8,000 Years of Forests in Maine: A Story Told by the Eastern Hemlock, Sugar Maple, and American Chestnut

Catherine (Cici) Conroy
Bates College, cconroy2@bates.edu

Follow this and additional works at: https://scarab.bates.edu/envr_studies_theses

Recommended Citation
Conroy, Catherine (Cici), "8,000 Years of Forests in Maine: A Story Told by the Eastern Hemlock, Sugar Maple, and American Chestnut" (2023). Standard Theses. 342.
https://scarab.bates.edu/envr_studies_theses/342

This Open Access is brought to you for free and open access by the Student Scholarship at SCARAB. It has been accepted for inclusion in Standard Theses by an authorized administrator of SCARAB. For more information, please contact batesscarab@bates.edu.
8,000 Years of Forests in Maine:
A Story Told by the Eastern Hemlock, Sugar Maple, and American Chestnut

A Senior Thesis
Presented to
The Faculty of the Environmental Studies Program

Bates College
In partial fulfillment of the requirements for the
Degree of Bachelor of Arts

By
Cici Conroy
Lewiston, Maine
19 December 2022
Acknowledgments

I would like to thank Tyler Harper, lecturer in Environmental Studies, for advising me. Tyler provided a flexible structure that allowed me to explore my passions and develop my unique thesis. I would not have been able to compose my ideas without Tyler’s guidance as we worked together to establish a strong theoretical framework. I would also like to thank Jesse Minor for taking the time to travel with me to an old-growth hemlock forest in Farmington, ME. Jesse’s course, “Biogeography”, greatly influenced my thesis and understanding of a vast geologic time scale. We also visited one of the few standing American chestnut trees in the state of Maine, which I am forever grateful for. My work could not have been completed without conversations with Richard Silliboy, Andrew Barton, and other various foresters. I am extremely appreciative of Barton’s book, The Changing Nature of the Maine Woods, as this was crucial in informing my research on the topic. A special thanks to my friends and family who all have to listen to me ramble on about trees.
# Table of Contents

Acknowledgments........................................................................................................... ii

Table of Contents........................................................................................................... iii

Introduction....................................................................................................................... 4

Chapter 1: 6000 BP - 0.................................................................................................... 8
  3500 BP - 0................................................................................................................. 18

Chapter 2: 0 - 2000 AP.................................................................................................. 29
  1600 - 1700.................................................................................................................. 36
  1820 - 1900.................................................................................................................. 41
  1900 - 2000.................................................................................................................. 45
  Present.......................................................................................................................... 49

Conclusion...................................................................................................................... 51

Bibliography................................................................................................................... 55
Introduction

Forests have behaved as dynamic ecosystems since their creation. The Earth’s history is one filled with complex relationships and changing climates which share the intricate nature of how our planet has come to be. The human species today knows the Earth as a perplexing structure that foregrounds our existence, providing resources and necessities that maintain societies and livelihoods. To think locally is to examine the ecosystems that surround our communities and may uphold current townships, cities, and governance. These typically provide various natural resources that local municipalities utilize, while also containing various other living systems that host their own relationships. The Maine forests in many ways have been the backbone of the state’s operations and are eminently recognized for both their economic and cultural value. These forests began adapting and transforming the post-glacial environment thousands of years ago, converting the tundra into a landscape of lush spruce forests. These ecosystems moved throughout time and diversified with varying animal, plant, and fungi species. 8,000 years of a moderately stable climate allowed for the migration and development of foundational tree species which would support the indigenous populations throughout the next thousands of years to come. This history is charged with varying speciations and extinctions, becoming more complicated with European settlement. My thesis works to examine the complex, 8,000 year history of forests in Maine by narrating the story through the voice of the Eastern hemlock, sugar maple, and American chestnut tree. I utilize the framework of big history, arguing that history should be studied at large time scales, ranging from thousands to even millions or billions of years. It encompasses all elements of past histories from the creation of the Earth to the present day. Rather than examining the history of a specific event, civilization, or subjective time period, big history proves that human history lies within a universal structure.
I use this framework, along with concepts from Dipesh Chakrabarty, William Cronan, and various other scholars, to narrate the changing forests and ecosystems in Maine, destabilizing anthropocentrism and evoking empathy towards the planet we share by narrating history from the perspective of trees.

One can examine empathy as “an attempt to get in touch with the experience of the other qua other, or, literally, to feel into the other… to empathize with plants is to recognize in ourselves certain features of vegetal life…”¹ The “ethical relation to vegetal life” is not some absurd application of thought.² To understand the vastness of geologic time is to understand the foundations of plants, fungi, protostomes, and then mammals.

My narration of the changing forests of Maine is not an attempt to project a certain perspective or voice onto trees. It is instead to destabilize the current foundations of how history is told. The

---

² Marder, Michael. June 2012. pp 265
human species is an evolving ancestor from the conditions of the Earth; one supported through millions of years of adaptation and stable climates.

