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# 3 Criterion

## Maintenance of Forest Ecosystem Health and Vitality

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### Criterion 3. Maintenance of Forest Ecosystem Health and Vitality

Forest health is difficult to assess at any one point in time, since forests are dynamic and influenced by many factors. Measures of forest health include forest age and composition, trends in tree growth and mortality, tree crown condition, vulnerability to forest health stressors and their frequency of occurrence, and the condition of soil, water, and wildlife. Forest condition throughout the Northern United States is assessed annually through the USDA Forest Service’s Forest Health Monitoring Program.

It is important to maintain healthy forests that are resilient to forest stressors in both urban and rural landscapes. Combinations of stressors, such as insects and pathogens combined with drought, cause the greatest impact. The impact from various stressors can result in decline in a forest stand as trees within the stand die back and deteriorate. This decline may eventually affect forest composition and productivity. All of these factors influence the selection of appropriate management strategies.

- The last century has brought an influx of human-influenced factors to Northern U.S. forests, including exotic insects and pathogens, invasive plants, and air pollution. These factors, especially when they occur in combination, have the potential for creating a greater impact on the health of urban and rural forests than natural factors alone.

#### Insects and Disease

- Population levels of native insect pests vary each year; fluctuations are influenced by weather conditions, availability of food sources, and occurrence of insect pathogens and predators (figure 16).

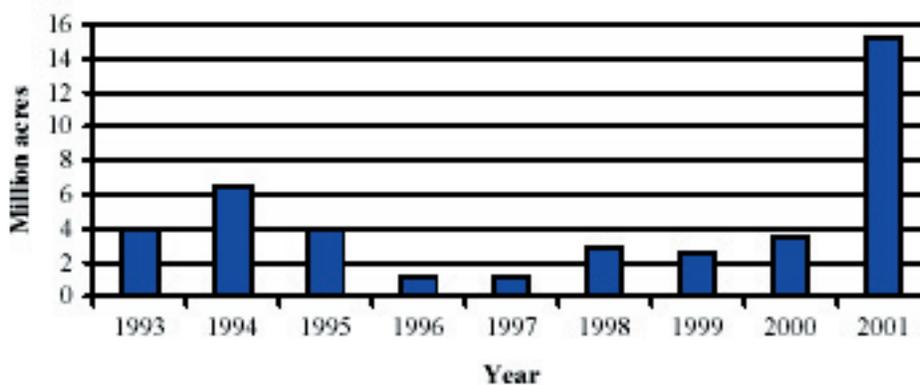


Figure 16. **Acres of defoliation.** Between 1993 and 2001, over 40 million acres were defoliated by native insects in the Northern United States. The large increase in 2001 was due primarily to a forest tent caterpillar outbreak in the Lake States (Source: USDA Forest Service).

- Historically, conifers in the Northern United States have been impacted by spruce budworm, jack pine budworm, and pine false webworm. Hemlock looper has caused significant dieback and mortality to eastern hemlock. The main native defoliators of oaks are oak leaf-tier and oak skeletonizer. Maples are affected by the maple leaf cutter and other defoliators. Forest tent caterpillar has also caused extensive defoliation of hardwoods

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(USDA Forest Service 2001).

- Since the turn of the century, exotic or introduced forest pests have had dramatic impacts upon Northern U.S. forests. These introduced pests usually have no natural factors in their new environment that can control their population. Of known exotics, 15 insects and 7 pathogens have had widespread impacts; many have become serious, persistent forest pests (table 8). Some, such as chestnut blight, Dutch elm disease, butternut canker, beech bark disease, white pine blister rust, and gypsy moth, have had long-term, devastating effects beyond the range of expected variation.

- Recently introduced pests are also becoming significant concerns. Examples include the hemlock woolly adelgid, pine shoot beetle, Asian longhorned beetle, and emerald ash borer. Such introductions have prompted quarantines and efforts towards eradication. The USDA Animal Plant Health Inspection Service is responsible for detecting and mitigating the initial introduction of exotic pests.

#### Abiotic Stressors

- Abiotic factors such as drought, ice storms, wind, and fire have historically caused significant damage in the Northern United States. Drought conditions that occurred during the 1980's and 1990's, in combination with other factors, caused a decline in tree health in some areas. The largest ice storm in recent years occurred in January 1998, impacting approximately 17 million acres of rural and urban forests in Maine, New Hampshire, Vermont, and New York. Wind damage has been significant in northern Minnesota and New York. Fires consume an average of 225,000 acres in the Northern United States each year.
- Exposure to atmospheric ozone and acidic deposition are significant threats to the forest

Table 8. **Introduced insects and pathogens in the Northern United States.** Several insects and pathogens have been introduced into the United States from Europe and Asia since the early 1800's, causing significant tree damage and mortality (USDA Forest Service 2002a).

	Origin	Year of entry
<b>Insects</b>		
Elm leaf beetle	Europe	1834
Gypsy moth	Europe	1869
Larch sawfly	Europe	1880
Larch casebearer	Europe	1886
Beech scale	Europe	1890
Pear thrips	Europe	1904
Balsam woolly adelgid	Europe	1908
Elm bark beetle	Europe	1909
Introduced pine sawfly	Europe	1914
Birch leafminer	Europe	1909
Hemlock woolly adelgid	Europe	Prior to 1953
Pine shoot beetle	Europe	Prior to 1992
Asian gypsy moth	Asia	1992
Asian longhorned beetle	Asia	Prior to 1997
Emerald ash borer	Asia	Prior to 2002
<b>Pathogens</b>		
Chestnut blight	Asia	1904
White pine blister rust	Europe	1906
Larch canker	Europe	1927
Dutch elm disease	Europe	1930
Butternut canker	Asia (uncertain)	Prior to 1960
Scleroderris canker	Europe	1962
Dogwood anthracnose	Asia (uncertain)	Prior to 1976

ecosystem. Ozone-induced foliar injury has been detected on many of the sensitive plants surveyed at biomonitoring sites in the Northern United States (figure 17).

- Studies show that acidic deposition has contributed to a regional decline in available calcium in spruce-fir forests in New York and New England. There is also evidence that acidic deposition has reduced cold tolerance of high-elevation red spruce, resulting in frequent winter injury of foliage.

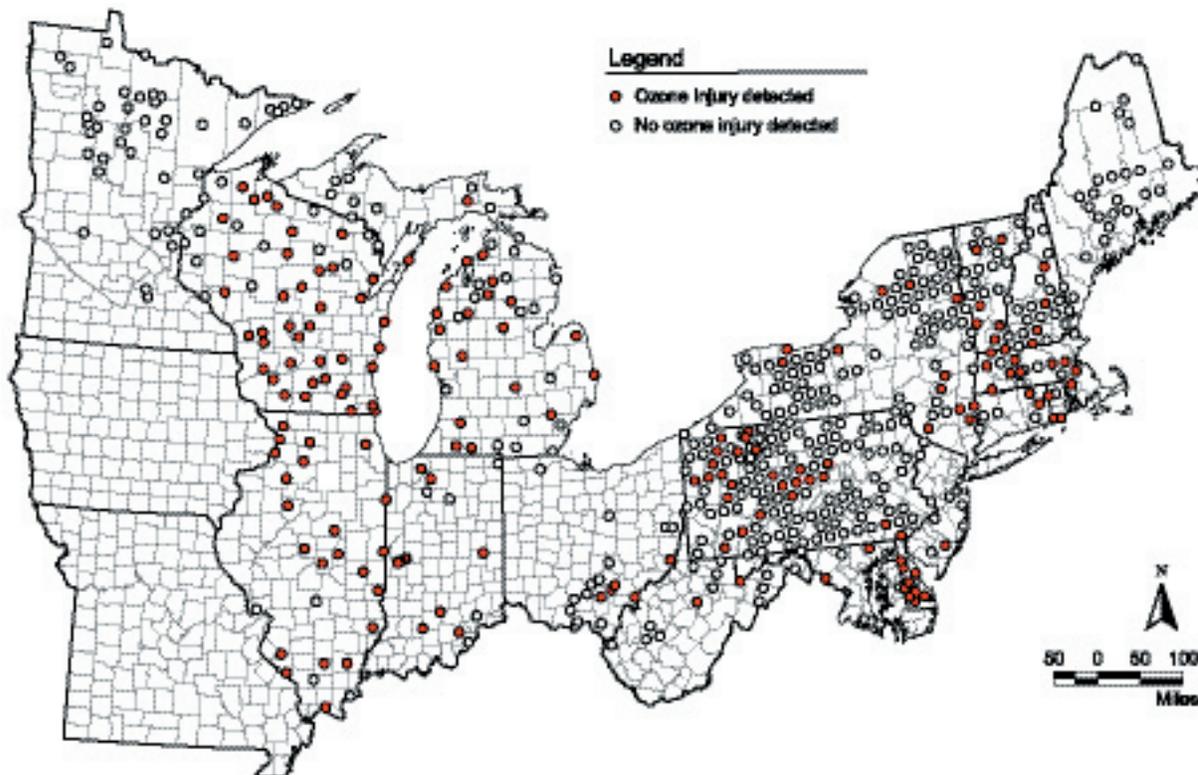


Figure 17. **Ozone injury detected, 1999.** Ozone injury was detected on biomonitoring sites associated with Forest Health Monitoring plots across the Northern United States (Source: USDA Forest Service).

- Several factors have been associated with the decline of sugar maple in New England, New York, and Pennsylvania. In response to concerns about the status of the maple resource, the United States and Canada formed the joint North American Maple Project in 1987. Selected sugarbush and forest maple stands in the Northern United States and Eastern Canada are monitored on an annual basis.

### Noxious Weeds

- Of the thousands of plant species introduced into the United States, 94 taxa are officially recognized as Federal noxious weeds. Invasive plants are currently estimated to occupy well over 100 million acres, and populations are predicted to increase by 8–20 percent annually. When invasive plants, such as mile-a-minute weed and Japanese knotweed, colonize a clearcut area, they become competitive with forest seedling regeneration. They can also displace native plant species, which can impact wildlife habitat.

### Deer Browsing

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- The increasing white-tailed deer population in the eastern United States affects forest sustainability and has impacted plant species composition and community structure (Stromayer and Warren 1997). Deer browsing has a profound impact on the establishment of regeneration, the density of hardwood seedlings, and the presence of understory plants (ferns, flowers, and shrubs). These factors ultimately influence biodiversity and affect other wildlife.