



5.4.5 Infestation and Invasive Species

This section provides a profile, and vulnerability assessment of the infestation and invasive species hazard.

5.4.5.1 Hazard Profile

This section provides profile information, including description, location and extent, previous occurrences and losses, and probability of future occurrences.

Description

An infestation is defined as an invasion or overrun by parasites that attack plants, animals, and humans. Insect, fungi, and parasitic infestations can result in destruction of various natural habitats and cropland, impact human health, and cause disease and death among native plants, wildlife, and livestock. An infestation is the presence of pest organisms within an area or field, on the surface of a host, or in soil at numbers or quantities large enough to harm, threaten, or otherwise negatively affect native plants, animals, and humans. Pests are any organisms (insects, mammals, birds, parasite/pathogen, fungi, non-native species) that threaten other living species within an environment. Pests compete for natural resources and can transmit diseases to humans, crops, and livestock. Human populations are generally affected by insect or animal infestations that can lead to epidemics or endemics.

Invasive species are non-native species that can harm the environment, the economy, or human health. They may come from anywhere in the world, and as international trade increases, so does the rate of invasive species introductions. Invasive species threaten nearly every aspect of the world and are one of the greatest threats to New York State's biodiversity (New York State Department of Environmental Control [NYSDEC] 2014). They can cause or contribute to the following:

- Habitat degradation and loss
- Loss of native fish, wildlife, and tree species
- Loss of recreational opportunities and income
- Crop damage, and diseases in humans and livestock (NYSDEC 2014).

Thousands of species have been introduced into the United States, posing serious threats to agriculture, human health, and the integrity of land and water. New York State and Monroe County are vulnerable to damage from these invasive species. The following are names of invasive species found in New York State; however, this list does not include all plant species that are invasive or potentially invasive within the state.

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|-----------------------|------------------------|------------------------|
| • Amur Cork Tree | • Carolina Fanwort | • European Common |
| • Amur Honeysuckle | • Chinese Lespedeza | Reed Grass |
| • Autumn Olive | • Chinese Sliver Grass | • Floating Primrose |
| • Beach Vitex | • Chinese Yam | Willow |
| • Black Locust | • Cogon Grass | • Floating Primrose- |
| • Black Swallow-wort | • Common Buckthorn | willow |
| • Border Privet | • Common Frogbit | • Garden Loosestrife |
| • Brazilian Waterweed | • Cup-plant | • Garlic Mustard |
| • Broad-leaf Pepper- | • Curly Pondweed | • Giant Hogweed |
| grass | • Cut-leaf Teasel | • Japanese Angelica |
| • Broadleaf Water- | • Cypress Spurge | Tree |
| milfoil | • Eurasian Water- | • Japanese Barberry |
| • Canada Thistle | milfoil | • Japanese Honeysuckle |



- Japanese Hops
- Japanese Knotweed
- Japanese Stilt Grass
- Japanese Virgin's-bower
- Kudzu
- Leafy Spurge
- Lesser Celandine
- Marsh Dewflower
- Mile-a-minute Weed
- Morrow's Honeysuckle
- Mugwort
- Multiflora Rose
- Narrowleaf Bittercress
- Norway Maple
- Oriental Bittersweet
- Pale Swallow-wort
- Parrot-feather
- Porcelain Berry
- Purple Loosestrife
- Reed Canary-grass
- Rock Snot (diatom)
- Rusty Willow
- Slender False Brome
- Small Carpgrass
- Smooth Buckthorn
- Spotted Knapweed
- Sycamore Maple
- Tall Glyceria
- Uruguayan Primrose-willow
- Water Chestnut
- Water thyme
- Wavyleaf Basketgrass
- Wild Chervil
- Wineberry
- Winged Euonymus
- Winter Creeper
- Yellow Floating Heart
- Yellow Iris

The Finger Lakes Partnership for Regional Invasive Species Management (PRISM) is a cooperative partnership of diverse stakeholders from throughout the central region of New York State, including Monroe County. According to the Finger Lakes PRISM agricultural working group, the priority invasive plant species of concern in the region include Autumn and Russian olive, Canada thistle, Field bindweed, Japanese knotweed, Johnson grass, Ragweed, Spotted knapweed, Swallow-wort, Velvet leaf, and Wild parsnip for plants; Basil downy mildew (*Peronospora belbahrii*), Grape crown gall (*Agrobacterium tumefaciens*), Late blight (*Phytophthora infestans*), *Phytophthora* blight (*Phytophthora capsici*), and Plum pox virus (*Potyvirus*) for diseases; and BMSB (*Halyomorpha halys*), Garlic bloat nematode (*Ditylenchus dipsaci*), Golden nematode (*Globodera rostochiensis* - not an insect but should be included), Spotted wing drosophila (*Drosophila suzukii*), and Swede Midge (*Contarinia nasturtii*) for insects. Aquatic species of concern include the macrophytes Hydrilla and *Trapa natans* (water chestnut); macroalgae *Nitellopsis obtusa* (starry stonewort); invertebrates *Corbicula fluminea* (Asian clam) and *Hemimysis* (bloody red shrimp); and the fish *Neogobius melanostomus* (round goby) (NYIS 2015).

New York State has been impacted by various past and present infestations, including high populations of mosquitoes, which can cause West Nile Virus (WNV); deer ticks, which can cause Lyme disease; and Asian longhorned beetles and hemlock woolly adelgid, which destroy trees. Other infestations that have affected the state include Eastern Equine Encephalitis, La Crosse Encephalitis, Powassan Virus, St. Louis Encephalitis, Western Equine Encephalitis, Emerald Ash Borer, and Sirex Woodwasp. Not all of these infestations have occurred in Monroe County. The infestations listed below merit attention.

True Armyworm, also known as the common armyworm, is primarily a pest of plants in the grass family: forage/pasture/ grasses and lawns, small grains, and corn. Young larvae appear smooth, cylindrical, pale green to brownish, while mature larvae are smooth and marked with two orange, white-bordered strips on each side. Larvae range in size from 1/8 inch to 1 ½ inches long. The insect spends winters in the south and flies up to New York State in the spring (Cornell Cooperative Extension 2015).

Black swallow-wort, also known as *cynanchum louiseae*, is a weed in the shape of a V and resembles a swallow's tail. The invasive plant has been found in gardens and parks throughout Monroe County.

Brown marmorated stink bug (BMSB) is an invasive species that made its way from Asia to North America and was first officially documented in Allentown, Pennsylvania, in 2001 (it probably had arrived several years earlier). The insect has spread across a number of eastern U.S. states, and its presence has now been documented in Oregon and California as well. The species was first documented in New York State in the Hudson Valley region in 2008 (Cornell Cooperative Extension 2015). These insects can impact numerous fruit and vegetable



crops (peaches, apples, tomatoes, soy beans, sweet corn, berries, apricots, grapes, cherries, nectarines, lima beans, peppers, and ornamentals). Severe damage from these insects can render crops unusable for processed products.

Emerald ash borer (EAB) was first discovered in the U.S. in 2002 in southeastern Michigan. It was also found in Windsor, Ontario, the same year. This Asian beetle infests and kills North American ash species (*Fraxinus* sp.) including green, white, black, and blue ash. Thus, all native ash trees are susceptible. Adult beetles leave distinctive D-shaped exit holes in the outer bark of the branches and the trunk. Adults are roughly 3/8 to 5/8 inch long with metallic green wing covers and a coppery red or purple abdomen. They may be present from late May through early September but are most common in June and July. Signs of infection include tree canopy dieback, yellowing, and browning of leaves (NYSDEC 2014).

