What are an Individual Maple Seed's Chances of Becoming a Mature Maple Tree?

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Introduction

Maple trees (*Acer saccharum*) are an important component of mixed hardwood forests across E. North America. Maple is a 'mast' species, meaning that it produces large numbers of seeds every ~3-7 years, and very few seeds most other years.[5] This strategy may increase the probability of seedling germination and survival by controlling the impact of seed-eating small mammals such as meadow voles (predator satiation hypothesis).[4] Sugar maple seedlings can then spend many years close to the forest floor until conditions are appropriate (eg. a canopy gap) for them to be released from the seedling bank and begin rapidly growing upwards.[3] For a seedling to successfully develop into a mature tree, it must overcome competition by other maples and the rest of the understory plant community, herbivory, insect and disease damage, light, water, and nutrient availability stresses, and further harm from falling branches and trampling.[1]

Research Questions:

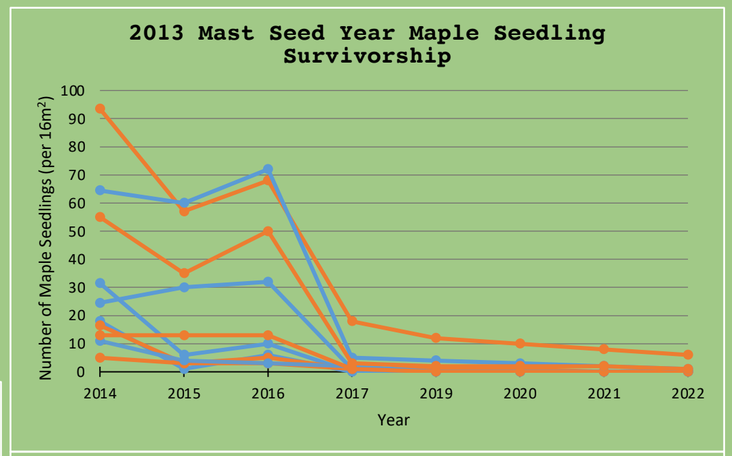
1. What is the decade-long pattern of maple seedling survivorship after masting?
2. Does the presence of deer significantly impact survivorship?

Forest floor of Pangman Tract in 2014 (top) and 2022 (below)

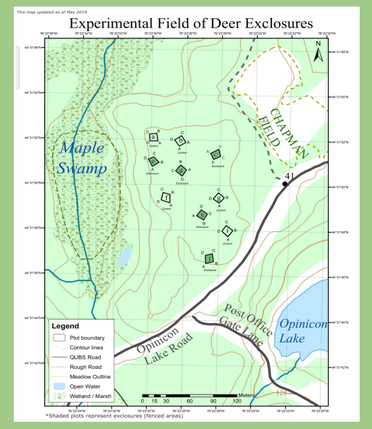
Results

Life Stage	Pangman Tract Data (per 100m^2)	Literature Data (per 100m^2)
Dispersed Seeds		670 – 26,440 [6]
1st Year Surviving Seedlings	208	0 – 1870 [6]
2nd Year Surviving Seedlings	133	23 – 6600 [2,4]
3rd Year Surviving Seedlings	164	1.1 [4]
4th Year Surviving Seedlings	20	0.6 [4]
5th Year Surviving Seedlings		0.6 [4]
6th Year Surviving Seedlings	12	
7th Year Surviving Seedlings	10	0.6 [4]
8th Year Surviving Seedlings	8	1.7 [4]
9th Year Surviving Seedlings	5	
30th Year Surviving Saplings		0.6 [4]
40th Year Surviving Trees		0.5 [4]
50th Year Surviving Trees		0.2 [4]
Mature Tree Abundance	0.1	0.6 [7]

A maple seedling in May 2019 arising from the 2013 mast seed year. Note that in 2014 (initial germination year) a pair of cotyledon axillary buds are apparent distally below the end of the growing season bud scar for the seedling's first true leaves



2014 germinated maple seedling densities over the following 8 years in each of the control (blue) and deer exclosure/fenced (orange) plots (n=5) in Pangman Tract at QUBS. Each datum is the sum of seedling counts in the four (2 x 2m) corners of each plot.



Germinated year 1 maple seedling with cotyledons and first leaves

Methods

Survivorship data have been collected since 2014, the year after a masting event at Pangman Tract, a mature mixed-hardwood forest at QUBS which contains ten 100m^2 plots of similar species composition and terrain. Half of these plots are fenced to keep out deer.

An exclosure plot in Pangman Tract at QUBS

Conclusions

Using Pangman tract data and a literature-based estimate of dense maple seed dispersal after a mast year in a New Hampshire mixed hardwood forest, we estimate that the likelihood of a single maple seed becoming a mature tree is about 1 in 250,000. By analogy, picture the entire population of Kingston… now double it! Only one of this number would succeed! Our analysis implies that there is an extremely slim chance for a seed to reach reproductive age (30+ years) and to significantly contribute to forest regeneration (70-100 years)[5].

This rare long-term survivorship data collected at Pangman, and the fact that deer had no significant impact on maples, provides important insights for understanding maple forest regeneration across Eastern North America.

References

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