

Forest trends in Acadia National Park

Sam A. Bietsch, Kate M. Miller, Aaron S. Weed, and Camilla E. Seirup

National Park Service – Northeast Temperate Network, P.O. Box 177, Bar Harbor, ME 04609



Introduction

The Northeast Temperate Inventory and Monitoring Network (NETN) has been monitoring forest health in a network of 176 randomly located permanent plots in Acadia National Park (ACAD) since 2006. The overall goal of the NETN forest monitoring program is to monitor status and trends in the structure, function, and composition of NETN forested ecosystems, and to use this information to guide park management decisions. Plots are sampled on a 4-year rotating panel, with one-quarter of plots sampled every year, and each plot sampled every 4 years. Currently each plot has been sampled at least 3 times. Here we present preliminary trend analyses of how forests in ACAD have changed over the 12 years of monitoring.

Methods

At each forest plot, NETN collects a suite of metrics related to the stand and site, understory composition, tree regeneration, soil chemistry, tree health, snag abundance, and coarse woody debris. NETN also tracks individual tree growth, mortality and recruitment across repeated surveys. Trend analyses in this study focus on forest plots located in spruce-fir forest types, which occur in over 2/3 of forest plots established in ACAD (Fig.1). Analyses cover years the 2007-2018, with cycle 1: 2007- 2010, cycle 2: 2011- 2014, and cycle 3: 2015- 2018 .

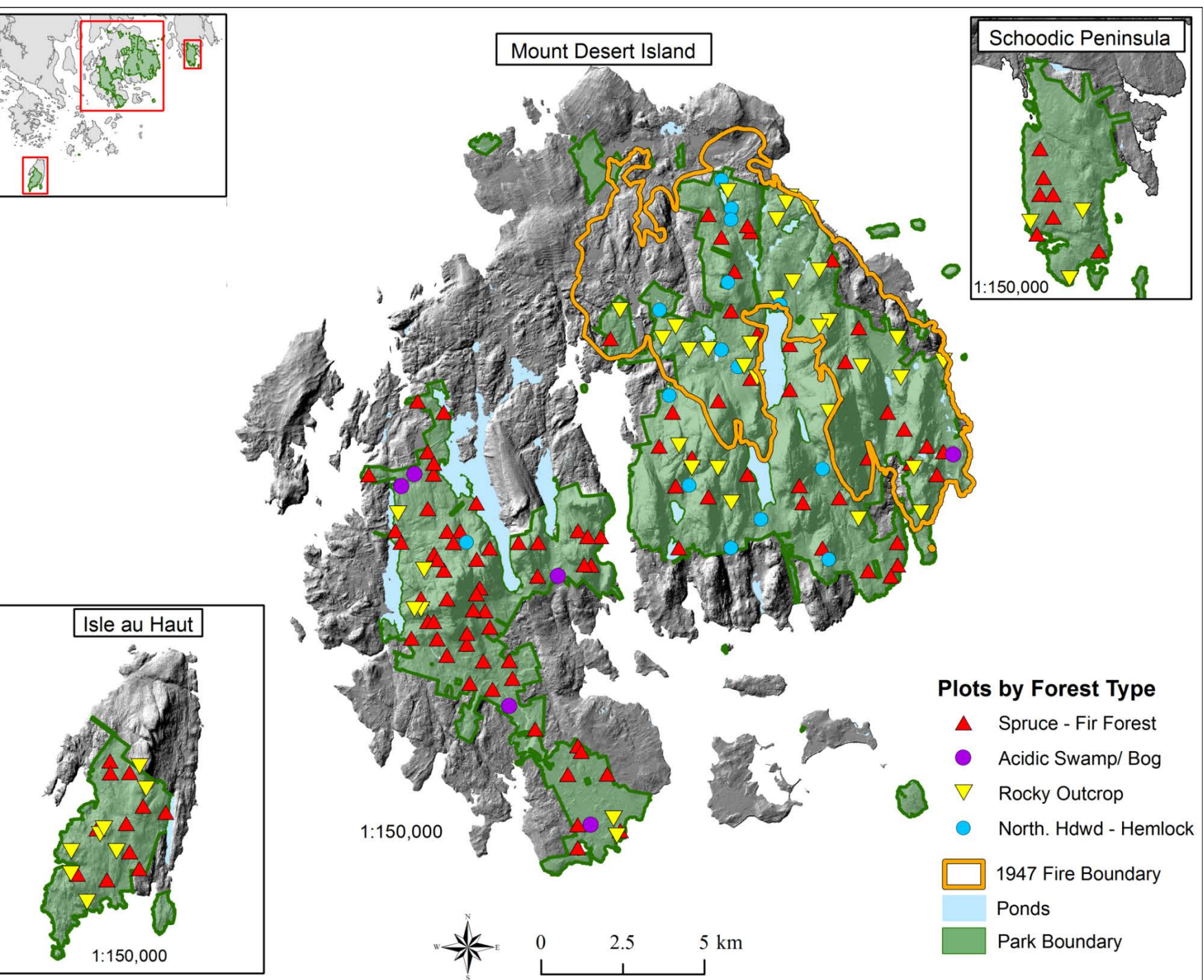


Figure 1. Location of forest plots in ACAD. Symbols represent the dominant forest type at each plot.