EAB affects black and white ash trees, which are valuable commercially and used for manufacture of flooring, furniture, and shipping pallets, as well as baseball bats. Approximately 114 million board-feet of ash lumber is grown annually in the eastern United States (approximately \$25 billion value). Hedgerows composed of ash trees help protect fields from drying and eroding from winds. These hedgerows also provide shelter to plants, animals, and humans (New York Invasive Species Network [NYIS] 2015).

Hemlock woolly adelgid is native to parts of Asia and was first discovered in New York State in 1985. It is in the family Adelgidae, which is related to aphids. The adelgid uses long mouth parts to extract sap and nutrients from hemlock foliage, preventing free growth and causing needles to discolor from deep green to grayish green and to drop prematurely. Loss of new shoots and needles seriously impairs tree health. Infestation is usually fatal to the tree after several years. Wind, birds, other wildlife, and movement of infested host material (wood) by humans are all factors in dispersion of the adelgid (NYSDEC 2014).

Hemlock wood is commonly used in barns and on farm building projects. Groves of hemlock trees provide habitat and cover for deer, ruffed grouse, turkey, rabbit, and snowshoe hare. Loss of hemlock groves can result in loss of cool, damp, and shaded microclimate that supports terrestrial plant communities. Losses can also result in warmer stream temperatures for fish and other aquatic species, thus harming them. Declines in hemlock can result in losses of unique plant and animal assemblages, and in drastic changes to the ecosystem (NYIS 2015).

In the summer of 2015, a crew from the state Department of Environmental Conservation surveyed the state for new or expanded hemlock woolly adelgid sites. The crew began in western New York and will soon be searching for infestations in the Finger Lakes region. The adelgid has already been identified in Monroe County. City of Rochester workers have identified early-stage infestations in some Mt. Hope Cemetery hemlocks, as well as in trees near the Cobb's Hill reservoir (Rochester City Newspaper 2015).

Lyme Disease is caused by the Lyme Disease Bacterium, *Borrelia burgdorferi*, which normally lives in mice, squirrels, and other small animals. It is transmitted among these animals and to humans via bite of a certain species of tick, particularly the deer tick. Lyme disease infections can cause symptoms affecting the skin, nervous system, heart, and joints of an individual (New York State Department of Health [NYSDOH] 2015).

West Nile Virus (WNV) is a mosquito-borne virus that can cause encephalitis (inflammation of the brain) or meningitis (inflammation of the lining of the brain and spinal cord). WNV is spread to humans by the bite of an infected mosquito. A mosquito becomes infected by biting a bird that carries the virus (NYSDOH 2015).

Regulations

The Invasive Species Council is a statutory body created in 2008 by Title 17, Section 9 of the Environmental Conservation Law (ECL). Its mission is to coordinate among multiple state entities and partners in addressing



the environmental and economic threats of invasive species. The legislation defines invasive species as “a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely causing economic or environmental harm or harm to human health.” The council is co-led by the NYSDEC and the Department of Agriculture and Markets (NYSDAM), and consists of nine members: Commissioners of the NYSDEC, NYSDAM, Transportation, and Education; the Office of Parks, Recreation, and Historic Preservation; the Secretary of State; the Chairperson of the New York State Thruway Authority; the Director of the New York State Canal Corporation; and the Chairperson of the Adirondack Park Agency (NYSDEC, 2015).

The NYSDEC, in cooperation with the Department of Agriculture and Markets, has proposed new invasive species regulations (6 *New York Codes Rules and Regulations* [NYCRR] Park 575). The proposed regulations include a list of prohibited species possession, of which shall be unlawful with intent to sell, import, purchase, transport, or introduce; a list of regulated species that shall be legal to possess, sell, purchase, propagate, and transport, but may not be knowingly introduced into a free-living state; and requirement of a permit for education, research, and other approved activities involving prohibited species and release of regulated species into a free-living state. The regulation also specifies the criteria for imposing these classifications and a means for future classification of species. The proposed regulation establishes grace periods for certain prohibited species to allow businesses to plan management of existing stock (NYSDEC 2015).

Extent and Location

The extent and location of an infestation or invasive species depend on the preferred habitat of the species, as well as the species’ ease of movement and establishment. Each threat can impact most areas of New York State, including Monroe County. Levels of threat from infestations and invasive species range from nuisance to widespread. The threat typically intensifies when the ecosystem or host species is already stressed, such as during periods of drought.

Black swallow-wort

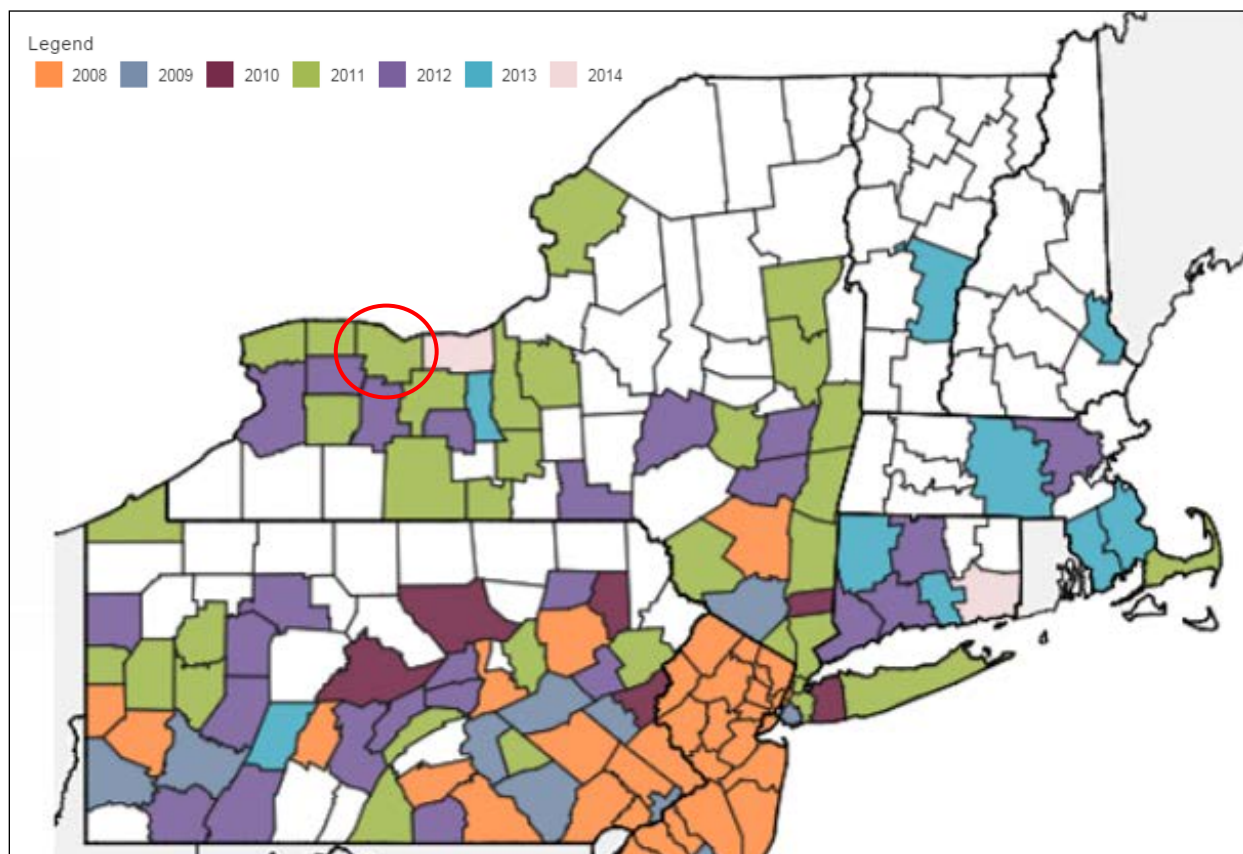
The Finger Lakes PRISM reported that swallow-wort is pervasive in Monroe County, and gardeners local to the Rochester region report seeing an emergence of the invasive plant. Representatives from Cornell Cooperative Extension suggested that, in 2015, there is not a park in Monroe County where the black swallow-wort cannot be found (Democrat & Chronicle 2014).

