



Beaver, Wind, and Fire: Landscape Change On Isle Royale

Disturbances, or distinct changes in land cover, are an important part of how ecosystems function. These changes can affect animal movements, plant composition and diversity, water quality, and carbon cycling.

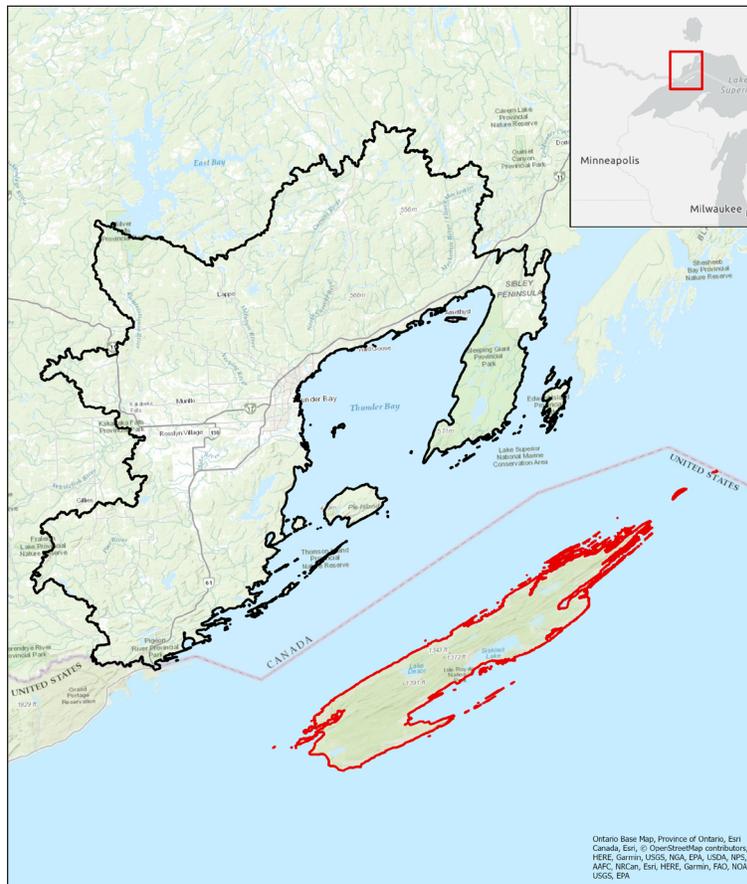
Monitoring these changes provides valuable information about what forces shaped the landscape historically and how those forces may or may not be the same in the present-day. But for a place like Isle Royale, why monitor disturbance types and patterns in Ontario? Because changes in forest cover on the mainland could drive moose, wolves, or nesting bird species to the island. Insect pests or forest diseases on the mainland could be brought to the island by wind or people. By looking at what is happening on the mainland, park resource managers gain valuable knowledge of the current and future patterns of change and from where those changes may come.

How We Do It

Disturbances in and around Isle Royale during a 23-year period (1995–2017) were delineated and checked using a combination of Landsat satellite imagery and high-resolution aerial photos. A set of computer algorithms known as LandTrendr analyzed the satellite imagery to track vegetation changes in the park and on the nearby Canadian mainland. LandTrendr was used to identify apparent disturbances on the satellite imagery, after which high-resolution air photos were used to confirm evidence of a disturbance, validate whether the disturbance occurred, and what caused it (fire, flooding due to beaver activity, forest pathogens, blowdowns, logging, or development). We also identified the year of occurrence and starting and ending vegetation classes.

What We Found

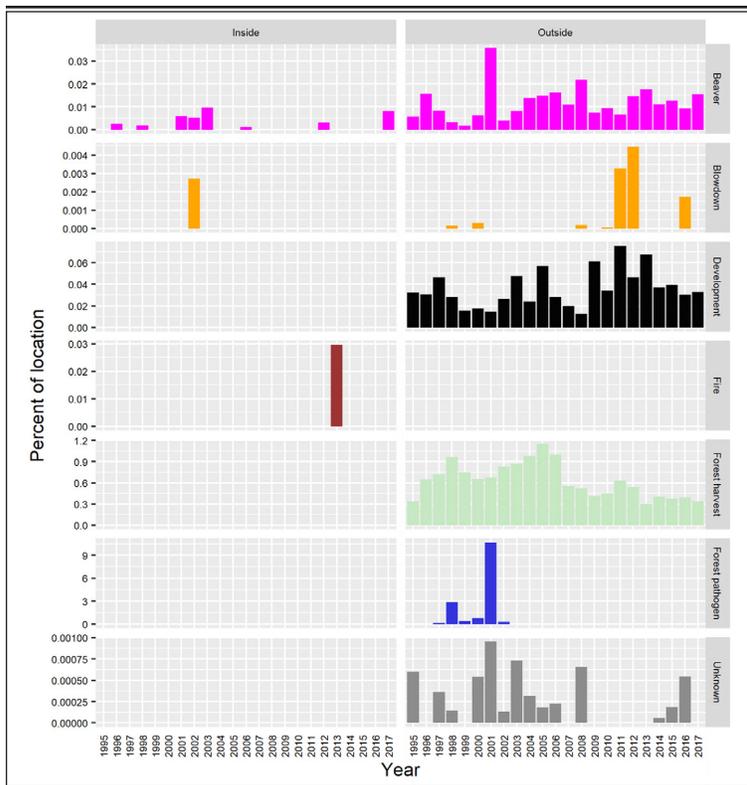
Disturbances on Isle Royale were caused by beaver, fire, or blowdown. Disturbances by beaver occurred in 8 of the 23 years, affecting a total of about 50 acres (20 hectares), or 0.04% of the



Isle Royale National Park and the adjacent mainland of Ontario, Canada. Red and black outlines indicate area monitored for landscape disturbances between 1995 and 2017.

island. Fire occurred in 2013 only, affecting 39 acres (15.80 ha), or 0.03% of the island. A small amount of blowdown occurred in 2002, affecting 3.5 acres (1.44 ha).

