The Vermont Legislative Research Service

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Felt-Soled Waders, Didymo and Whirling Disease

On April 1, 2011, the Vermont State Legislature passed H.211, "Ban on Felt-Soled Boots and Waders." The legislation made it "[un]lawful to use external felt-soled boots or external felt-soled waders in the waters of Vermont, except that a state or federal employee or emergency personnel, including fire, law enforcement, and EMT personnel, may use external felt-soled boots or external felt-soled waders in the discharge of official duties."[1]

This report will examine three main issues surrounding the use of and the ban on felt-soled wading boots: (1) the diseases associated with felt-soled waders; (2) the correlation between the use of felt-soled wading boots and other external factors that could contribute to the spread of harmful water-borne microorganisms and diseases; and (3) the potential safety issues resulting from the ban on felt-soled waders. The report will also look at the actions taken by other state legislatures regarding this issue.

Background

Felt-soled waders are associated with the spread of Didymosphenia Geminata (Didymo, or also known as "rock snot"), New Zealand Mudsnails, and Myxobolus Cerebralis (whirling disease), Spiny Waterflea, VHS disease of Fish, and Faucet Snails.[2] However, only Didymo and whirling disease have been discovered in Vermont waterways.[3]

[1]Vermont Statues, Title 10: Conservation and Development, Ch. 111: Fish. § 4616, "Felt-soled boots and waders; use prohibited," Vermont General Assembly, April 1, 2011, accessed January 28, 2014, http://legislature.vermont.gov/statutes/section/10/111/04616.

[2] Minnesota Department of Natural Resources, "Fly-anglers and Waders Users: Felt-soled Wader Issues and Alternatives," accessed January 28, 2014, http://www.dnr.state.mn.us/invasives/felt.html.

[3] Vermont Department of Environmental Conservation: Watershed Management Division, "Didymo or Rock Snot (Didymosphenia geminate) in Vermont and the Northeast," May 2013, accessed January 26, 2015, http://www.watershedmanagement.vt.gov/lakes/htm/ans/lp_didymo.htm.

Didymo is an invasive freshwater diatomic species (microscopic algae).[4] Didymo appears as stalks and blooms attaching itself to the rocky bottom of rivers, smothering aquatic insects, native algae, and other organisms.[5] The presence of Didymo can have "a significant biological impact to stream ecosystem function with the ability to alter food web structure and hydraulics of streams and rivers."[6] Didymo was first reported in Vermont during the summers of 2006 and 2007 in the Batten Kill River, Connecticut River and the White River.[7] In 2008 it was found in the Mad River (VT), and then in the Gihon and Passumpsic Rivers (VT) in 2010.[8] Didymo findings are highlighted in the map below:

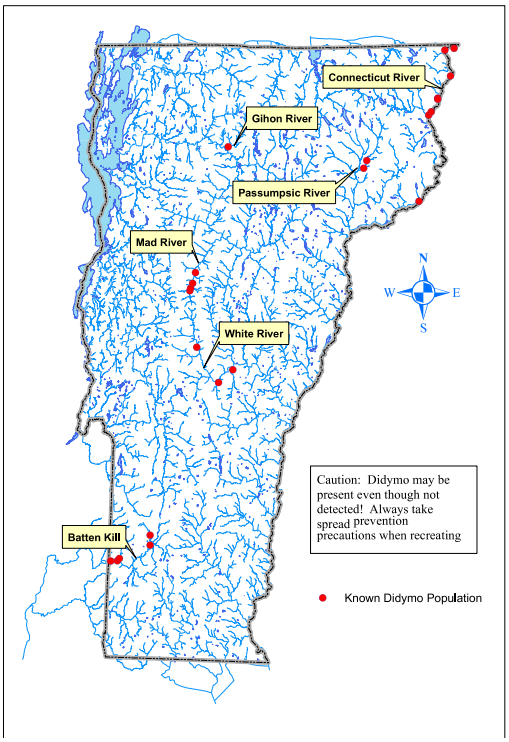

Figure 1: Didymo in Vermont

Source: Vermont Department of Environmental Conservation, Watershed Management Division, accessed January 28, 2015, http://www.vtwaterquality.org/lakes/docs/ans/lp_didvtdistmap.pdf.