Brown Marmorated Stink Bug

Figure 5.4.5-1 shows the distribution of the Brown Marmorated Stink Bug (BMSB) in New York State, as of 2013. This map indicates that the BMSB has been identified in Monroe County.



Figure 5.4.5-1. Brown Marmorated Stink Bug Detections since 2008



Source: EDDMaps 2014

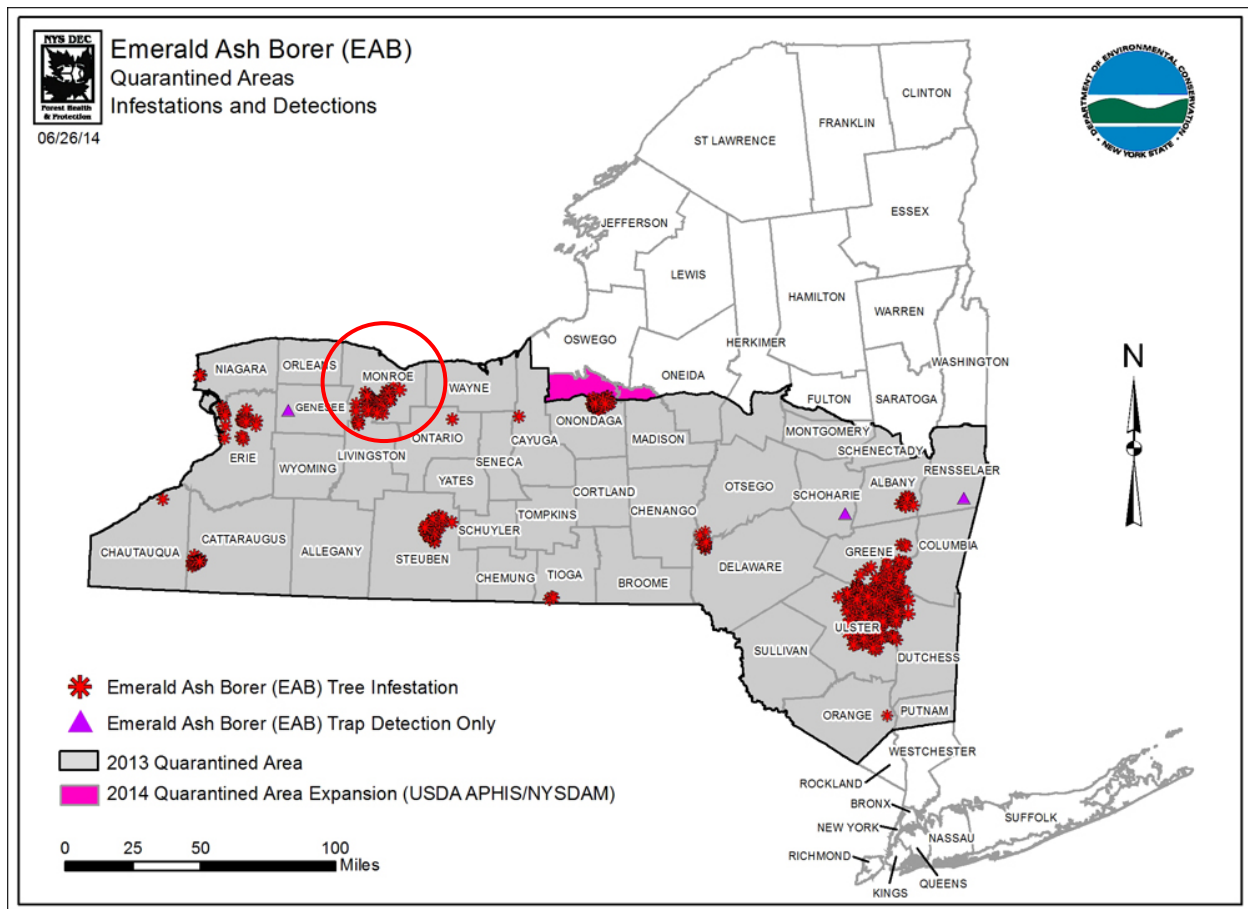
Updated reports from the Hudson Valley Research Laboratory indicate that there was one positive BMSB detection in Monroe County in 2014, and none detected from January 1, 2015, through August 8, 2015 (EDDMaps 2015).

Emerald Ash Borer

According to the national EAB information website, which is operated through a grant from the U.S. Forest Service, presence of emerald ash borer has been confirmed in 26 states, including New York State, and two Canadian provinces as of August 2015. A federal quarantine is in place within all or portions of states where presence of this insect has been confirmed. Figure 5.4.5-2 shows locations of quarantined areas of New York State, which includes Monroe County.