Results

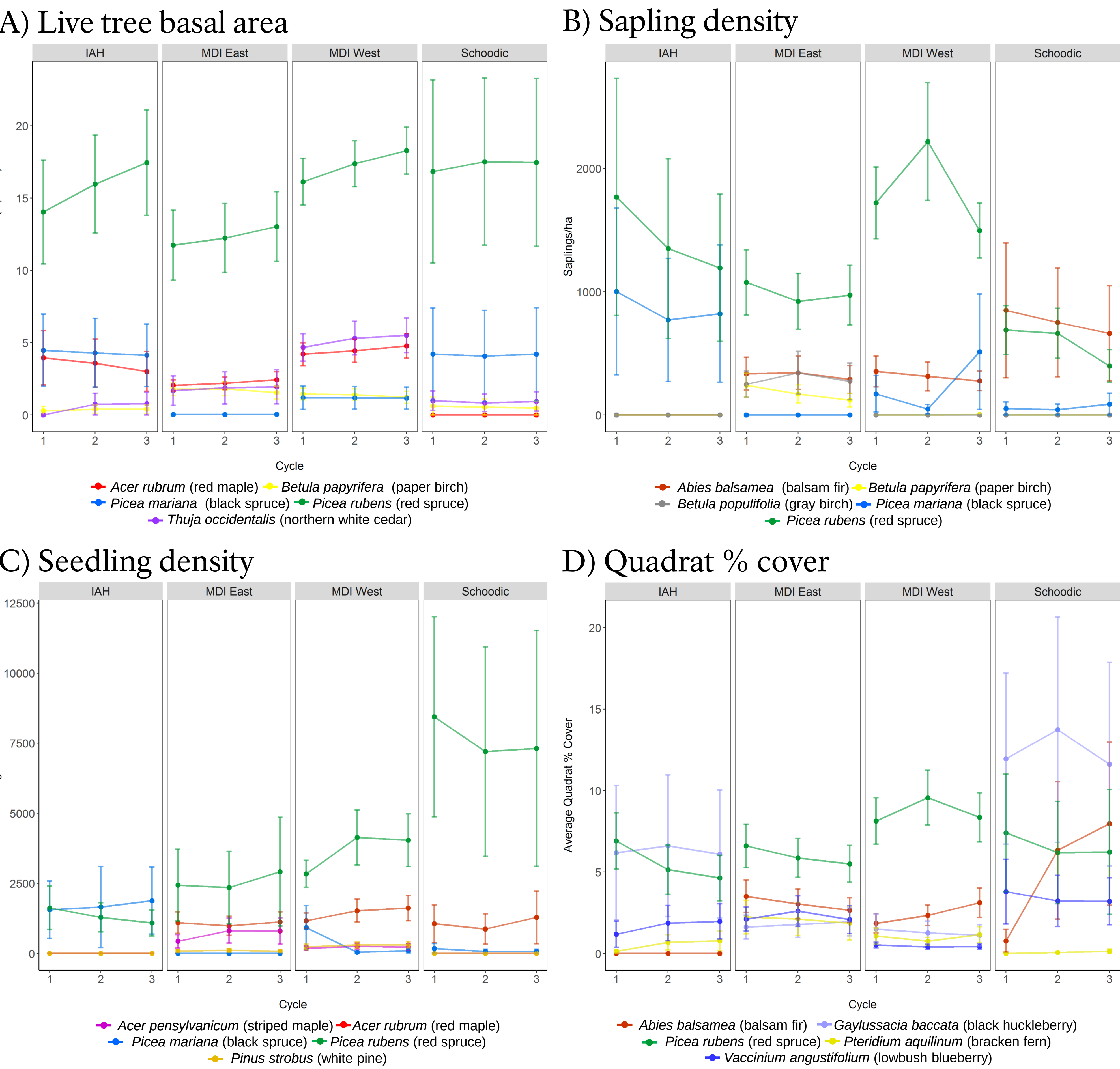


Figure 2. Trends in ACAD forest composition for the 5 most abundant species per strata. Figures A-C only include the 5 most abundant tree species in each strata. Figure D includes the 5 most abundant species in the understory. Cycle 1= 2007-2010; Cycle 2= 2011- 2014; Cycle 3= 2015- 2018. Error bars represent ±1 SE.

