

4-10: Invasive Species

Hazard Impacts	Probability	Potential Impact					Score*:
		Infrastructure	Life	Economy	Environment	Average:	
Invasive Species	2	1	1	2	3	1.75	3.5

*Score = Probability x Average Potential Impact

The National Invasive Species Council defines an invasive species as one that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Invasive species can overwhelm native species and their habitats, forcing the native species out. They are considered to pose the second greatest threat to biodiversity globally. Invasive plants in Vermont, such as Japanese knotweed, common reed (*Phragmites*), and purple loosestrife, can change soil composition, change water tables, and disrupt insect cycles. They often lack food value upon which wildlife depends. Some invasive animals prey heavily upon native species while others, such as the alewife and zebra mussel, out-compete native species for food and nutrients with significant impacts reverberating up and down food chains.

The spread of invasive species is primarily caused by human activity. Common examples include¹:

- **Ships:** Can carry aquatic organisms in their ballast water or on the hull.
- **Wood Products:** Insects can get into wood, shipping palettes, and crates that are shipped around the world as well as travel in firewood.
- **Ornamental Plants:** Some ornamental plants can escape into the wild and become invasive.
- **Pet Trade:** Some invasive species start as pets that are intentionally or accidentally released.

The Nature Conservancy reports that invasive species have contributed directly to the decline of 42% of the threatened and endangered species in the United States. Further, the annual cost to the U.S. economy is estimated at \$120 billion per year, with more than 100 million acres suffering from invasive plant infestation. Freshwater ecosystems and estuaries are especially vulnerable to invasion, as these areas are very difficult to contain and reverse². In Vermont specifically, examples of economic impacts of invasive species can be observed in the costs of managing invasive water chestnut in Lake Champlain³ and payments to private landowners to improve tree regeneration and wildlife habitat by controlling buckthorn and honeysuckle in forests⁴. Water pipes in Lake Champlain must now be cleaned out regularly to rid them of invasive zebra mussels. Invasive pests such as Emerald Ash Borer, first found in Vermont in 2018, will have serious financial implications for forest landowners and municipalities alike, as productive timber is destroyed and trees along roads become potential hazards as they die.

1 <https://www.vtinvasives.org/intro-to-invasives/what-are-invasive-species>

2 <https://www.nature.org/ourinitiatives/urgentissues/land-conservation/forests/invasives-101.xml>

3 <http://dec.vermont.gov/sites/dec/files/wsm/lakes/ans/docs/2016VTWCFinalReport.pdf>

4 https://efotg.sc.egov.usda.gov/references/public/VT/Landowner_Acknowledgment_2016.pdf

Additionally, invasive species can directly or indirectly cause harm to human health. Giant hogweed, wild parsnip and wild chervil are three invasive plant species in Vermont that have phytophototoxic properties, meaning direct contact of their sap with human skin can cause a chemical reaction that makes skin hypersensitive to ultraviolet light. Vermonters have received serious skin burns from the toxicity of the sap of these plants combined with exposure to sunlight. Another example is that of Japanese barberry, which has been proven to increase the incidence of Lyme disease by providing sheltered habitat that increases the abundance of small rodents, which act as hosts to the ticks that carry Lyme disease pathogens⁵.

Invasive Terrestrial Plants & Forest Pests:

Vermont's Agency of Agricultural, Food and Markets (VAAFAM) maintains a list of invasive plants and regulates their importation, movement, sale, possession, cultivation and distribution⁶ based on the following categories:

- **Noxious Weed:** any plant in any stage of development, including all current and subsequent subspecies, varieties, and cultivars, and parasitic plants whose presence, whether direct or indirect, is detrimental to the environment, crops or other desirable plants, livestock, land, or other property, or is injurious to the public health or the economy generally.
- **Class A Noxious Weed:** any noxious weed that is not native to the State, not currently known to occur in the State on the date of listing, and poses a serious threat to the State.
- **Class B Noxious Weed:** any noxious weed that is not native to the State, is of limited distribution statewide, and poses a serious threat to the State, or any other designated noxious weed being managed to reduce its occurrence and impact in the State, including those on the Federal Noxious Weed List⁷.