Figure 5.4.5-2. Emerald Ash Borer Quarantined Areas in New York State

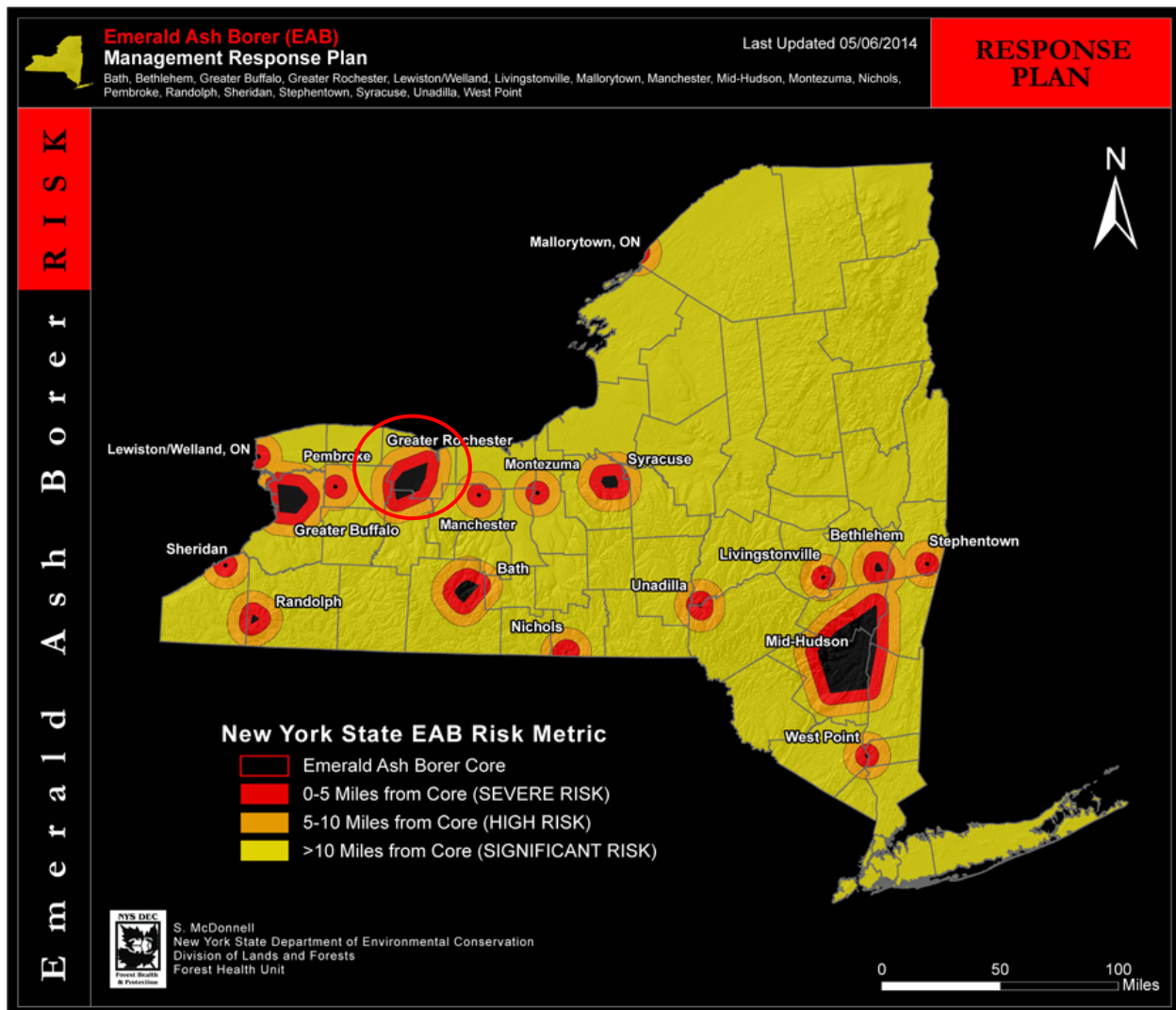


Source: NYSDEC 2014

According to Figure 5.4.5-3 below, the central and southwestern portions of Monroe County are within the Greater Rochester EAB core. Surrounding the central core, all other parts of the county are at severe or high risk, excepting portions in the far eastern edge and the northwestern corner. Those exceptions fall within a significant risk area for EAB.



Figure 5.4.5-3. Emerald Ash Borer Risk Areas

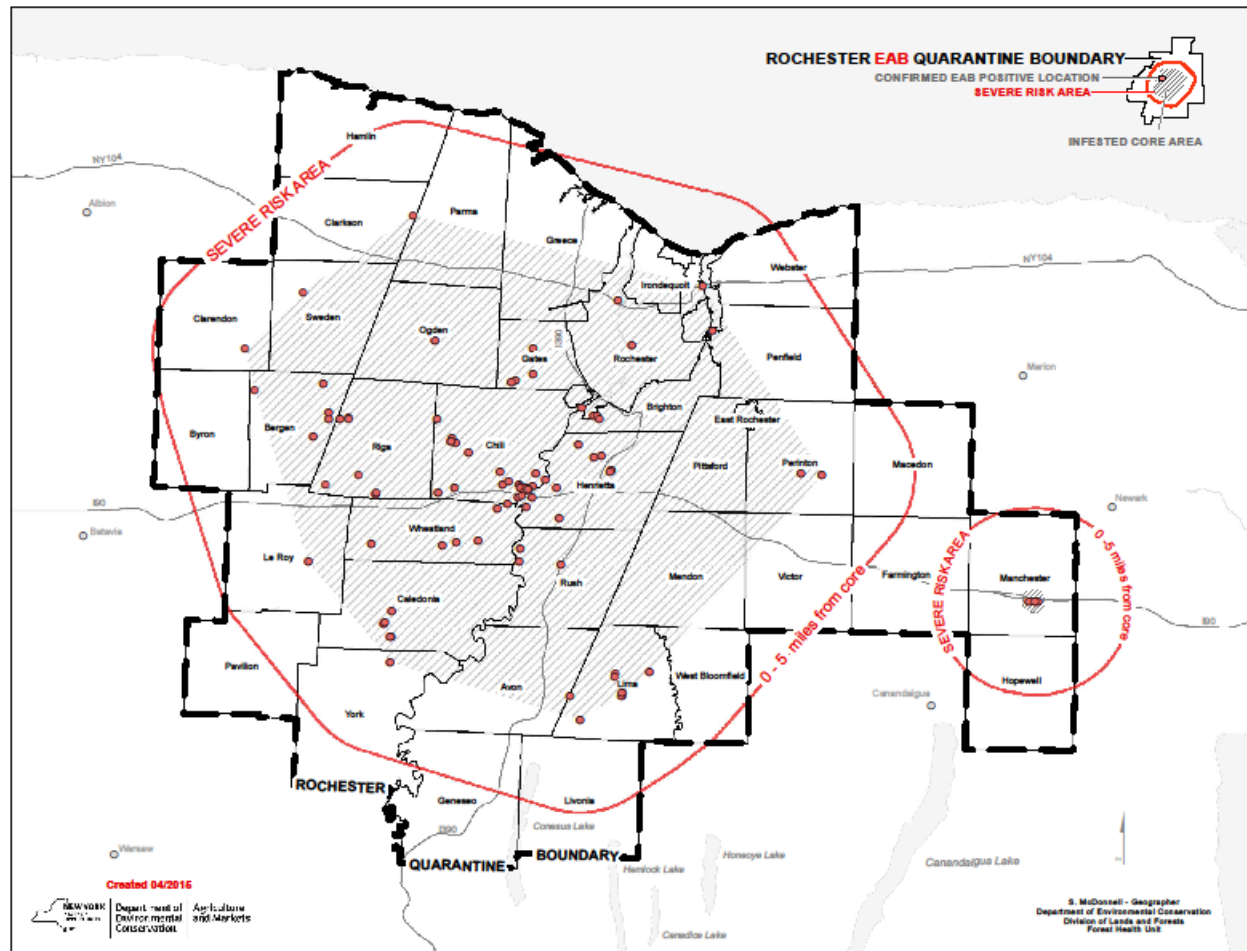


Source: NYSDEC 2014

In 2015, the NYS Department of Agriculture and Markets (NYSDAM) and NYS DEC updated EAB quarantine regulations by creating 14 restricted zones correlating to the current known EAB infestations. A restricted zone is a quarantine around an EAB infestation, defined by municipal boundaries. These zones are regulated by agreements and permits from the State Department of Agriculture and Markets, and limit the import and export of ash trees, ash products, and firewood. If 30 percent or more of a municipality falls within the core infested area or the surrounding 5-mile buffer, it will be included in the restricted zone. Figure 5.4.5-4 shows the infested areas and quarantine boundaries around Monroe County municipalities in 2015 (NYSDEC 2015).