The current climate crisis pits all evolutionary history into one small lens; one that now recognizes humans are geological agents who have resourced the Earth in impressive, exploitative ways within the last few hundreds of years. The atmospheric composition of carbon dioxide has exceeded 400 parts per million in the last decade. The last time our planet felt these conditions was around three million years ago: oceans were 30 feet higher and camels lived in the northern regions of the arctic. Anthropogenic climate change has left unprecedented alterations which will shape planetary conditions for millions of years. To conceptualize this is nearly impossible as we typically imagine history using short, human-centric time scales. Contemporary history typically examines the past 4,000 years of which written records have existed, separating all else into a “prehistory” or “natural history". Without the conjunction of all historical epochs, “it would be difficult to arrive at a secular understanding of why climate change constitutes a crisis for humans”. Exploring the past histories of the Maine woods since deglaciation means examining ancient and current Wabanaki cultures, forest and species interactions, and the eventual reshaping due to colonial entanglements. I recognize the archival silence that is apparent when detailing this history, as written documents were not of value until colonists brought with them their own constructs of knowledge and power.

In defamiliarizing past histories by voicing different ecosystems, I highlight various relations and entangled events between trees and the human species. As a result of colonization

---

5 Ibid.
7 Chakrabarty, Dipesh. 2009. pp 212
8 Chakrabarty, Dipesh. 2009. pp 213
and European expansion, Maine’s landscapes soon transformed into “a form of capital, a thing consumed for the express purpose of creating augmented wealth… [Therefore] the colonists’ economic relations of production were ecologically self-destructive”.  

William Cronan reveals that “we live with their legacy today… Ecological abundance and economic prodigality went hand in hand: the people of plenty were a people of waste”.  

The Maine forests now echo past chronicles of the land. There are few spots of old-growth left, and most are now regrowth stands of young, uniform trees. These woods are now facing the effects of globalization and climate change, being hit with various pathogens, invasives, and suddenly needing to adapt to the warming conditions. The narration of the past 8,000 years of Maine woods, told from the perspective of three tree species, begins at a time when woodlands were first getting their footholds. The next thousands of years to come detail changes in relations, populations, and help us understand what these past histories may tell us about the future of the Maine forests. In utilizing big history as a framework for understanding Maine’s past forests and their current trajectory with climate change, my narration works to illustrate the intricate symbiosis between humans and the forests, foregrounding the agency of these extraordinary landscapes.

---

Chapter 1

6000 BP - 0

Eastern hemlock

When the last glaciers of the northeast receded, our species began to populate and migrate throughout the forested ecosystems of the east coast. Our family lives wherever there is moist, fertile soil. When seeds of our kind are first evolving into saplings, the young Eastern hemlock thrives in the shady understory, where we supply our offspring with nutrients and care beneath the soil. Our saplings and seedlings vary in age since we are a patient, slow-growing species. If we do not meet the light requirements, which is common in our shady canopy cover, our species can remain as a tiny growth on the forest floor. Once sunlight does reach our trees, our growth is immense. We later turn into wooded giants that can live for over 500 years. Still, when we get the opportunity to live next to red oak, maple, and black birch, we grow and mature two to three times slower. Our slow growth is never something that has bothered us. It is through our leisure that we do not have to exhaust water and nutrients from our forests. Since we do not thrive in dry, hot climates, we choose to shut our pores during the warm summer months. Intense heat and drought create great stress in our species, so we inspire carbon during other seasons.

---

15 Foster 2014, pp 15
16 Ibid.
17 Hemlock Restoration Initiative, editor.
18 Foster 2014, pp 17
19 Ibid.
20 Foster 2014, pp 17
21 Foster 2014, pp 15
The Eastern hemlock despises heat to such an extent that the forests we create can be 10-15°F cooler under our thick, coniferous canopy.\textsuperscript{22} The dark, needle-woven floor is home to other species that can tolerate the lack of sunlight. We communicate underground with “partridgeberry, wintergreen, Canada mayflower, wood sorrel, and the saprophytic Indian pipe”.\textsuperscript{23} The only other tree species that seem to enjoy our shady environment as much as our species are red spruces, sugar maples, and American beech, creating a cohesive mosaic of species and soil networks.\textsuperscript{24} This attracts salamanders, red efts, mites, and other insects that provide an essential food source for many different songbirds.\textsuperscript{25} Spend time under our canopy in the spring, and one will enjoy the calls of black-throated green warblers, Acadian flycatchers, blackburnian warblers, and hermit thrushes.\textsuperscript{26} Come winter, you will find grouse, owls, and hawks nesting and hunting within our branches.\textsuperscript{27}

\textbf{Figure 1: Contrast of Eastern hemlock forest and beech-oak forest in Albany, NH}

\textsuperscript{22} Foster 2014, pp 13
\textsuperscript{23} Foster 2014, pp 19
\textsuperscript{24} Ibid.
\textsuperscript{25} Ibid.
\textsuperscript{26} Foster 2014, pp 20
\textsuperscript{27} Ibid.
We have occupied this northern region for the past 2,000 years. Our elders lived in the Southern Appalachian mountains, where we first began our 900-mile journey northward. We migrate in ways different from animal species. We do not have legs, wings, or any amount of speed when it comes to our migrations, but our seed dispersal and germination are perspicacious. If our seeds land in areas with warm summers, cold winters, precipitation, and moist, fertile soil, we will find a way to call the environment home. 5,000 years later and the Eastern hemlock thrives in the northern hardwood forests.  