The State also maintains a watch list⁸, updated regularly, of non-native plants that have the potential to become invasive in Vermont based on their behavior in northeastern states. One-third of the plant species found in Vermont are not native to the State, but only about 8% have the potential to create environmental and economic harm due to their ability to grow rapidly, profusely, and widely. These are the plant species monitored on the watch list, which acts as a resource for public information and as a means to enlist volunteers to monitor potentially harmful plants in Vermont, although it has no regulatory force.

Vermont's Department of Forests, Parks and Recreation (FPR) is responsible for survey, detection, and management of forest pests in Vermont⁹. Additionally, the Vermont Invasives Gallery of Land Invasives is a resource for identification of invasive plants and forest pests¹⁰.

Aquatic Invasive Species (AIS):

The Department of Environmental Conservation (DEC) has a Vermont Aquatic Invasive Species Program that coordinates management activities associated with both aquatic invasive and nuisance species. The AIS webpage has information about the types of AIS, monitoring, spread prevention, grant opportunities and laws and regulations relating to AIS¹¹. The Vermont AIS Program has identified twelve high-priority invasive and nuisance species affecting the State and issues informational pamphlets in an attempt to prevent their proliferation.

5 <https://mnfi.anr.msu.edu/invasive-species/JapaneseBarberryBCP.pdf>

6 http://agriculture.vermont.gov/plant_pest/plant_weed/invasive_noxious_weeds

7 <https://www.law.cornell.edu/cfr/text/7/360.200>

8 http://fpr.vermont.gov/forest/forest_health/invasive_plants

9 http://fpr.vermont.gov/forest/forest_health/insects_diseases

10 <https://www.vtinvasives.org/gallery-of-land-invasives>

11 <http://dec.vermont.gov/watershed/lakes-ponds/aquatic-invasives>

Invasive Species History

Because invasive species often spread over a long period of time, identification of a hazard event concerning invasive species is rather difficult. Vermont, like much of the eastern United States, has long been susceptible to invasive species brought from overseas – whether they were plants intentionally transported or organisms clinging to vessels¹². The State has a long history of invasive species infestation at the aquatic (e.g. water chestnut), terrestrial (e.g. Japanese knotweed) and forest pest (e.g. Emerald Ash Borer) levels.

- Most notably, the emerald ash borer, first discovered in Michigan in 2002, has spread to 30 states and three Canadian provinces and was reported and confirmed to be in Vermont in 2017.
- The water chestnut, which spreads rapidly across lakes and ponds, preventing recreation and choking out sunlight from native aquatic species, has been actively managed since 1982.
- Japanese knotweed, an invasive plant that spreads by sprouting from broken plant rhizomes, was introduced into the United States in the 1800s and has been established in New England ever since.

Invasive Species Trends & Vulnerability

Native forests and ecosystems are projected to experience negative impacts of these warming trends, as well¹³. With 76% of the Vermont landscape covered by forest, and more than 50 tree species, increases in average annual temperatures will force these species to adapt. Potential impacts on forests include increased stress on native tree species, shifts in forest composition due to a climate more suitable for southern species, and the potential for isolated species having a reduced ability to migrate and respond to climate change¹⁴. Of particular concern are the Asian longhorned beetle (not yet detected in Vermont), emerald ash borer and hemlock woolly adelgid, which have killed millions of trees across the U.S. and Canada.

In 2017, the first reported cases of the emerald ash borer occurred in Vermont in Orange, Washington and Caledonia Counties¹⁵. Emerald ash borer larvae burrow through the inner layer of the ash tree's bark, impeding the tree's ability to conduct water and nutrients throughout the tree¹⁶. Lacking sufficient water and nutrients,

12 https://docs.google.com/spreadsheets/d/123tCXdNH8yhZ_A7oblCfLzAtBos6kBy2qZCmrFDtO_o/edit#gid=0

13 <http://climatechange.vermont.gov/sites/climate/files/documents/Data/VTCCAdaptForestry.pdf>

14 https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs173.pdf

15 <https://www.vtinvasives.org/land/emerald-ash-borer-vermont>

16 <https://www.nature.org/ourinitiatives/urgentissues/land-conservation/forests/interactive-media-emerald-ash-borer-slideshow.xml>

Adult Emerald Ash Borer and the results of larvae burrowing through the bark of an Ash tree.