Figure 5.4.5-4. NYS Emerald Ash Borer Infested Areas and Quarantine Boundaries



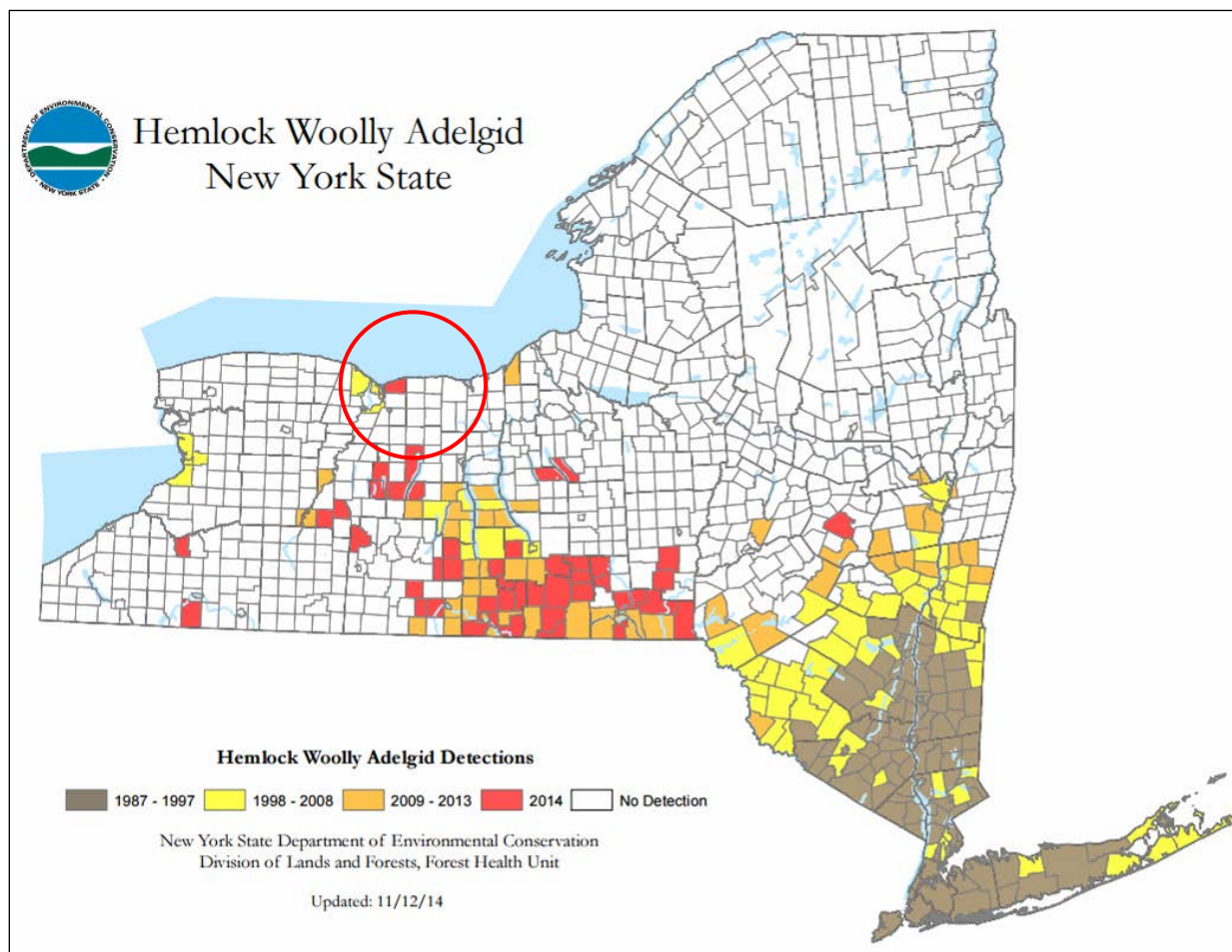
Source: NYSDEC 2015

Hemlock Woolly Adelgid

Since the first discovery of the hemlock woolly adelgid in the Hudson Valley in the 1980s, the insect has spread north and west to the Catskills, the Capital region, the Finger Lakes, and other parts of western New York (Figure 5.4.5-5). Currently, 25 New York counties are infested with the hemlock woolly adelgid, including Monroe County.



Figure 5.4.5-5. Hemlock Woolly Adelgid in New York State, 2014



Source: NYSDEC 2015

Lyme Disease

Lyme disease is the most commonly reported vector-borne illness in the United States. In 2013, it was the fifth most common nationally notifiable disease. In 2013, 95 percent of Lyme disease cases were reported in 14 states—Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Jersey, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and Wisconsin (Centers for Disease Control and Prevention [CDC] 2015).

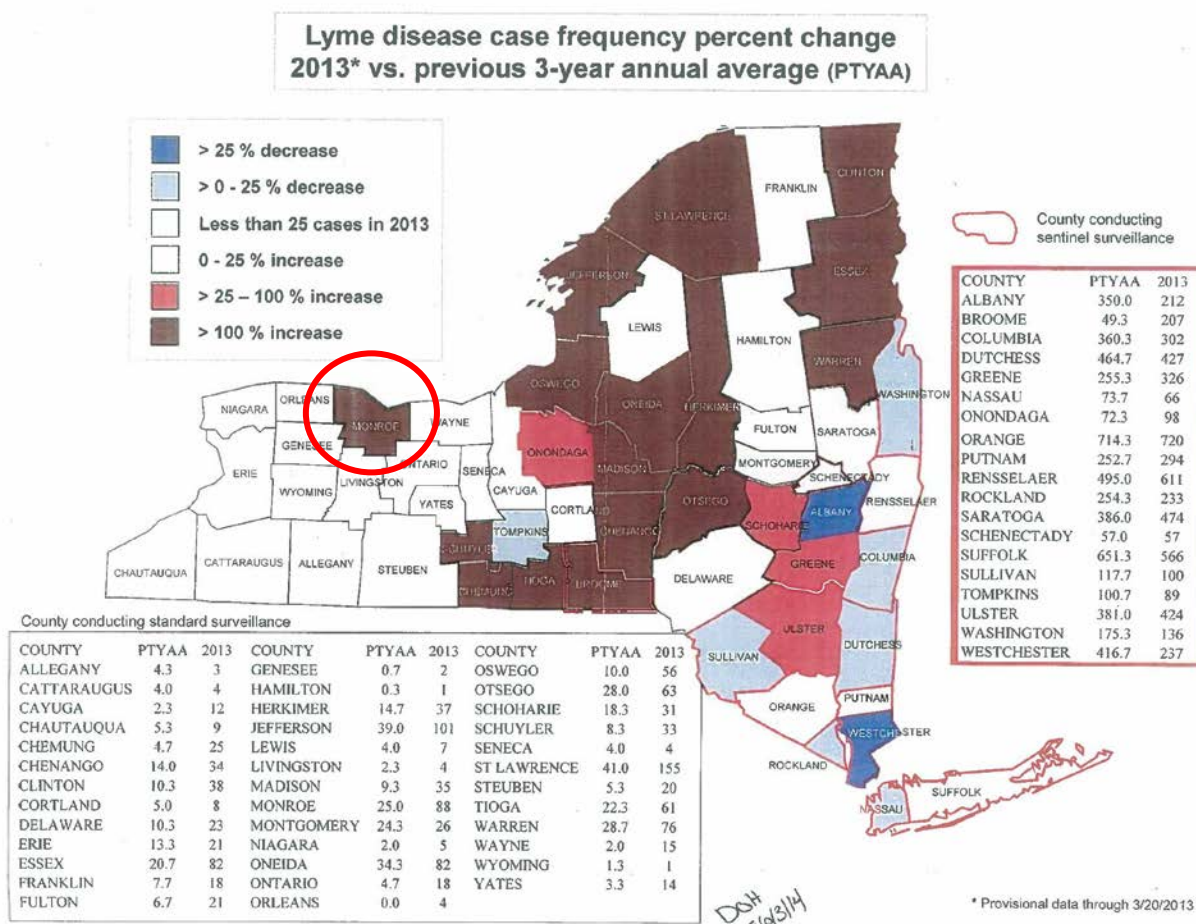
The CDC Division of Vector-Borne Diseases (DVBD) indicated that New York State reported the second-highest number of confirmed Lyme disease cases from 2003 to 2012, totaling approximately 42,111 cases. Only Pennsylvania had a higher total, with 42,189 (CDC 2015). As of March 2013, over 95,000 cases in New York State were reported to NYSDOH, since Lyme disease became reportable in 1986 (NYSDOH 2015). Figure 5.4.5-6 shows the reported cases of Lyme disease in New York State in 2013 compared to the previous 3-year annual average, and indicates that Monroe County has seen a 100 percent or greater increase in the incidence of Lyme disease.