[4] New Hampshire Department of Environmental Services, "Didymo (aka "Rock Snot") Found in Vermont and New Hampshire," 2014, accessed January 29, 2015, http://des.nh.gov/organization/divisions/water/wmb/exoticspecies/didymo/index.htm.

[5] New Hampshire Department of Environmental Services, "Didymo (aka "Rock Snot") Found in Vermont and New Hampshire."

[6] S.A. Spaulding and L. Elwell, "Increase in Nuisance Blooms and Geographic Expansion of the Freshwater Diatom. *Didymosphenia Geminata*," U.S. Department of the Interior, U.S. Geological Survey (file report 2007–1425), accessed January 29, 2015, http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_015176.pdf.

[7] New Hampshire Department of Environmental Services, "Didymo (aka "Rock Snot") Found in Vermont and New Hampshire."

[8] New Hampshire Department of Environmental Services, "Didymo (aka "Rock Snot") Found in Vermont and New Hampshire."

Whirling disease is a neurological disorder caused by a parasite.[9] It primarily affects juvenile trout, causing severe deformities of the skeleton and skull leading to mortality rates as high as 100 percent.[10] The parasite releases spores into the fish, attacking cartilage tissue, particularly in the head, causing serious physical damage to the fish.[11] Whirling disease was reportedly found in the Batten Kill River in 2002.[12]

Research Studies

In 2008, the *North American Journal of Fisheries Management* published a report examining the retention rate of M. cerebralis (whirling disease) in rubber, felt, lightweight nylon, and neoprene waders.[13] The study found that felt retained the highest the percentage of myxospores out of the four materials.[14] The pore size of the felt waders creates a moist environment within the shoe sole "allowing cells and parasites to remain viable for hours, or even days, after leaving a river."[15] The study concluded that the potential for felt to carry even small numbers of myxospores suggests that it is probable that felt-soled wading boots leads to the introduction of whirling disease.[16] Laboratory tests conducted by the Coastal Oregon Marine Experiment Station at Oregon State University with felt soled waders confirmed these findings. "The OSU researchers also tested whether the parasite could be passed through birds – especially mergansers, mallards and crows – that might feed on the juvenile fish or worms, but results were inconclusive."[17]

With regard to Didymo, research reported in *Fisheries* in 2009 found that "the pattern of didymo spread among rivers on Vancouver Island correlates with the activity of fishermen and the commercial introduction and widespread use of felt-soled waders in the late 1980s."[18] A more recent report published in 2014 by the *Canadian Journal of Fisheries and Aquatic Science* examined the causes of the recent emergence of Didymo in waterways around Gaspesie,

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[9] Oregon State University, "Parasite Causing Whirling Disease Could be Transmitted Via Fishing Waders," Press Release, October 26, 2006, accessed January 27, 2015, http://oregonstate.edu/ua/ncs/archives/2006/oct/new-study-parasite-causing-whirling-disease-could-be-transmitted-fishing-waders.

[10] Oregon State University, "Parasite Causing Whirling Disease Could be Transmitted Via Fishing Waders."

[11] Vermont Department of Fish and Wildlife, "Whirling Disease found in the Batten Kill!" Newsletter, Vol. 3, Issue 2, (2002) accessed February 5, 2015, http://www.vtfishandwildlife.com/library/newsletters/battenkill/2002_Summer_and_Fall_Issue.pdf.

[12] Vermont Department of Fish and Wildlife, "Whirling Disease found in the Batten Kill!"

[13] Kiza K. Gates, Christopher S. Guy, Alexander V. Zale, and Travis B. Horton, "Adherence of Myxobolus cerebralis Myxospores to Waders: Implications for Disease Dissemination," *North American Journal of Fisheries Management*, 28: 1453-1458 (2008), accessed February 5, 2015, http://afs.tandfonline.com/doi/pdf/10.1577/M08-025.1.

[14] Gates et al., "Adherence of Myxobolus cerebralis Myxospores to Waders: Implications for Disease Dissemination."

[15] Bothwell et al., "On the Boots of Fishermen."