Source: <https://www.nature.org/ourinitiatives/urgentissues/land-conservation/forests/interactive-media-emerald-ash-borer-slideshow.xml>



healthy ash trees can die within 1-4 years of exhibiting first signs or symptoms of ash borer invasion and, because 5% of Vermont’s trees are ash, the State’s forest composition is extremely vulnerable to this invasive species. It is estimated that the majority of ash trees infested with the emerald ash borer will die, causing public hazards from standing dead trees that may impact structures and infrastructure, as well as add to riverine debris during high precipitation events (see: [Inundation Flooding & Fluvial Erosion](#)).

Hemlock woolly adelgid is an invasive pest that feeds on hemlock trees, first discovered in Vermont in 2007 and primarily located in the southern counties. Due to our harsh winters in Vermont, hemlock woolly adelgid has not caused significant mortality among hemlocks; however, south of Vermont where winters are more mild this is a significant concern. Based on Vermont’s trend of increasing temperature (see: [Extreme Heat](#)), this invasive is expected to be a much more significant concern in the future. In the winter of 2016-2017, a significant portion of the hemlock woolly adelgids were able to survive the winter, which was not the case in the previous three winters¹⁷.

In addition to concerns over Vermont’s ash population, northern hardwood species like maple, yellow birch and American beech are anticipated to be nearly eliminated in the State, replaced by those tree species that thrive in warmer, drier conditions, like oak and pine. Additionally, the changing climate will allow for greater survival and reproduction of forest pest species, as trees that are stressed due to lower water availability reduce their ability to maintain sufficient defense mechanisms, making them more vulnerable to pest invasion and disease. As trees die at an increasing rate, concerns regarding wildfire susceptibility also rise (see: [Wildfire](#)).

Along the State’s riverbanks, Japanese knotweed continues to spread uncontrollably, negatively affecting native insect populations, and therefore those species like birds, fish and mammals, that rely on those insects as a food source. With shallow root systems, the spread of Japanese knotweed significantly reduces streambank stability, thereby exacerbating fluvial erosion (see: [Inundation Flooding & Fluvial Erosion](#)). Road maintenance efforts near ditches infested by Japanese knotweed allow for quick spread of the knotweed’s rhizomes and stems. While Japanese knotweed is already prevalent in Vermont, Figure 59 illustrates the area of potential spread based on habitat suitability.

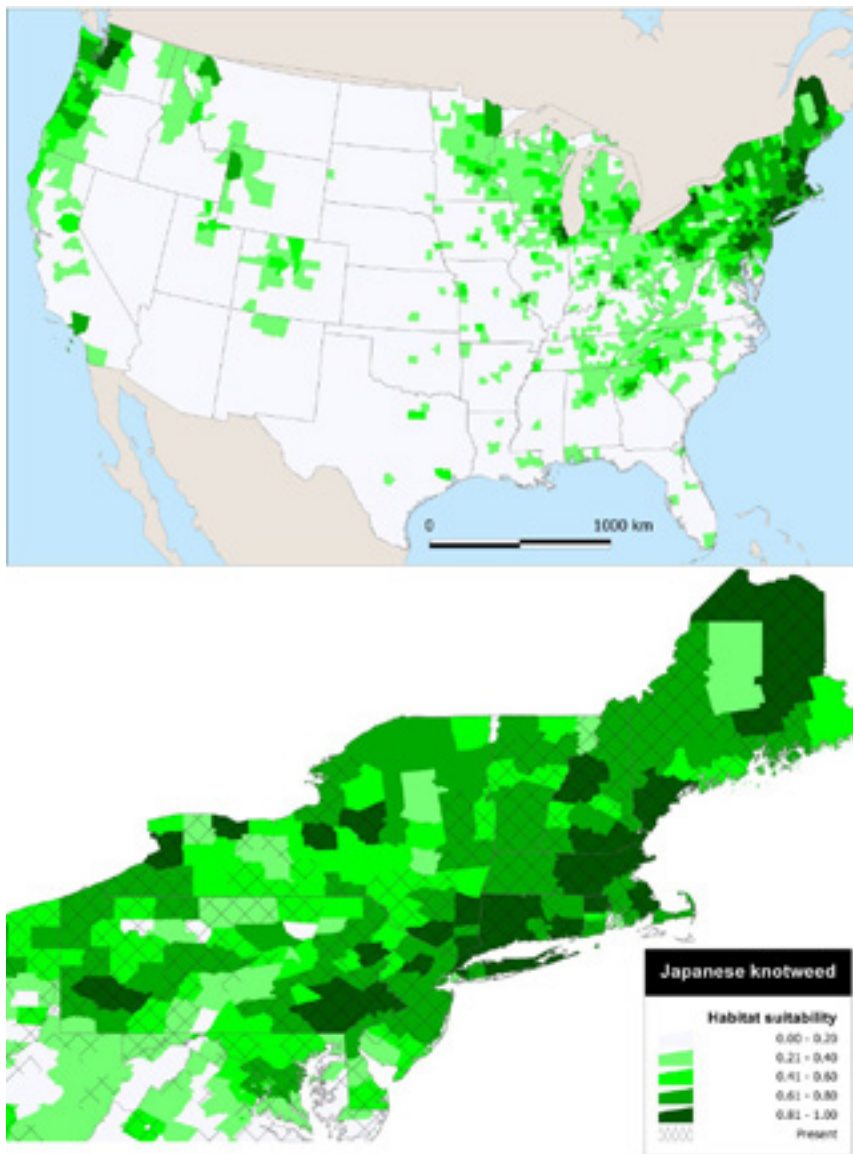


Figure 59: Model Predictions of Habitat Suitability - Japanese Knotweed
 Source: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0001635>

The Steering Committee considered the probability of a plausibly significant extreme invasive species event to be Occasional, with the most significant impacts felt by the environment, followed then by the direct and indirect impacts to the economy.

Invasive Species Mitigation

The Vermont Invasives website maintains a crowd-sourced invasive species map that allows users to upload locations and photos of invasive species, which acts as an aid in determining spread rate and control measures across the State¹⁸. This comprehensive website also includes information on all of the significant invasive species affecting Vermont, including identification, treatment and prevention measures. The Lake Champlain Basin Program also has information regarding the aquatic invasive species threatening the Lake Champlain Basin and how to prevent their spread¹⁹.

Additionally, Vermont joined the United States Department of Agriculture (USDA)'s 31-state quarantine boundary, aimed at reducing the movement of emerald ash borer-infested ash wood to un-infested regions outside of Vermont's borders²⁰. The February 2018 State of Vermont Action Plan for the Emerald Ash Borer identifies the Agency of Agriculture, Foods and Markets and the Department of Forests, Parks and Recreation as the lead agencies responsible for developing a means by which the emerald ash borer can be quickly detected/identified and managed. The intent of the Action Plan is to establish effective lines of communication between pertinent State agencies and to clearly identify the roles and responsibilities of each agency in preventing the spread of the emerald ash borer across Vermont²¹. A first step to actualize this effort will take place in late 2018, when the Department of Forests, Parks and Recreation intends to develop an application for emerald ash borer mitigation education and outreach, as part of FEMA's 5% Initiative Program.

Given the compounding impacts invasive species have on other hazard impacts addressed in this Plan (see: [Inundation Flooding & Fluvial Erosion](#) and [Wildfire](#)), several of the high priority actions regarding hazard mapping and data sharing are pertinent to invasive species mitigation. Also, as the climate models project increases in both temperature and precipitation, it is anticipated that invasive species infestation in Vermont will continue to grow and, as such, the State's efforts concerning education and outreach of the hazards associated with invasive species need to be bolstered in the years to come. Accordingly, an action to support the education of the general public around invasive species and their role in altering the beneficial functions of natural ecosystems was developed (see: [Mitigation Strategy](#)).

18 <http://www.inaturalist.org/projects/mapping-for-healthy-forests-vermont>

19 <http://www.lcbp.org/water-environment/aquatic-invasive-species/>

20 https://www.vtinvasives.org/sites/default/files/images/NE_EAB_Quarentine%205.7.18.pdf

21 http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Forest_Health/Library/State%20of%20Vermont%20Action%20Plan_Emerald%20Ash%20Borer.pdf