In Monroe County, between 2005 and 2015, there were 277 cases of Lyme disease reported in the County (MCDPH 2015). In 2013 alone, according to the New York State Department of Health, Monroe County



physicians reported 89 cases of Lyme disease. In 2015, Monroe County Public Health and Emergency Preparedness officials noted that Lyme disease is the greatest insect-borne health threat in the county.

Figure 5.4.5-6. Lyme disease case frequency percent change in 2013 compared to the previous 3-year annual average



Source: MCDPH 2015

In general, adult deer ticks are twice as likely to be infected with pathogens as their younger counterparts. However, due to their larger size, attached adult deer ticks are more frequently detected and removed before they can transmit pathogens. Conversely, while younger deer ticks are less likely to carry Lyme disease and have a lower infection rate than adults from the same geographic area, they are the life stage most likely to transmit the disease because they are difficult to detect. An attached deer tick takes approximately 36 to 48 hours to feed and transmit Lyme disease (MCDOH, 2015).

Adult deer ticks are typically active in Monroe County from early October until temperatures are consistently below freezing. They reappear in late winter and early spring, from March through June. Nymphal, or younger, ticks are active from mid-May through July.

True Armyworm

The armyworm is typically found in southern parts of the United States. Occasionally, during the growing season, the armyworm can make its way into the northern United States, including New York State (Young

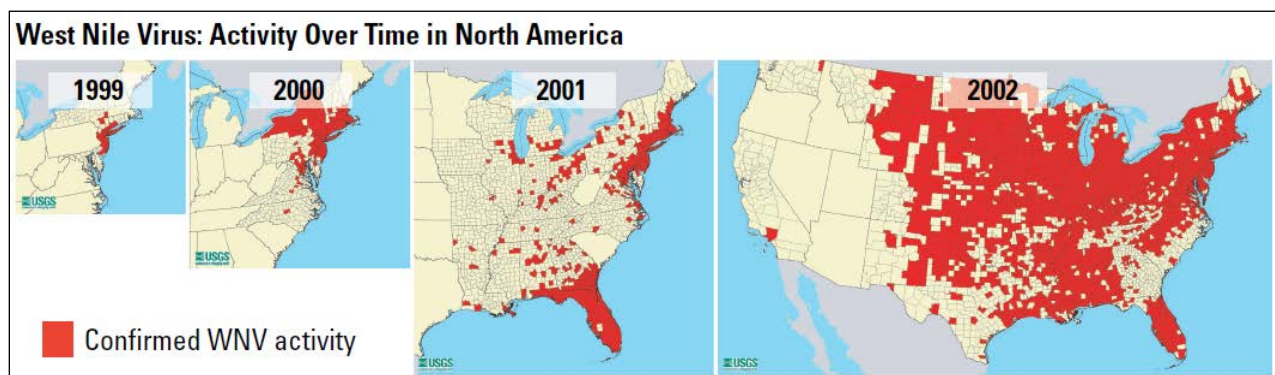


2012). The most recent infestation of the armyworm in New York State occurred in 2012 when it impacted the western part of the state that includes Monroe County. Armyworms have also been reported in northern and eastern New York State and the Finger Lakes (Associated Press 2012).

West Nile Virus

Since it was discovered in the western hemisphere, WNV has spread rapidly across North America, affecting thousands of birds, horses, and humans. WNV swept from the New York City region in 1999 to almost all of the continental United States, seven Canadian provinces, and throughout Mexico and parts of the Caribbean by 2004 (U.S. Geological Survey [USGS] 2014). Figure 5.4.5-7 shows the activity of WNV in North America from 1999 to 2002. This figure indicates that WNV was been confirmed in New York State since 1999 and in Monroe County since 2000.

Figure 5.4.5-7. WNV Activity over Time in North America

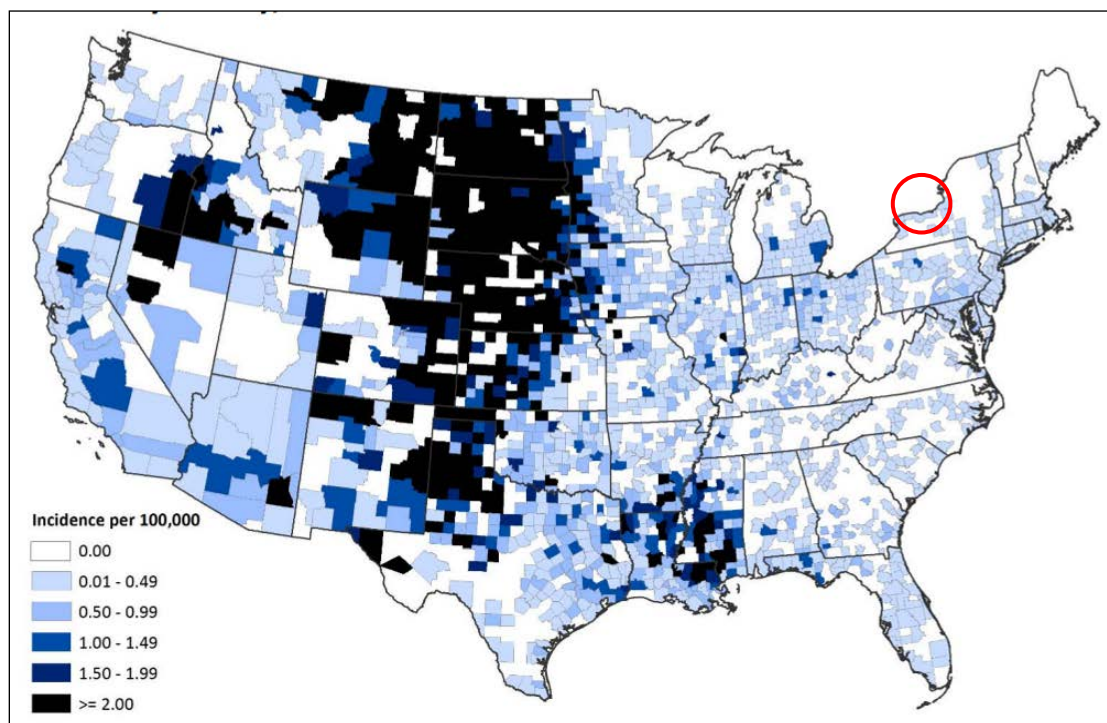


Source: USGS 2003

The CDC conducts a surveillance program for WNV. Data are acquired weekly and reported within five categories: wild birds, sentinel chicken flocks, human cases, veterinary cases, and mosquito surveillance (CDC 2015). Figure 5.4.5-8 illustrates WNV activity in the United States from 1999 to 2014. According to this figure, between 0.01 – 0.49 incidences of WNV occurred in Monroe County during that time span.