[16] Gates et al., "Adherence of Myxobolus cerebralis Myxospores to Waders: Implications for Disease Dissemination."

[17] Oregon State University, "Parasite Causing Whirling Disease Could be Transmitted Via Fishing Waders."

[18] Bothwell et al., "On the Boots of Fishermen," p. 382.

Quebec.[19] The researchers found that the region surrounding Gaspesie is "experiencing substantial environmental shifts related to recent climatic warming and provides strong support that the recent rise in Didymo is, at least in part, climate related."[20] The study concluded, "given Didymo's habitat and environmental preferences, we propose that climate-related changes in regional rivers are likely an important factor that favors its proliferation."[21]

Moreover, in May 2014 the journal *BioScience* published a report that found evidence indicating that Didymo blooms were, "not caused solely by [human] introduction," and may be attributed to, "environmental conditions that promote excessive stalk production."[22] The *BioScience* study concluded that, "observational and experimental evidence shows that the nuisance or invasive characteristics of D. geminata are caused by a specific set of environmental conditions."[23]

Thus, while studies have concluded that the spread of whirling disease is attributable to felt-soled waders, the spread of Didymo may be due, at least in part, to climate change.

Safety Concerns

The main safety concern regarding H.211 is that alternatives, like rubber-soled waders, offer less traction in turn making them a potentially dangerous alternative.[24] The only evidence for this, however, is found in anecdotal accounts from various fly-fishermen. An article in the Juneau Empire cited an interview with Dr. Donald Harrell and Dr. Doug Webber, who claimed they often dealt with numerous fly-fishing injuries, which they attributed to improper wading boots.[25] On the contrary, Kenny Clarke an outdoorsmen/photographer blogger, claimed that rubber waders, in fact, offered "better traction and stability."[26] In the trial three angler fishers

[19] J.M. Lavery, J. Kurek, K.M. Rühland, C.A. Gillis, M.F.J. Pisaric, and J.P. Smol, "Exploring the Environmental Context of Recent *Didymosphenis Geminate* Proliferation in Gaspesie, Quebec, Using Paleolimnology," *Canadian Journal of Fisheries and Aquatic Science,* 71: 616–626 (2014), accessed January 27, 2015, http://www.nrcresearchpress.com/doi/pdf/10.1139/cjfas-2013-0442.

[20] Lavery et al., "Exploring the Environmental Context of Recent *Didymosphenis Geminate* Proliferation in Gaspesie, Quebec, Using Paleolimnology."

[21] Lavery et al., "Exploring the Environmental Context of Recent *Didymosphenis Geminate* Proliferation in Gaspesie, Quebec, Using Paleolimnology."

[22] Max Bothwell and Brad Taylor, "The Origin of Invasive Micro-organisms Matters for Science, Policy and Management: The Case of Didymosphenia geminata," *BioScience*, May 8, 2014, accessed February 12, 2015, http://bioscience.oxfordjournals.org/content/early/2014/05/05/biosci.biu060.abstract.

[23] Bothwell & Taylor, "The Origin of Invasive Microorganisms Matters for Science, Policy and Management: The Case of Didymosphenia geminate."

[24] Alaska Department of Fish and Game, "Alaska's Ban on Felt-Soled Wading Footwear," April 16, 2012, accessed, February 5, 2015, http://www.adfg.alaska.gov/static/species/nonnative/invasive/pdfs/felt_soled_waders_faq.pdf.

[25] Juneau Empire, "Caution: Fly fishing can be hazardous to your health," March 8, 1998, accessed February 5, 2015, http://juneauempire.com/stories/030898/flyfishing.html.

[26] Clarke, Kenny, "FELT vs. RUBBER: The Show Down," 2010 accessed February 5, 2015, http://www.kenny-clarke.com/writing-2/gear/felt-vs-rubber-the-show-down/.

wore a felt-soled boot on one foot and a rubber soled boot on the other foot.[27] Clarke summarized the test trial results as follows:

> "This (referencing the *StreamTread* rubber sole by SIMMS and the Vibram company) rubber sole provides better traction and stability in the majority of the situations that anglers will encounter in the field, providing a much safer overall fly fishing experience. And to be 100% objective we did note one area in which the felt did provide a *slight* advantage to the rubber, most notably when wading on algae covered rocks.[28] To overcome this technical wading situation with rubber soled wading boots anglers are encouraged to utilize screw in studs, which are available from a variety of different manufacturers."[29]

As the quote suggests, there are a number of alternatives to felt-soled waders. [30] A variety of companies like Patagonia,[31] StreamTread,[32] and L. L. Bean[33] offer alternatives to felt-soled waders, and each company claims that their products outperform felt-soled waders. Tom Estilow, a writer for *Hatch Magazine*, reviewed the aforementioned StreamTread rubber soles and said:

> "Not only do the StreamTread soles carry their own on all kinds of aquatic terrain, they clean up quick and easy after the day is done. The traction and hiking ability of the Riversheds [with StreamTread soles] on river banks and dry land beats felt hands down."[34]

Another alternative is known as svelte, a material made by Korkers. Kirk Deeter wrote in *Field & Stream* that svelte has the texture of "a pot scrubber...hard, gritty texture that's often on the back side of a dish sponge… It dries four times faster than felt, and absorbs five times less water (hence the eco-friendliness)."[35] Deeter claims it grips as well, or better than felt.[36]

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[27] Juneau Empire, "Caution: Fly fishing can be hazardous to your health."
[28] It's important to note that wading into an area containing algae covered rocks is a high-risk activity that should be coupled with a certain level of experience and a thorough understanding of the area.
[29] Clarke, "FELT vs. RUBBER: The Show Down," 2010 accessed February 5, 2015.
[30] Minnesota Department of Natural Resources, "Fly-anglers and Wader Users: Felt-soled Wader Issues and Alternatives."
[31] "Patagonia Foot Tractor Wading Boots," YouTube video, 2:11, posted by "Patagonia," January 6, 2015, https://www.youtube.com/watch?v=P-UKSJnWWQE&t=17.
[32] Tom Estilow, "Review: Simms Rivershed Boots with StreamTread," November 15, 2013, accessed March 4, 2015, http://www.hatchmag.com/articles/review-simms-rivershed-boots-streamtread/7711108 .
[33] "Fly Fishing: Learn About the Gear," accessed March 7, 2015, http://www.llbean.com/outdoorsOnline/outdoorSports/flyfishing/gear/.
[34] Estilow, "Review: Simms Rivershed Boots with StreamTread."
[35] Kirk Deeter, "New Product Review: Svelte - An Alternative to Felt on Wading Boots," March 3, 2011, accessed March 4, 2015, http://www.fieldandstream.com/blogs/flytalk/2011/03/new-product-review-svelte-alternative-felt-wading-boots.
[36] Deeter, "New Product Review: Svelte - An Alternative to Felt on Wading Boots."

Other States' Policies

Didymo has been found in multiple waterways across the United States.[37] States have tried to mitigate the spread Didymo and other potential invasive species to other waterways using a number of different tactics. Figure 2 illustrates the various state policies. Vermont, Alaska, Maryland, Missouri, Nebraska, Rhode Island and South Dakota currently ban the use of felt-soled waders. Idaho, Maine, Montana, New Hampshire, New Mexico and Oregon are considering or have considered a ban through departmental rulings or legislative action. Massachusetts, Minnesota, New Jersey, Oklahoma, Pennsylvania, Utah, Washington, and West Virginia provide a warning about felt-soled boots' connection with Didymo.