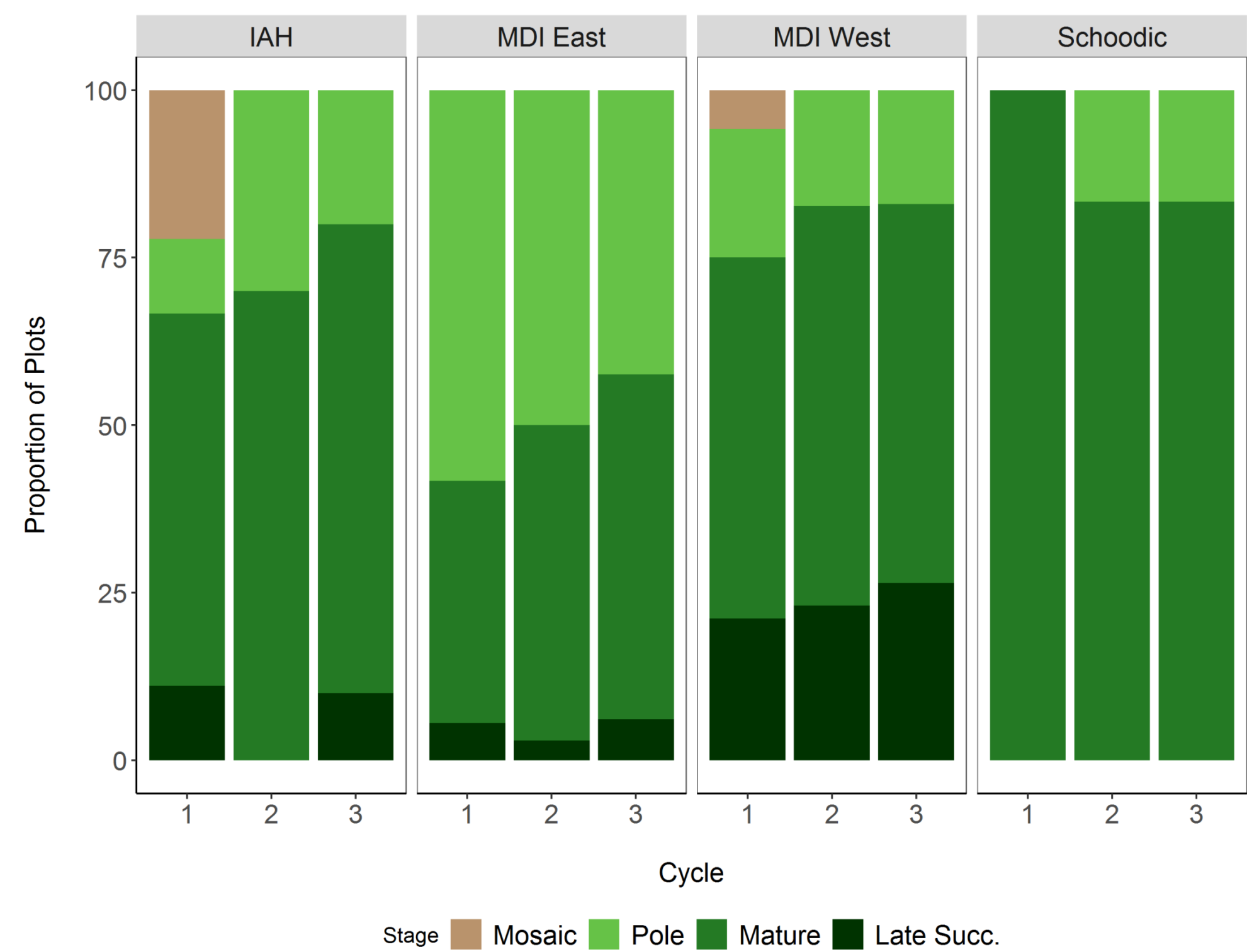


Figure 3. Proportion of plots by successional stage across cycles. Mosaic plots cross multiple stages.