Figure 5.4.5-8. Average Annual Incidence of WNV Reported to CDC, 1999-2014



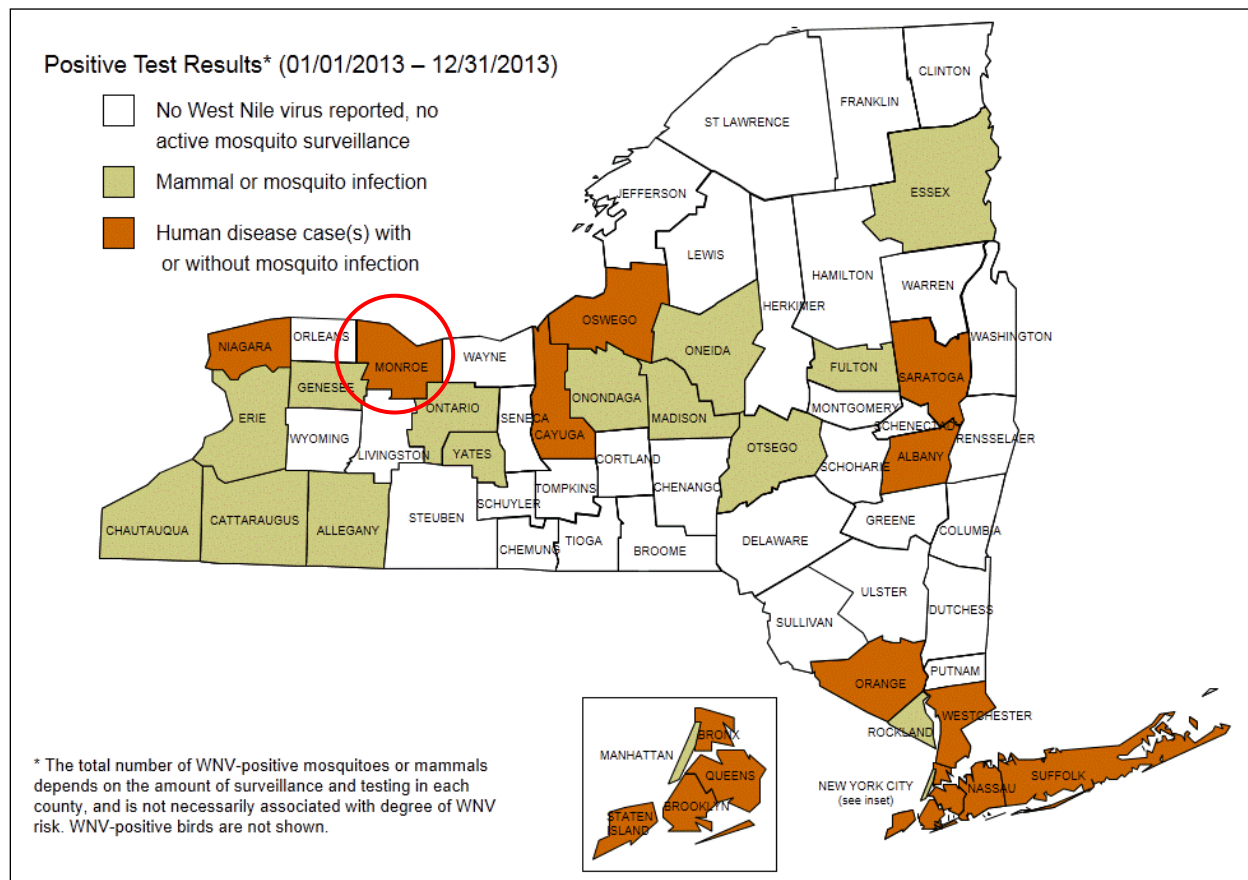
Source: CDC 2015

Note: The circle indicates the approximate location of Monroe County. The figure indicates that the county averaged between 0.01 – 0.49 incidences per 100,000 incidents annually between 1999 and 2014.

New York State's Department of Health reported two positive human disease cases and one equine case of WNV in Monroe County from laboratory testing results in 2013. Figure 5.4.5-9 illustrates locations of positive test results for WNV in New York State during 2013.



Figure 5.4.5-9. 2013 West Nile Virus Surveillance Summary



Source: NYSDOH 2015

Note: The total number of WNV-positive mosquitoes/mammals within each county depends on the amount of surveillance and testing within that county, and is not necessarily associated with degree of WNV risk. This figure does not include reported instances of WNV-positive birds.

Previous Occurrences and Losses

The Federal Emergency Management Agency (FEMA) has declared that New York State underwent one infestation-related emergency (EM) classified as a virus threat between 1954 and 2015. In 2000, Monroe County was included in that declaration related to an outbreak of the West Nile virus (FEMA 2015). Generally, this and other EMs cover a wide region of the state and may impact many counties; however, not all counties have been included in previous disaster declarations. Monroe County was also included in one USDA disaster declaration (S3411) for the armyworm outbreak in 2012.

For this 2017 HMP Update, known infestation and invasive species events impacting Monroe County between 1950 (as documented in the 2011 HMP) and 2015 are listed in Table 5.4.5-1. Detailed information regarding infestations, invasive species, and losses resulting from these within the county is scarce. Therefore, Table 5.4.5-1 may not include all events that occurred within the county during the period between 1950 and 2015.



Table 5.4.5-1. Infestation and Invasive Species Events in Monroe County, 1950 to 2015

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
2010 to 2015	West Nile Virus	N/A	No	Between 2010 and 2015, Monroe County had a very low occurrence of WNV among birds, horses, humans, and pets. • 2013 – 2 human cases, 1 equine • 2012 – 2 human cases • 2011 – 0 cases reported • 2010 - 0 cases reported
2012	Armyworm	N/A	No	A spring storm system brought adult armyworm moths to western New York (from the south). The early arrival of warm spring weather was blamed for the appearance of an unusually high number of army worms. Ordinarily, they arrive later in the season, when more of their natural predators are present. Monroe County was included in a USDA disaster declaration (S3411) for the armyworm outbreak.
2010-2013	Emerald Ash Borers	N/A	No	Emerald ash borers (EAB) were first found in North America in 2002 and have been blamed for killing tens of millions of ash trees in 15 states and two Canadian provinces. The tiny green beetles from Asia were first identified in New York in 2009. In 2013, EAB colonies had populated large swaths of ash trees in Monroe County within the municipalities of the Towns of Chili, Henrietta, and Rush, and the Village of Scottsville, and had entered adjoining sections of the Town of Brighton and City of Rochester. As of August 3, 2015, Monroe County remained under both state and federal quarantines due to EAB infestations. All Monroe County municipalities were included in the 2015 New York State EAB Quarantine Boundary Severe Risk Area as of April, 2015. Precise damage estimates from infestation are difficult to quantify, though municipal costs of clearing dead trees and downed power lines from dead limbs are expected to climb in infested areas. Further, severe loss of ash in riverine communities may lead to bank erosion, sedimentation, flooding caused by debris in waterways, and less groundwater absorption
2010	Stink Bug	N/A	No	Populations of the brown marmorated stink bug caused catastrophic damage to most mid-Atlantic states in 2010, including New York State. Losses in Monroe County to the green pea and sweet corn crops totaled \$46,288 in 2010.
1950s-1960s	Dutch Elm	N/A	No	Dutch Elm Disease destroyed a multi-state region of elms in the 1950s through the 1960s.

Source: USGS 2014; USDA 2015; NYSDOH 2015; CDC 2015
 CDC Centers for Disease Control
 EAB Emerald Ash Borer
 FEMA Federal Emergency Management Agency
 N/A Not applicable
 USDA U.S. Department of Agriculture
 WNV West Nile Virus



Probability of Future Events

Based on historical documentation and given the overall impact of changing climate, New York State is expected to undergo increased incidences of infestation. Monroe County and all its jurisdictions will continue under threat of infestations that may induce secondary hazards and health threats to the county population if infestations are not prevented, controlled, or eradicated.

