, B.E., S.D. Whitney, D.E. Kelner, K.D. Blodgett, and H.L. Dunn.** 2011. Post-extirpation recovery of the freshwater mussel (Bivalvia: Unionidae) fauna in the upper Illinois River. *Journal of Freshwater Ecology* 16: 273–281. <https://doi.org/10.1080/02705060.2001.9663813>
- Terui, A., and Y. Miyazaki.** 2015. A “parasite-tag” approach reveals long-distance dispersal of the riverine mussel *Margaritifera laevis* by its host fish. *Hydrobiologia* 760: 189–196. <https://doi.org/10.1007/s10750-015-2325-y>
- Waller, D.L., S. Gutreuter, and J.J. Rach.** 1999. Behavioral responses to disturbance in freshwater mussels with implications for conservation and management. *Journal of the North American Benthological Society* 18: 381–390. <https://doi.org/10.2307/1468451>
- Williams, J.D., M.L. Warren, Jr., K.S. Cummings, J.L. Harris, and R.J. Neves.** 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries* 18: 6–22. <http://doi.org/d7t3vm>

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