Forest harvest was the largest and most consistent disturbance agent in Canada, occurring at nearly twice the rate it had in 1996–2006. The rate of harvest fell sharply in 2007 and has stayed at about half the prior rate. In total, harvest occurred on 128,814 acres (52,129.53 ha), or 14.5% of land during the 23-year period. In contrast, disturbances due to development slightly increased since 2008, with most of the development occurring on the edges of Thunder Bay. Four Ontario watersheds in the analysis area experienced higher rates of forest harvest than



Percent of land disturbed by year, disturbance agent, and location (inside vs outside park). Note: Y-axis scale is different for each disturbance agent.

the others. These watersheds are generally located in heavily forested watersheds further away from Thunder Bay. Some of these watersheds have experienced forest harvest rates of almost 2% in some years, similar to some watersheds in the Voyageurs National Park study area.

In 2001, a *defoliation event* disturbed 10% of all land in the mainland analysis area, but interestingly did not show up on Isle Royale. This defoliation event was well documented by the Ontario Ministry of Natural Resources and Forestry and was attributed to the forest tent caterpillar. The distance between Isle Royale and the Ontario mainland may have been enough of a buffer to keep the forest tent caterpillar from landing on the island and defoliating deciduous trees.

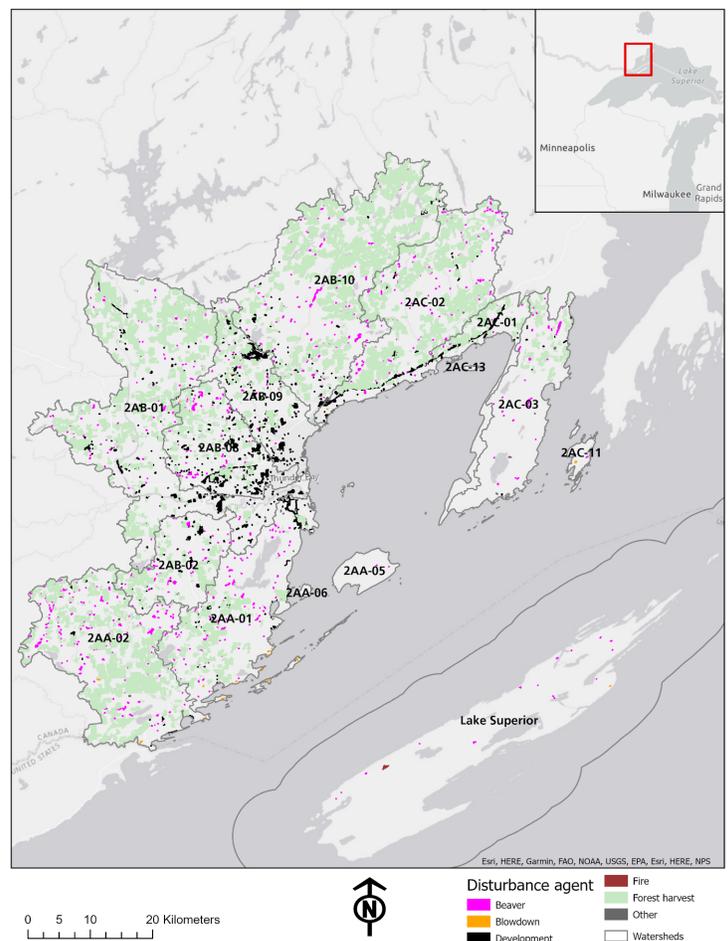
Management Implications

Identifying and quantifying disturbances on Isle Royale and beyond its shores provides the context necessary to understand the outside forces that can affect the park’s natural resources. For example, knowing the location, extent, and level of forest harvest occurring in Ontario gives an indication of when and from where animals such as moose, wolves,

or songbirds may be dispersing into new territory.

We did not detect large landscape disturbances in the park during the analysis period, but we are aware of broadscale regeneration issues for some species and some areas of the park. Balsam fir is not regenerating on the west side, where instead there are scattered individuals of spruce with a largely open understory. Similarly, in areas where the 1936 fire occurred, senescing paper birch covers large areas where the understory is dominated by bracken fern. Trajectories in these forests are uncertain. We will explore the use of LiDAR to identify these areas.

Within the Canadian portion of the analysis area, we continue to see development on the outskirts of Thunder Bay that will affect the movement of wildlife on the landscape and may affect water quality on Thunder Bay tributaries.



Categorized disturbances within the analysis area with delineated watersheds. Note: the forest pathogen disturbance agent has been omitted from this map because it was too widespread.

For More Information

Kirschbaum, A. A. 2021. Landsat-based monitoring of landscape dynamics at Isle Royale National Park: 1995–2017. Natural Resource Data Series NPS/GLKN/NRDS—2021/1324. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2285268>.