In Section 5.3, the identified hazards of concern for Monroe County were ranked according to a number of parameters. Probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence of infestation within the county is considered “frequent” (likely to occur within 25 years).

Climate Change Impacts on Infestation and Invasive Species

Climate change is beginning to affect both people and resources in New York State, and increase of these impacts is expected. According to the 2014 New York State HMP update, hazards linked to climate change have the potential to instigate both direct and indirect consequences related to infestation. Extreme weather events encourage outbreaks of disease and infestation, and drought leads to increases in locust and white fly populations (NYS DHSES 2014). Effects related to increasing temperatures are already evident within the State.

The Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the state’s vulnerability to climate change, and to facilitate development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA] 2011). Each region within New York State, as defined by ClimAID, has attributes that will be affected by climate change. Monroe County is part of Region 1, which includes western New York and the Great Lakes plain. Attributes that will be affected by climate change include impacts on agricultural revenue (Region 1 counties have the highest in the state), relatively low rainfall that may increase summer drought risk, high-value crops that may need irrigation, and projected improved conditions for grapes (NYSERDA 2011).

Total precipitation amounts have slightly increased in the northeast United States—by approximately 3.3 inches over the last 100 years. The number of 2-inch rainfall events over a 48-hour period has also increased since the 1950s (a 67 percent increase). The number and intensity of extreme precipitation events are increasing in New York State as well (Cornell University College of Agriculture and Life Sciences 2011).

Temperatures and precipitation amounts are expected to increase throughout the state, as well as within Region 1. The state’s temperature is expected to rise between 2.0–3.4 degrees Fahrenheit (°F) by the 2020s, between 4.1–6.8 °F by the 2050s, and between 5.3–10.1 °F by the 2080s. The lower ends of these ranges assume lower greenhouse gas emissions scenarios, and the higher ends of these ranges assume higher greenhouse gas emission scenarios (NYSERDA 2014).

Within Region 1, temperatures are anticipated to increase between 4.3 to 6.3°F by the 2050s, and between 5.7 to 9.6°F by the 2080s (baseline of 47.7°F). Precipitation totals will increase between 4 and 10 percent by the 2050s, and between 4 and 13 percent by the 2080s (baseline of 34 inches).

Table 5.4.5-2 lists projected seasonal precipitation changes within Region 1, western New York and the Great Lakes plain ClimAID Region (NYSERDA 2014).

Table 5.4.5-2. Projected Seasonal Precipitation Change in Region 1, 2050s (% change)

Winter	Spring	Summer	Fall
5 to +15	0 to +15	-10 to +10	-5 to +10



Source: NYSERDA 2011

Temperature and rainfall increases due to climate change are anticipated, and evidence exists that climate change may be a factor in expansion of infestation and infectious diseases in the United States. Warmer temperatures and changing rainfall patterns provide an environment where mosquitos can remain active longer, greatly increasing the risk for animals and humans. Lyme disease could also expand throughout the United States as temperatures warm, allowing ticks to move into new areas of the country. The changes in climate can also allow tropical and subtropical insects to move from regions where diseases thrive into new places (Natural Resources Defense Council 2015). Armyworms die in colder temperatures. Warmer spring and winter temperatures allow them to continue to reproduce—a factor contributing to the outbreak in 2012. Mosquitoes capable of carrying and transmitting diseases now live in at least 28 states. Warmer temperatures, heavy rainfall, and high humidity have reportedly increased the rate of WNV infections in humans (Natural Resources Defense Council 2013). As temperatures increase and rainfall patterns change, these insects can remain active for longer seasons and within wider areas.

An increase in temperature and humidity may also lead to a larger number of influenza outbreaks. Studies have shown that warmer winters led to an increase in influenza cases. During warm winters, fewer people contract influenza which causes a large number in population to remain vulnerable into the next season. This causes an early and strong occurrence of the virus (Spross 2013).



5.4.5.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable within the identified hazard area. All of Monroe County has been identified as the hazard area for invasive species; therefore, all assets within the county, as described in the County Profile (Section 4), are vulnerable to the invasive species hazard. The following factors are addressed below, as well as potential impacts of the invasive species hazard on the county:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health, and safety of residents; (2) general building stock; (3) critical facilities; (4) economy; and (5) future growth and development
- Change of vulnerability compared to the 2011 Monroe County Hazard Mitigation Plan
- Further data acquisitions that will increase understanding of this hazard over time.

Overview of Vulnerability

Infestation and invasive species are of significant concern to Monroe County, mainly due to their effects on public health, natural resources, and agriculture. Estimated losses are difficult to quantify; however infestation can impact Monroe County's population and economy. Direct effects of infestation lead to cascading indirect impacts. As vegetation dies or becomes stressed and weakened by pests such as the emerald ash borer, available fuel and high-intensity wildfires increase. As species compositions change due to infestation outbreaks, whole fire regimes can shift. Physical stresses on trees may also affect how trees respond to other natural hazards such as hurricanes, drought, and ice storms (Kurtz 2007).

Data and Methodology

Because of lack of quantifiable loss information, a qualitative assessment has been used to evaluate assets exposed to this hazard and potential impacts associated with this hazard.

Impact on Life, Health, and Safety

The entire population of Monroe County is vulnerable to infestation. According to the 2010 U.S. Census, Monroe County had a population of 744,344. The elderly population and people with suppressed immune systems are most susceptible to effects of WNV. According to the 2010 U.S. Census, one in seven people in Monroe County is 65 and over.

Impact on General Building Stock and Critical Facilities

No structures are anticipated to be affected directly by infestation or invasive species; however, the emerald ash borer may cause a catastrophic loss of the ash tree throughout state forests, which could result in stream bank instability, erosion, and increased sedimentation. In addition, a preponderance of dead tree limbs could increase the occurrence of downed trees on roadways and power lines in storms with heavy winds.

Impact on Economy

Impacts of infestation and invasive species on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with activities and programs implemented to conduct surveillance and address infestation have not been quantified in available documentation. Spreads of diseases will impact worker productivity as individuals miss work to recover. Crop losses from invasive species may be significant; during 2012, the county's crop was severely impacted by the armyworm.



The emerald ash borer can infect nursery stock and mature trees, which could reduce the timber value of hardwood exports (CFIA 2014). In 2010, the USDA Northern Research Station conducted computer simulations of EAB spread to estimate the cost of ash tree treatment, removal, and replacement (re-planting of new trees) between 2009 and 2019. The simulations predicted an EAB infestation covering 25 states, and assumed treatment, removal, and replacement of more than 17 million ash trees on developed land within established communities. The total costs were estimated at \$10.7 billion. This figure doubled when the model was reset to include developed land outside, as well as inside, human communities (USDA 2013).

Impact of Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the county. Any areas of growth could be impacted by the infestation hazard because the entire planning area is exposed and vulnerable.

Change of Vulnerability

Overall, the county's vulnerability has not changed since the 2011 HMP, and exposure and vulnerability to infestation and invasive species will continue throughout Monroe County.

Additional Data and Next Steps

For this HMP Update, any additional information regarding localized concerns and past impacts will be collected and analyzed. These data will be developed to support future revisions to the plan. Future mitigation efforts could include partnering and collaborating with existing New York State, Monroe County, and local efforts.