Rumor has it that a tundra landscape dominated the northern region before glaciers moved into this region. The land was treeless and cold, not suitable for species of our kind. Glaciers formed and danced across the region, transforming the soil and land composition. Thousands of years later, the Laurentide Ice Sheet melted and the tundra landscape “was invaded by northern boreal species - spruce larch, and birches. With further warming, white pine followed, and then came the temperate tree species, including hemlock”.

American beech, a strong member of our wooded community, did not join our forests for another 2,000 years. Our northern migration allowed us to adapt to the changing landscape and familiarize ourselves with white pine.

The climate slowly grew warmer and drier, pushing foundational tree species northward. We still feel spruce in our forests. The environment is now more suited for species that can tolerate warmer temperatures and occasional droughts as the land portrays these once dominant glaciers as a relic. We are beginning our slow farewells to species like the red spruce, especially in our southern regions. Our population interacts with diverse plant and animal species. As we
mature we drop our branches to the forest floor and create a wide-open domain, a welcoming aperture that allows humans and animals to wander underneath our canopy. Our soil food webs develop ectomycorrhizal and arbuscular mycorrhizal fungi, where we share information and nutrients.\textsuperscript{31} The fruiting bodies of our networks are vast, providing medicine and edibles for our forest friends.

\textit{Sugar maple}

Our species is abundant throughout the northeastern coast. We survive in cool, moist climates, requiring freezing winters and warm, wet summer seasons.\textsuperscript{32} Once our seedlings receive appropriate sunlight, which can take years under our shady canopy, we send deep roots into the soil and grow at an extremely accelerated rate.\textsuperscript{33} The northern hardwood forest becomes our permanent home as we were quick to populate after glaciation. Sugar maple communities typically involve American beech, red maple, yellow birch, red spruce, and hemlock.\textsuperscript{34} Beneath our canopy, we support countless amounts of understory vegetation, including ferns, starflower, partridgeberry, foamflower, whorled wood aster, Indian cucumber-root, Jack-in-the-Pulpit, hobblebush, striped maple, and dogwood.\textsuperscript{35} Our soil interactions with each plant is unique.

Ever since our speciation into the region, sugar maples have constructed homes and habitats for many different animal species. Our leaf litter and bark is a crucial edible for white-tailed deer, moose, hares, squirrels, and porcupines.\textsuperscript{36} Songbirds enjoy our seeds, buds, and

\textsuperscript{33} Ibid.
\textsuperscript{34} Ibid.
\textsuperscript{35} Ibid.
\textsuperscript{36} Ibid.
flowers for food, and branches for nesting sites. Our other wooded neighbors recognize and enjoy the sentience we initiate in the forest.

Sugar maples store starches and sugar as we go dormant for the winter months. Anytime the temperatures dip below freezing, our trees suck sap through pores that connect our trunk to our roots. All hardwood trees have four longitudinal cell types acting as canals. Unlike other tree species, our dead wood fiber cells are filled with gas which forms frost as the cells freeze. Once the winter months come to an end and temperatures rise above freezing, sap trickles down our trunks. The sap ebbs and flows within our trunk, roots, and limbs as temperature varies. “In the daylight, pressure exerted from the work of [our] leaves pulls sugared water up [our] trunk — through the xylem that carries the starch that [we] stored in [our] roots last summer and fall — and up to [our] leaves as they photosynthesize. [We] inhale and exhale. [We] drink in sunlight”. During the spring and summer seasons, sugar maple trees are busy creating food through our leaves. The chlorophyll that gives us our deep green foliage absorbs energy from the sun. The sun gives us the energy required to transform water and carbon dioxide into sugar and carbohydrates. As soon as our first buds form, leaves begin this process. Carbon dioxide soon runs through our bodies, feeding our trunks and supplying our forested children with nutrients. As the sun begins to rise later and set earlier, our chlorophyll breaks down. Carotenes,

37 Ibid.
39 Ibid.
40 Ibid.
41 Ibid.
42 Ibid.
44 Ibid.
xanthophyll, and red anthocyanin pigments present themselves instead, constructing a warm blanket of red, orange, and yellow hues throughout our canopies.\textsuperscript{46} Our forested neighbors display other shades of fall tones due to the varying amounts of chlorophyll and other pigments, forming a uniquely warm, variegated landscape.

