



Forest Health on Isle Royale, 2010–2019

We began long-term forest monitoring on Isle Royale in 2010, returning in 2019 to resample the 52 original sites and eight additional plots.

Each sample site is assigned to one of five broad forest types: Sugar Maple–Yellow Birch, Cedar–mixed, Paper Birch–mixed, Mixed Conifer–Hardwood, and Balsam Fir. A plot consists of three parallel transects, each 50-meter (164-feet) long. Along these transects, we measure different characteristics of live trees, seedlings, snags, shrubs, and herbs; and we document signs of browsing on both woody and herbaceous species.

What We Are Finding

Trees

Regeneration of several overstory species such as trembling aspen, balsam fir, and yellow birch remains impaired, particularly on the western end of the island where high browse pressure by moose has resulted in neither balsam fir nor trembling aspen being common. Sugar maple is still abundant on the west end, but the density of maple saplings fell 33% between 2010 and 2019. Old trees dominate the paper birch forests, with little regeneration of hardwoods and, in some places, dense bracken fern coming up in the understory. In the Mixed Conifer–Hardwood and Balsam Fir sites concentrated on the central and eastern parts of the island, the number of trembling aspen in the smallest size classes has increased, probably due to lower moose density in 2006–2011.

Higher recent moose density was reflected in seedling data in forest types common on the west side. From 2010 to 2019, seedling density for all tree species fell 26.2% in the Sugar Maple–Yellow Birch sites and 25.8% in the Cedar–Mixed sites. Browse on woody species was markedly higher in 2019. Among individual species, parkwide proportion of browse was greatest on red maple and sugar maple.

Herbs

Changes in the herbaceous layer during the nine



Balsam fir heavily browsed by moose. NPS/A. WAKEEN



It's what's for dinner. Bluebead lily (center with yellow flower), rosy twisted-stalk (bottom edge of photo), and starflower (top middle) are three herbs preferred by browsing moose. To the left of the bluebead lily and in the lower right corner are sugar maple seedlings, which are also favored food items. NPS/T. GOSTOMSKI.

years between sampling events were notable. Site-level species richness (the number of herb species at a site) fell 20% in Sugar Maple–Yellow Birch sites and 6.6% in Paper Birch–mixed sites. Species known to be preferred by moose also experienced declines in both site-level richness and abundance. Declines in abundance were most notable in the forest types common on the west side of the island, where abundance of preferred herbs declined 38% in Sugar Maple–Yellow Birch sites and 22% in Cedar–Mixed sites.

Herbs identified as preferred browse by moose on Isle Royale.

Common name	Species
Bigleaf aster	<i>Eurybia macrophylla</i>
Bluebead lily	<i>Clintonia borealis</i>
Bunchberry	<i>Cornus canadensis</i>
Canada mayflower	<i>Maianthemum canadense</i>
Clasping twisted-stalk	<i>Streptopus amplexifolius</i>
Cowparsnip	<i>Heracleum sphondylium</i> ssp. <i>montanum</i>
Crested woodfern	<i>Dryopteris cristata</i>
False Solomon's seal	<i>Maianthemum racemosum</i>
Fireweed	<i>Chamerion angustifolium</i>
Hairy Solomon's seal	<i>Polygonatum pubescens</i>
Intermediate woodfern	<i>Dryopteris intermedia</i>
Lady fern	<i>Athyrium filix-femina</i>
Largeflower bellwort	<i>Uvularia grandiflora</i>
Oak fern	<i>Gymnocarpium dryopteris</i>
Purple meadow-rue	<i>Thalictrum dasycarpum</i>
Rattlesnakeroot	<i>Prenanthes alba</i>
Rosy twisted-stalk	<i>Streptopus lanceolatus</i> var. <i>roseus</i>
Spinulose woodfern	<i>Dryopteris carthusiana</i>
Spotted touch-me-not	<i>Impatiens capensis</i>
Starflower	<i>Trientalis borealis</i>
Whip-poor-will flower (Nodding trillium)	<i>Trillium cernuum</i>
Wild sarsaparilla	<i>Aralia nudicaulis</i>

The Big Picture

We attribute the marked changes we observed in the forest plant community to the increased herbivore populations on the island. While moose abundance was slightly greater than 500 individuals when we first sampled here in 2010, the population had been low for approximately four years prior to that time. However, as wolf density declined, the moose population exploded to an estimated 2,000 individuals by the time we returned in 2019. In addition to moose, snowshoe hare density also reached high levels, with a spike in abundance in 2012 and 2013. This is believed to be an indirect result of low wolf abundance. Hares browse many of the same species as moose and in the same time period, but our data does not allow us to know for sure which is having the biggest affect on the forest plant community.

Climate Change and Invasive Species

As air and water temperatures rise, the ability of Lake

Superior to moderate the effects will decline, causing a loss of boreal habitat. This will create uncertain conditions for forest overstories, particularly within the boreal forest on the island's east side and in a band around the perimeter.

The greatest invasive plant threat may come from species whose seeds are dispersed by birds, including buckthorns (*Rhamnus* spp.) and honeysuckles (*Lonicera* spp.). Originally from Europe, these aggressive shrubs are found in Minnesota and Michigan. Any seeds deposited on the island will likely not be near a trail or populated area, so a population could become well-established before becoming known to managers.

Also, the emerald ash borer, native to northeastern Asia, is found in Thunder Bay, Ontario, and Houghton, Michigan. Black ash often grows in very wet areas with no other overstory species. If the EAB comes to the island and kills it off, it will lead to a complete loss of the overstory.

What Can Be Done?

There are three things we can do to maintain the character of island forests:

1. Keep herbivore density low.
2. Study the four moose exclosures on the island to gauge differences in browse preferences and impacts between moose and hare.
3. Continue monitoring for invasive plants, especially those on the island's perimeter.

Though facing numerous threats, the forests of Isle Royale are currently in good health. Maintaining ecological diversity and function will help promote overall resilience of the island ecosystem and reduce the chance of having to consider costly restoration actions.