Factors Driving *Pinus contorta* Invasions in Montana and New Zealand.

Authors: Hannah Funke, Department of Forestry, Salish Kootenai College, Pablo, MT. Bruce Maxwell and Kimberley Taylor, Department of Land and Environmental Science, Montana State University, Bozeman, MT

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INTRODUCTION

Pinus contorta (Lodgepole pine) is a growing problem in the Southern Hemisphere (SH). *P. contorta* has escaped from plantations and is invading native plant communities with the potential to cause significant changes to SH ecosystems. In Montana, *P. contorta*, is a native species with a distribution that may be limited by age to cone maturity, seed predation, fire and germination and emergence habitat qualities (bareground). Our goal was to determine what factors limit *P. contorta* invasivions in the native habitat and SH.

***P. contorta* growth since 1988 in Western portion of Yellowstone National Park in Montana.**

***P. contorta* invasion near Lake Pukaki on the South Island of New Zealand**

METHODS

- 10x10 meter plots were randomly placed along transects established in invaded areas adjacent to *P. contorta* plantations in New Zealand and native stands in Montana. The following measurements were taken per tree within the plot: DBH, basal, height, cones, herbivory evidence and age. Percent cover bareground was estimated in each plot.

Measuring tree in a 10x10 meter plot in New Zealand.

- Seed predation was recorded by using seed sticks. Two seeds were glued to each end of a popsicle stick, then staked into the ground. Seed sticks were placed randomly along a transects in the study area. Seed sticks were picked up after one week and predation of seeds (missing seeds) were recorded.

Seed stick in the field in new Zealand.

Results

- Seed predation rates were higher in Montana than in New Zealand. This can be associated with the lack of natural predators (small mammals) in New Zealand. Mortality and damage from large game animals (such as bison, elk, moose and bear) in Montana was also common, but not observed in New Zealand.
- Bareground was not different in Montana and New Zealand. Although, Montana had a higher percent bareground in grass dominated sites.
- Montana *P. contorta* trees take a longer time to produce cones, compared to New Zealand. The peak cone production in Montana was between 30-41 years of age. The average cone number was 50-60 per tree.
- In New Zealand peak cone production was on trees between 8-15 years of age (i.e. the oldest trees in the invasion). The average cone number was 45-55 per tree.
- The average age of invading *P. contorta* outside of native stands in Montana was between 6-11 years of age.
- The average age found outside of plantations in New Zealand was 7 years of age. No trees were found to be over the age of 25.

Funke (5'3") next to *P. contorta* in New Zealand with impressive leader growth (around 2 m growth in one year).

CONCLUSIONS

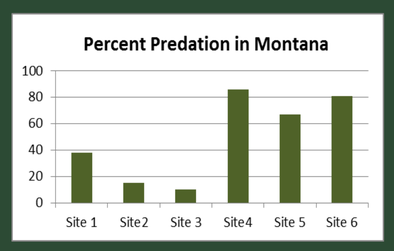
Our preliminary results suggest that *P. contorta* invasions in New Zealand can be best explained by the Enemy Release Hypothesis. New Zealand does not have the natural seed predators or herbivores including damaging agents) common in its' native range. We believe that this is why New Zealand *P. contorta* populations are aggressively invasive. Seeds are being produced at a younger age and bareground availability for germination, may also encouraging invasion potential.

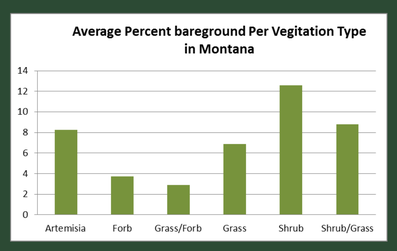
This research can lead to fundamental understanding of plant invasions and subsequent effective management strategies around the world.

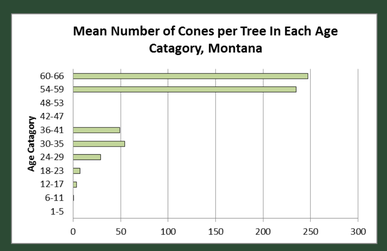
From left to right: (left) Cone litter beneath *P contorta*, Montana. (Right) trunk damage due to animal(s), Montana. (bottom) Cones produced from a young *P. contorta*, in New Zealand.

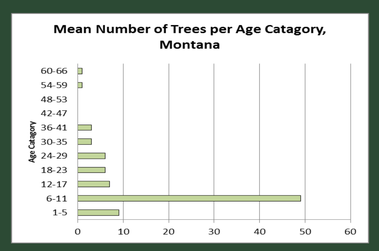
RESULTS

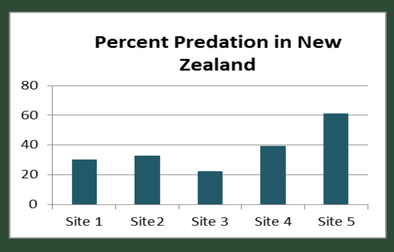
Graphs below represent data collected in Montana and New Zealand. Data is presented from Montana on top and New Zealand data is displayed on bottom.

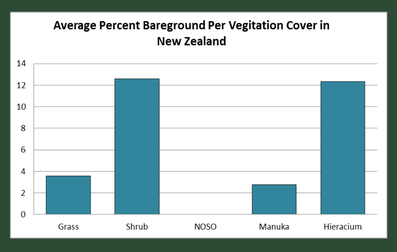


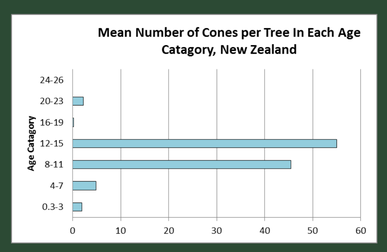


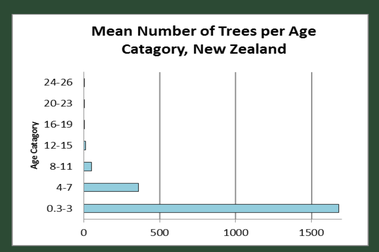












FUTURE WORK

More research needs to be conducted to gather further information as well as new data in other areas of native and nonnative invasions. Other factors such as climate, soil and vegetative data could be analyzed to further assess the drivers of invasion. It is important to understand what drives invasions in order to protect natural ecosystem. It is also important to understand the threat of invasive behavior in management decisions.

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