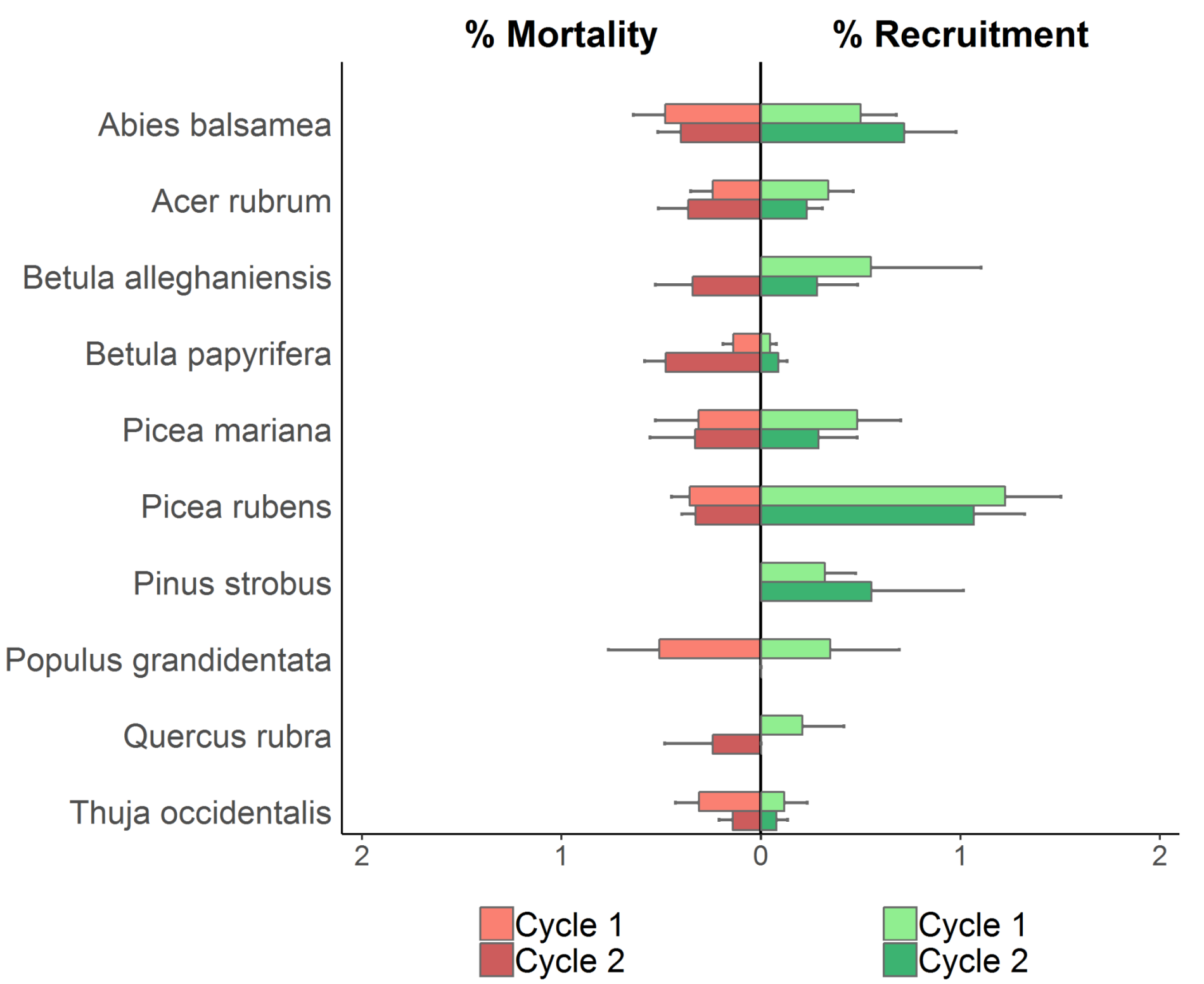


Figure 4. Mortality and recruitment rates by cycle for the most abundant tree species.

Summary of Trends

Overall patterns indicate that forests in ACAD are transitioning into later stages of succession

- Successional trends are strongest on eastern MDI, but signals of succession are evident park-wide.
- Early successional species, such as paper birch (*Betula papyrifera*), are low in abundance or are declining across strata (Fig. 2A-B).
- Shade tolerant species like red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) are increasing in abundance across most forest strata (Fig. 2A-D)
- Red spruce is the most abundant understory, subcanopy and canopy species in ACAD forests, particularly on MDI.
- Proportion of plots in mature and late-succession stages continues to increase over time, especially on MDI (Fig. 3)
- Invasive species are at low levels, and were only found in 5 out of 176 plots.
- Red spruce has the highest recruitment rate, whereas bigtooth aspen (*Populus grandidentata*) has the highest mortality rate (Fig. 4)
- Red pine (*Pinus resinosa*) mortality from red pine scale (*Matsucoccus resinosa*) has been observed in the most recent 4-year cycle, although less than 1% of trees in ACAD are red pine.

As long as stressors and climate change impacts remain low, older forest structure will continue to develop over time.

For more information

NETN forest health monitoring website:
<https://www.nps.gov/im/netn/forest-health.htm>

Kate Miller, Plant Ecologist
kathryn_miller@nps.gov

Camilla Seirup, Forest Crew Leader
camilla_seirup@nps.gov