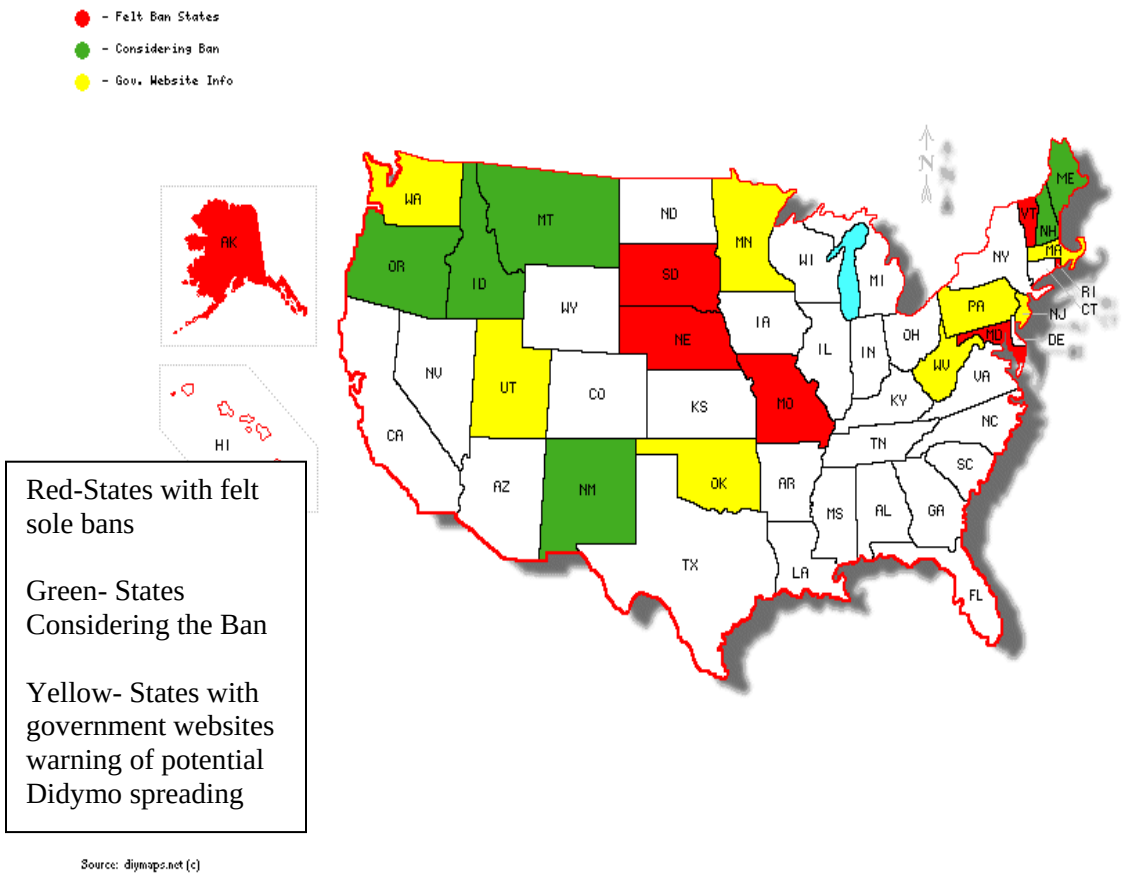

Figure 2: State Policies on Felt Sole Waders

Source: This map was created at http://diymaps.net/us_12.htm by compiling information from sources listed in Appendix A.

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[37] Leah C. Elwell, "Dealing with Didymo," *Flyfisher*, Autumn 2006, accessed February 5, 2015, http://dnr.state.md.us/invasives/pdfs/Didymo_Flyfisher_Article.pdf.

Conclusion

This report discussed the potentially harmful effects that Didymosphenia geminate (Didymo) and whirling disease may have on Vermont waterways, if they are spread. Studies have concluded that felt-soled waders are the likely cause of the spread of whirling disease. While some studies have also implicated felt-soled waders in the spread of Didymo, more recent studies have found that climate change may also be responsible. States affected by Didymo and/or whirling disease have responded in a variety of ways ranging from educational information dissemination to legislative bans on the use of felt-soled waders. Fishers and anglers have voiced safety concerns regarding the prohibition of felt-soled waders; however, systematic safety studies have yet to be conducted to test this claim. There are alternatives products to felt-soled waders, which the produces, and some anglers, claim to be just as good a product, if not better, than felt-waders.

This report was completed on March 17, 2015 by Matt Cleary, Dahne Duffy and Kyle Heffrin under the supervision of Professors Jack Gierzynski, Robert Bartlett and Eileen Burgin in response to a request from Representative David Deen.