Sugar maple seeds are pollinated and dispersed by wind, making our long journey northward fairly effortless. The samara, our winged seeds, drop in late summer.\textsuperscript{47} Sugar maple trees do not drop seeds until they are about 30 to 40 years old, typically dropping to the forest floors in late summer and early fall. Our roots connect us to varying species beneath the soil. We typically communicate through arbuscular mycorrhizal fungi, which help us transfer nutrients and fight environmental stressors common in forested ecosystems.\textsuperscript{48} If our forests encounter severe droughts, heat, or floods, these fungal pathways that bond our roots through a common mycorrhizal network will come into action.\textsuperscript{49} We can exchange phosphate, nitrogen, simple carbs, sugars, and enhance our photosynthetic rates with the help of our fungal friends.\textsuperscript{50} This is how we look after our forested family.

Our distribution varies across Maine, as we become less frequent in the northern regions. Sugar maple prefers moist climates with cool winters and relatively warm summers, which Maine has supplied since the outmigration of glaciers. Over the past few thousand years, our soils noticed a change in wooded neighbors throughout these northern forests. We have witnessed lake levels dropping as the summer months slowly become warmer, and trees migrating to higher elevations in areas where spruce once composed the forest composition.\textsuperscript{51}

\textsuperscript{46} Ibid.
\textsuperscript{47} Wild Adirondacks, editor.
\textsuperscript{49} Costanzo, Nadine, et al. Mycorrhizas and sugar maples: the impact of pollutants. Concordia University.
\textsuperscript{50} Begum et al. 2019.
The once dominant red spruce now dwindles in population, gradually being replaced with white pine and oak in southern and central Maine.\textsuperscript{52} Eastern hemlock, American beech, and yellow birch later joined this northern migration as precipitation rose. Our roots understand that these areas once held amounts of charcoal in the sediment, signifying a reduction in fire frequency throughout Maine’s forests.\textsuperscript{53} The transition from spruce “was driven by higher temperature, drier conditions, and a resulting increase in lightning-caused wildfire”.\textsuperscript{54}

There are rumors that one continental tree species has gone extinct.\textsuperscript{55} Although climates change slowly, some species have difficulty adapting. Some may not have strong seed dispersals that migrate with the velocity needed, either not finding the climate they can prosper or not locating the particular soil conditions necessary for seedling nourishment. Tree species may go extinct due to pathogens, insects, or other ecosystem disturbances. Still, this seed migration has occurred for millions of years, resulting in the speciations and extinctions of thousands of different trees.

\textit{American Chestnut}

We moved into Maine in the last few hundred years, joining the forested elders of Eastern hemlock, white pine, maples, beech, birch, spruces, and many other species that compose the northern hardwood forests. The pioneer species were able to grow throughout the “undeveloped soil, [with] scarce nitrogen vital to plant growth, little anchorage for roots, and stark exposure to the vagaries of weather”.\textsuperscript{56} First, the state supported low tundra vegetation, eventually providing\textsuperscript{52,53,54,55,56}

\textsuperscript{52} Ibid.  
\textsuperscript{53} Ibid.  
\textsuperscript{54} Ibid.  
\textsuperscript{56} Barton, Andrew M., et al., 2012. pp 29
enough support for spruce, aspens, and white birch.\textsuperscript{57} This initial ecosystem “slowly built up the soil through weathering, trapping of wayward particles, and the transformation of living matter into soil organic matter generation after generation.”\textsuperscript{58} This primary succession gave way to conditions suitable for the American chestnut, allowing us to become one of the great foundation tree species on the east coast.

The genus Castanea is thought to originate in Laurasia, the northern supercontinent that separated from Pangea around 200 million years ago. Before the split, Maine was “at a latitude of 5 degrees north and longitude of 0 degrees. If you went to that intersection today, you’d be in Africa, in Ghana.”\textsuperscript{59} 70 million years later and Pangea breaks into Laurasia and Gondwana. We have heard that other regions of the globe now have different varieties of the chestnut tree, meaning we share distinct homologies. This includes similar flowers, leaves, nuts, bark, and appearance. The cladogenesis of the chestnut species created unique nut-bearing trees throughout the northern hemisphere, leaving the American chestnut to speciate across the eastern coast of North America.

Our species does not do well in cold climates or extreme heat. Low temperatures are a challenge for us, which greatly limits our range throughout Maine. Although we would like to someday join the forests in the north, we are restricted to southwestern regions. The American chestnut has high water requirements, thriving in well-drained soil. Other than being restricted to moderate climates and certain soil compositions, we are typically understood as ecological generalists.\textsuperscript{60} We are fast-growing trees, reaching heights well above 100 feet. Some of our

\textsuperscript{57} Barton, Andrew M., et al., 2012. pp 29
\textsuperscript{58} Barton, Andrew M., et al., 2012. pp 29-30
relatives in the south are said to grow trunks more than ten feet wide, although our average diameter is around five to eight feet.\textsuperscript{61} Our leaves have sharp, serrated edges that make our foliage distinct from the other canopy trees. When the cold winter months end, we emit yellow flowers in June and July. The American chestnut depends on other neighboring chestnuts to pollinate, which eventually creates our burly nuts. Our catkins will disperse pollen from male flowers. The tree's hope is that the catkin pollen will settle in the flowers of a nearby tree and the female flower will transform “into a spiny capsule called a bur that contains three nuts. Every autumn, the plentiful burs… open up and nuts… fall to the ground, feeding wild turkeys, passenger pigeons…, blue jays, black bears, deer, raccoons, squirrels, and chipmunks”\textsuperscript{62}

![Catkin and burr from an American chestnut tree. Bonney Woods, Farmington, ME.](image)

Our forest bodies form intricate root systems throughout the soil, connecting our species through ectomycorrhizal fungi.\textsuperscript{63} The soil beneath our trees is extremely nutrient dense due to our falling leaf litter, containing “more nitrogen, phosphorus, potassium, and magnesium than other trees”.\textsuperscript{64} When trees supply mushrooms with sugars, the fungi increases the absorption of water and other nutrients.\textsuperscript{65} This symbiotic relationship has been crucial in chestnut forest

---


\textsuperscript{62} Hale, Dan. 15 Feb 2021.


\textsuperscript{64} Hale, Dan. 15 Feb 2021.

\textsuperscript{65} Ibid.
development and speciation. The passage of nutrients through fungi ensures our saplings will
grow alongside their parent trees, as well as supporting other forest species underneath the earth.

The Late Archaic period slowly comes to an end. This time of “deep interglacial warming
called the Hypsithermal period” allows for the Gulf of Maine to reach high levels of biological
productivity.\textsuperscript{66} This led to an expanse of marine populations that became crucial in supporting
Wabanaki communities.\textsuperscript{67}

On land, this mid-Holocene climate amelioration allowed southern vegetation zones to
invade and supplant the northern types… These forests contained new and important
resources for the ancient Wabanakis, especially walnut, [chestnut], oak, and hickory, trees
that produced edible nutmeats, as well as increased populations of more southerly
animals, such as gray squirrels and deer.\textsuperscript{68}

We experience populations exploding in “numbers, sizes, and complexity of sites in the interior
of Wôbanakik… This may coincide with the penetration of hardwoods into the area, as indicated
by the pollen data, and the probable expansion of animals that this would have supported”.\textsuperscript{69} If
humans come into forests and cut down forested bodies, perhaps using the wood for fires and
other projects, then natural succession will support the development of fruit and nut trees.\textsuperscript{70} This
“fuelwood procurement, in and of itself, selectively opened up relatively large tracts of
Wôbanakik forest… [as] a more open canopy produces much more edible biomass than stressed,
crowded, closed-canopy conditions”.\textsuperscript{71}

\textsuperscript{66} Wiseman, Frederick Matthew. Reclaiming the Ancestors: Decolonizing a Taken Prehistory of the Far Northeast.
\textsuperscript{67} Ibid.
\textsuperscript{68} Wiseman, Frederick Matthew, 2005. pp 136-137
\textsuperscript{69} Wiseman, Frederick Matthew, 2005. pp 144-145
\textsuperscript{70} Wiseman, Frederick Matthew, 2005. pp 151
\textsuperscript{71} Ibid.
As human populations grow, nut bearing trees like ourselves begin to appear and prosper in areas near settlement and homes. There is an increase in crops, such as the Wabanaki squash, Penobscot Pumpkins, groundnuts, and an abundance of birch, basswood, maple, plum, and cherry trees. These trees support different needs including shelter, containers, bark canoes, inner bark, sap, and splints for basket making. If one needed firewood, they would need to travel further into different forested regions. As these forests continue to support the surrounding communities, they become more open and filled with light, resulting in fruit and nut trees producing food on their lower branches. The Wabanaki influence these plant communities, forming symbiotic relationships between plants and people. These “anthropogenic forests… encouraged deer, grouse, turkey, raccoons, and other animals… [bringing] people and animals into a new complex proximity where ecosystem management… [becomes] systematic”.

3500 BP - 0 AP

Eastern Hemlock

Our species vanishes. We do not disappear from the landscape, but we fail to send shoots above the ground. Our roots remain embedded beneath the forest floors, not growing or maturing, but still existing. Many hypothesize this near extinction event is caused “by a virulent pathogen or a massive insect outbreak that killed most individuals”. There is speculation that

---

72 Wiseman, Frederick Matthew, 2005. pp 153  
73 Ibid.  
74 Ibid.  
75 Wiseman, Frederick Matthew, 2005. pp 154  
76 Ibid.  
77 Barton, Andrew M., et al., 2012. pp 36
the hemlock looper, a native North American moth, inflicted severe harm by damaging needles.\footnote{Home and Garden IPM from Cooperative Extension, editor. "Hemlock Looper." The University of Maine, extension.umaine.edu/home-and-garden-ipm/fact-sheets/common-name-listing/hemlock-looper/. Accessed 3 Nov. 2022.} Areas with high populations of the hemlock looper can kill an entire tree by eating away at the needles in just one season.\footnote{Home and Garden IPM from Cooperative Extension, editor.} Our decline may also have been a result of changing climates.\footnote{Hessl, A., & Pederson, N. 2013. Hemlock Legacy Project (HeLP): A paleoecological requiem for eastern hemlock. Progress in Physical Geography: Earth and Environment, 37(1), 114–129. https://doi.org/10.1177/0309133312469218} Decrease in precipitation makes our species extremely vulnerable. Although the past few thousand years have produced warm, stable climates, a lack of water supply is detrimental to the Eastern hemlock. With drought being common throughout the northeast, our species endures great stress. Once drought and pathogens mix together, the Eastern hemlock faces extraordinary loss.

The thing with trees is that we usually never face complete extinction. We are the only known tree species that have faced a population crash during the early Holocene, yet our roots ground us in soil networks.\footnote{Barton, Andrew M., et al., 2012. pp 37} The other forested neighbors recognize our disappearance, feeling our rhizomes beneath the littered floor. We are certain that the maples, beeches, white pine, spruces, and understory flora miss our presence. The removal of a foundation species causes the reconstruction of forest compositions. The Eastern hemlock creates dark, cool woods supporting unique relationships with ants, salamanders, fish, and other shade-loving species.\footnote{Ellison, A.M., Barker-Plotkin, A.A., Foster, D.R. and Orwig, D.A. 2010. Experimentally testing the role of foundation species in forests: the Harvard Forest Hemlock Removal Experiment. Methods in Ecology and Evolution, 1: 168-179. https://doi.org/10.1111/j.2041-210X.2010.00025.x} These bonds are lost as we recede from the forests. It will take us another 2,000 years to return to the northeastern woods, never returning to our “pre-decline levels”.\footnote{Foster, David R., editor. 2014. pp 58}
The Eastern hemlock will miss our human companions the most. These are the populations who tramp through our forest floors, observing the beautiful ecosystems we support. Our forests provide various medicinal benefits and delicious edibles. We often support the growth of gold thread, a low-growing evergreen that treats a soreness of the mouth, heals eye sores, thrush, and can be used as a tonic. The Eastern hemlock holds other unique properties. Our needles are especially rich in vitamin C, similar to white pine and other evergreens. In case of emergency, our inner bark makes for an adequate survival food. It can be eaten and chewed raw, boiled, or dried and ground into flour for baking. When our forest bodies begin to decompose, decaying hemlock bark supports the fungal growth of Ganoderma tsugae, or the hemlock reishi mushroom. This common shelf fungus is “widely distributed throughout the world, from the Amazon through the southern regions of North America and across much of Asia”. The saprophytic mushroom can also establish a host on decaying oak, elm, and beech. When our trunks decay, hemlock reishi “acts as an opportunistic infection, springing into action only when the host tree is stressed or diseased from other causes”.

---

87 Stamets, Paul. 2005, pp 233
88 Stamets, Paul. 2005, pp 234
Ganoderma tsugae, also known as hemlock reishi, growing on the rotting body of an old Eastern hemlock. Bonny Woods, Farmington, ME.

The ebb of the hemlock comes at a time when the climate grows colder. There is a slight expansion southward of boreal forests shortly before and after our vanishment.89 Hardwood forests become more frequent at this time, increasing populations of beaver and muskrat.90 This influences human populations throughout Maine, providing greater rodent populations which supply “native peoples with a highly productive resource”.91

2,000 years is not a long breadth of time for a tree species. With a slow and steady return, hemlock-beech-birch forests will occupy most of Maine once again.92 The Eastern hemlock has watched robust glaciers recede inch by inch, leisurely transforming glacial environments to eventually be taken over by forests and animals. Trees understand that life on this planet is complex, moving at time scales that are near incomprehensible. The Earth moves on, and we will slowly return once again.

89 Wiseman, Frederick Matthew, 2005. pp 167
90 Barton, Andrew M., et al., 2012, pp 44
91 Ibid.
92 Barton, Andrew M., et al., 2012. pp 37
Sugar maple

When a member of our community is removed, forest species are left feeling their loss. Eastern hemlock participates in mycorrhizal fungi networks that support other species in our ecosystems. Although this loss is not detrimental to the nourishment of plants, it is quite sorrowful to lose such a unique evergreen that participates in the dark forest tessellations. Still, the sugar maple continues on, understanding the Eastern hemlock will soon return to the northeastern woods..

Our love for the human species is pronounced. Although we rely on the sweet sap of the sugar maple tree for food, our favorite use of the saccharine liquid is through human consumption. There is a story among the Algonquin people that our maple syrup was once easily accessible:

*Gitchee Manitou made things so that life was very easy for the people. There was plenty of game and the weather was always good and the maple trees were filled with thick sweet syrup. Whenever anyone wanted to get maple syrup from the trees, all they had to do was break off a twig and collect it as it dripped out.*

Manabozho went to see how the people were spending their time. He traveled to a village and found no one.

*[They] were in the grove of maple trees near the village. They were just lying on their backs with their mouths open, letting maple syrup drip into their mouths... Manabozho went down to the river. He took with him a big basket he had made of birch bark. With

---

this basket, he brought back many buckets of water. He went to the top of the maple trees and poured water in, so that it thinned out the syrup. Now, thick maple syrup no longer dripped out of the broken twigs. Now what came out was thin and watery and just barely sweet to the taste.94

The goal was to make the maple syrup difficult to harvest. Manabozho claims:

When people want to make maple syrup they will have to gather many buckets full of the sap in a birch bark basket like mine. They will have to gather wood and make fires so they can heat stones to drop into the baskets. They will have to boil the water with the heated stones for a long time to make even a little maple syrup.95

This creation story emphasizes that trees “give us maple sap and other gifts such as wood to build with and to burn for heat; beauty… a place to find solitude; shade… When you stand on the floor of an ancient forest there is a timeless, cathedral-like feeling”.96 The humans that interact with our forests wait “for the preparation of Pkwamhadin (gathering maple sap) [to] start when winter temperatures rise above freezing during the day, and fall below freezing at night”.97

Spiles of cedar and slippery elm are inserted into a diagonal laceration below the bark layer. It is from these cavities that our sap will steadily cascade into birch bark buckets.98

…

The practice of tapping our trees will continue for thousands of years. Being relatively new to the landscape, we have long witnessed the first settlements of Paleoindian migrations into this area. The populations now permanently occupy our lands, establishing different bands and

94 Ibid.
95 Ibid.
98 Ibid.
cultures throughout the region. As forest composition changed, so did the hunting techniques and settlement patterns. The warmer, altithermal period that allowed for temperate forests to advance northward concluded the last years of the Paleoindian lifestyle. The climate grew stable and the ocean receded. Our species ebbs and flows alongside our human companions.

The sugar maple tree provides other edibles, quite different from our sugary sap. While we can occasionally host reishi mushrooms, similar to our hemlock neighbors, our rotting bodies typically support Ganoderma applanatum, or Artist's Conk. These perennial polypores “can live for 40 to 50 years, perhaps longer. Its spores fall from the pores on the underbelly of the conk; due to electrostatic and thermal differentials, many of the spores float upward to settle on the top of the cap…” This is the third largest mushroom in the world. We tend to interact with this fungi in old-growth regions; forested areas that have been left moderately undisturbed for hundreds, even thousands of years: “Given its widespread range and perennial nature, this species can be seen as one of the sentinels of the forest ecosystems, and a fantastic recycler of dead trees”. The Artist’s Conk is thought to be an “effective… antimicrobial agent and immune enhancer; for these reasons, it can be said that G. applanatum serves as a steward not only for the ecological health of woodlands but also for improving the health of their human inhabitants”. With the help of fungi and other forest fauna, our species has come to prosper throughout Maine. Both the unique properties of our trees and the fungi we support validate our altruism towards the human species. As human populations grow and settle, we continue to flourish alongside one another.

99 Barton, Andrew M., et al., 2012. pp 45
100 Wiseman, Frederick Matthew, 2012. pp 83
101 Ibid.
102 Stamets, Paul. 2005, pp 229
103 Ibid.
104 Stamets, Paul. 2005, pp 231
105 Stamets, Paul. 2005, pp 232
American Chestnut

Eastern hemlock populations declined and areas of intensely shaded forests decreased. The near-extinction of the hemlock comes at a time where our distribution throughout the state begins to grow. The lack of dark forests allow our species to prosper. This is a slow increase, as we do not advance with the same breadth of time as animals or other plant species. Plant diffusion and speciation “profoundly questions assumptions, deeply embedded in [certain] culture[s], about the degree to which nature is governed by timeless laws that maintain long-term stability in natural communities…” 106 Our assemblages are “unique combinations of temperature, precipitation, and seasonality with no modern counterpart” 107 We are not a dominant species here in Maine. The American chestnut composes a large extent of the canopy throughout the Appalachian region, yet our northern range is sparse when compared to other dominant trees.

106 Barton, Andrew M., et al., 2012, pp 46
107 Ibid.
Fire and other disturbances aid in our distribution. We sprout from old stumps and grow vigorously after land has been impaired. Our catkins are highly flammable, increasing the likelihood of wildfire. Species such as spruce and fir are not well adapted to frequent fires, creating room for white pine, birches, aspens, oaks, and chestnuts to extend their ranges. With our range slowly expanding, human interactions grow more frequent.

Our catkins contain nuts which are an important food source for all organisms that wander beneath our canopies. Humans can dry our nuts and use them in flour, bread, soups, or roasted and eaten whole. Since each tree releases a high number of catkins to the forest floor, our foragables are easily accessible in autumn just after the first frost. The beds of catkins can be inches deep in chestnut forests. Our nuts can then be stored as a protein-rich snack throughout the winter months, which have proved to be a crucial food source for Paleoindians.

108 Barton, Andrew M., et al., 2012, pp 36
American chestnut leaves contain high tannin profiles and amounts of vitamin k, which can be dried and used in teas to treat respiratory ailments and whooping cough.\(^{111}\)

Our gifts to humans and animals are reciprocal. Our human companions benefit from all parts of our above-ground bodies, as they provide us with life and movement in our forest floors. We sustain our offerings and forest bodies through the ectomycorrhizae networks underground, a different sort of communication that bodes unique forest offerings.\(^{112}\) The American chestnut supports the fruiting bodies of truffles, porcinis, chanterelles, Caesar's mushroom, and Russula mushrooms.\(^{113}\) The fungi increase the “uptake of nutrients such as nitrogen, potassium, and phosphorus” which is frequently deposited in the bed of the forest through leaf litter, fecal waste, and decaying parts of other plants and animals.\(^{114}\) Humans have evolved with the forest; we are one common ancestor.

The “ectomycorrhizal root tips tend to grow short and thick, branch dichotomously, and may have vegetative fungal elements (hyphae) wrapped around the root”.\(^{115}\) Our communication with other plants and trees is typically limited to the types of fungal networks they work within. Since oak and beech trees participate in the same networks, we can exchange nutrients and support different fruiting bodies beneath our canopies.\(^{116}\) Still, there are exceptions in these networks as each tree and sapling can form distinctive mycorrhizal relationships that correspond with individual needs.

Hundreds of thousands of years continue, and the climate continues to support our species. The American chestnut gradually wanders throughout landscapes year by year through

\(^{111}\) Ibid.
\(^{113}\) Ibid.
\(^{114}\) Ibid.
\(^{115}\) Palmer, Jonathon. The American Chestnut Foundation
\(^{116}\) Ibid.
wind-dispersed pollination and varying seed distributions. Our cathedral-like trunks create unique ecosystems in the forests, leaving an expansive forest floor for all species to enjoy. We continue to grow in numbers and expand our families. We interact with other plants, animals, and humans; all understand we are interdependent.
Chapter 2

0 - 2000 AP

Eastern Hemlock

Our reemergence to the forest is celebrated. Species we once cohabitated with now rejoice at our return, networking through the mycorrhiza and interacting with our shaded forest floors. Our species will never quite return to the population levels before our disappearance. This would take thousands of years of regrowth and seed dispersal, something that previously occurred after generations of moving into post-glaciated land.

![Ganoderma lucidum, or red reishi, fruiting from a rotting stump. Camden, ME.](image)

Eastern hemlock growth brings about a new relationship with humans. The populations we once knew have developed new trade routes, technologies, cultural practices, and ways of forest management.\(^\text{117}\) Still, the generations of our old friends seek out all that our hemlock ecosystems provide: edible and medicinal mushrooms, firewood, insolation from our needles,

tanning properties from our trunks, and many different medicinal properties from our bark, branches, and needles.

The forest composition we create through gradients of shade-loving species, such as beech, maple, and birch, ever so slowly returns to the landscape. Spruce, our cold-loving neighbor, begins to dramatically increase in population as the climate grows slightly cooler. This pushes the species further inland throughout the state.\footnote{Barton, Andrew M., et al., 2012, pp 46} While this shift occurs rapidly in vegetative migration, mammals and other short-lived species will likely not notice a great change in their lifetime. The movement of spruce forests will come to occupy land composed predominantly of beech and hemlock, creating more frequent interactions between our species than ever before.\footnote{Ibid.} This new forest comes “at the expense of hardwoods, increasing the ratio of moose to deer.”\footnote{Ibid.} This strongly influences human relations with the land as a greater amount of protein-rich food is provided throughout the ecosystems. Around 500 AP there are “very modest declines in temperature… as well as apparent increases in moisture availability, indicated by lake level rise”.\footnote{Ibid.} Spruce has always been abundant along the coastline, hosting refugia that “provided the source for the eventual upsurge in the interior”.\footnote{Ibid.} This shift in forest composition will persist as a “unique combination of tree species, a mixing of southern and northern elements… sandwiched between two massive global biomes, the temperate deciduous forest to the south and the boreal forest to the north”.\footnote{Ibid.}
Sugar maple

We have interacted with the Wabanaki in this area for the last 9,000 years now, building our relations as generations grow.\textsuperscript{124} The ancient seasonal visitors traveled northward to hunt and fish during the summer months.\textsuperscript{125} Our interactions grew more frequent as time went on:

Prior to the adoption of agriculture, the [Wabanaki] People lived in units best described as nomadic family bands. The bands associated with a particular watershed may have gathered together at various times of year to share seasonal resource, trade, or socialize…

With the adoption of agriculture, family bands learned to come together and share the work associated with the clearing of land, planting, harvesting, and preserving the produce for winter.\textsuperscript{126}

The sugar maples are told of the various agricultural sites near our forests. These plots are typically around hundreds of acres of “fertile flood-plains along our river banks”.\textsuperscript{127} The populations and sites expand, shift, and behave with our environment. Different areas hold different conditions for growing crops. To the south and west of Androscoggin county, there are “longer growing seasons and deeper soils to support crops. To the east, they did not attempt any serious agriculture. In the Androscoggin, Kennebec, and Saco watersheds, their crops had perhaps a 50-50 chance of maturing to produce a food resource”.\textsuperscript{128} