

## Didymo Origins and Aquatic Invasive Species Vector Review

Eric Palmer, Fish Division Director, VT Fish & Wildlife, 2/11/16

Prepared by Jud Kratzer, Fisheries Biologist, Vermont Fish and Wildlife Department

### On the Origins of Didymo:

Bothwell, M. L.; B. W. Taylor; and C. Kilroy. 2014. The Didymo story: the role of low dissolved phosphorus in the formation of *Didymosphenia geminata* blooms. *Diatom Research* 29(3):229-236.

- Didymo is native to the northern hemisphere.
- Didymo blooms form because of low phosphorus conditions.
  - Atmospheric deposition of reactive nitrogen resulting from the burning of fossil fuels and urbanization.
  - Climate-induced shifts in timing of snow melt and growing season that decreases P inputs to rivers.
  - N-enrichment of landscapes during agricultural and silvicultural activities that result in greater retention of terrestrial P.
  - A decline in marine-derived nutrients, particularly P, resulting from widespread depletion in spawning salmon.

Lavery, J. M.; J. Kurek; K. M. Ruhland; C. A. Gillis; M. F. J. Pisaric; and J. P. Smol. 2014. Exploring the environmental context of recent *Didymosphenia geminata* proliferation in Gaspésie, Quebec, using paleolimnology. *Canadian Journal of Fisheries and Aquatic Sciences* 71:1-11.

- Didymo is native to eastern Canada.

Taylor, B. W; and M. L. Bothwell. 2014. The origin of invasive microorganisms matters for science, policy, and management: the case of *Didymosphenia geminata*. *Bioscience* 64:531-538.

- Didymo is native to PA, NY, VA, QC.
- Didymo fossils have been found on every continent except Africa, Australia, and Antarctica.

AIS	Main Vector(s)	Other Vectors	Citations
Didymo	Wading boots and waders (Note: Didymo is native and widespread in North America)		Bothwell et al. (2014) Bothwell et al. (2009) Kilroy et al. (2007) Lavery et al. (2014) Taylor and Bothwell (2014)
Crayfish	Bait buckets	Aquaculture, pet trade	DiStefano et al. (2009) Peters and Lodge (2009)
Fish	Bait buckets, Intentional introduction	Natural dispersal	Litvak and Mandrak (1993) Ludvig and Leitch (1996) Johnson et al. (2009)
Viral hemorrhagic septicemia virus (VHS)	Movement of infected fish		Phelps et al. (2014)
Whirling disease	Movement of infected fish	fish-eating birds, pet-store trade of oligochaetes, boating and fishing equipment (including felt soles)	Bartolomew and Reno (2002) Bergersen and Anderson (1997) El-Matbouli and Hoffmann (1991) Gates et al. (2008) Koel et al. (2010)
Amphibian diseases	Commercial trade of amphibians		Picco and Collins (2008)
Aquatic macrophytes	Boats and trailers		Bruckerhoff et al. (2015) Rothlisberger et al. (2010)
Zebra mussel	Movement with macrophytes entangled on boat trailers	Bilge water, birds (minor)	Johnson and Carlton (1996) Johnson et al. (2001)
Spiny water flea	Ballast water	Boating and fishing equipment, natural dispersal, transport of resting eggs by birds and fish	Gertzen and Leung (2011) Jacobs and MacIsaac (2007) Weisz and Yan (2010)
Asian clam		Ballast water, boat hulls, food resource, utilization as fish bait, aquarium releases	McMahon (2000, 2002) Darrigran (2002) Lee et al. (2005) Sousa et al. (2008)
New Zealand mud snail	Birds (survive in gut)	Angling equipment (including felt soles), boats, movement of aquaculture products	Haynes et al. (1985) Hosea and Finlayson (2005) Bowler (1991), Loo et al. (2007) Davidson et al. (2008) Naser and Son (2009)