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Appendix A: Sources for Figure 2

General Assembly of the State of Vermont, "House Bill 488 (Act 130): An Act relating to the use of felt-soled boots in the waters of Vermont," accessed January 30, 2015, http://www.leg.state.vt.us/docs/2010/Acts/ACT130.pdf; Alaska Department of Fish and Game, "Alaska's Ban on Felt soled Wading Footware-FAQ," April 16, 2012, accessed February 4, 2015, http://www.adfg.alaska.gov/static/species/nonnative/invasive/pdfs/felt_soled_waders_faq.pdf ; Maryland Department of Natural Resources, "Felt-Soles Ban – FAQ," 2011, accessed February 5, 2015 dnr2.maryland.gov/fisheries/Documents/Felt_sole_faq.pdf; Missouri Department of Conservation, "Porous-Soled Wader Ban," accessed February 3, 2015, http://mdc.mo.gov/fishing/regulations/porous-soled-wader-ban; Nebraska Game and Parks Commission, "2015 Nebraska Fishing Guide," 2015, accessed February 5, 2015, http://outdoornebraska.ne.gov/fishing/guides/fishguide/pdf/FishGuide.pdf; Rhode Island Department of Environmental Management, "DEM revises regulations so that felt-soled foot gear is prohibited only in state freshwaters," February 21, 2012, accessed February 5, 2015 http://www.dem.ri.gov/news/2012/pr/0221121.htm; South Dakota Game, Fish and Parks, "2014 South Dakota Fishing Handbook," 2014, accessed February 5, 2015, http://gfp.sd.gov/ePubs/wildlife/2014-fishing-handbook/2014FishingHandbook-02.pdf; 2011 Legislature of the State of Idaho, "Senate Concurrent Resolution No. 101," accessed February 6, 2015, http://www.legislature.idaho.gov/legislation/2011/SCR101.pdf; 125th Maine Legislature, "An Act To Amend the Law Governing Aquatic Nuisance Species," accessed February 6, 2015, http://www.mainelegislature.org/legis/bills/bills_125th/billtexts/HP020501.asp; 2011 Montana State Legislature, "MT SB230: Prohibit felt-soled wading boots," accessed February 6, 2015, https://legiscan.com/MT/text/SB230/2011; Smagula, Amy P, New Hampshire Department of Environmental Services, "Personal Communication," February 1, 2015; New Mexico State Game Commission, "Minutes of December 3, 2009," accessed February 6, 2015, http://www.wildlife.state.nm.us/legacy/commission/minutes/documents/2009/Minutes12309HobbsOFFICIAL.pdf; Oregon Legislative Assembly - 2011 Regular Session, "House Bill 2338," accessed February 6, 2015, https://olis.leg.state.or.us/liz/2011R1/Downloads/MeasureDocument/HB2338/Introduced; Massachusetts Department of Energy and Environmental Affairs, "Stop the Spread of Didymo," November 26, 2008, accessed February 5, 2015, http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/didymobrochure.pdf; Minnesota Department of Natural Resources, "Fly-anglers and Wader Users; Felt Soled Wader Issues and Alternatives," accessed February 5, 2015, http://www.dnr.state.mn.us/invasives/felt.html; New Jersey Department of Environmental Protection, "Invasive Didymo (aka "rock snot") in New Jersey," July 10, 2012, accessed February 5, 2015, http://www.nj.gov/dep/wms/bfbm/didymo.html; Oklahoma Department of Wildlife Conservation, "Didymo," accessed February 5, 2015, http://www.wildlifedepartment.com/fishing/didymo.htm; Pennsylvania Fish and Boat Commission, "Do you know about Didymo?" accessed February 2, 2015,

http://www.fish.state.pa.us/water/habitat/ans/didymo/faq_didymo.htm; Utah Division of Wildlife Resources, "Didymo (Rock Snot)," accessed February 5, 2015, http://wildlife.utah.gov/pdf/AIS_plans_2010/AIS_12bDidymo-Dan-final.pdf; Washington Department of Ecology, "Minimizing the spread of invasive species through field work," accessed February 4, 2015, http://www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html; West Virginia Department of Natural Resources, "Didymo (Rock Snot) Fact Sheet," accessed February 5, 2015, http://www.wvdnr.gov/fishing/didymo.shtm.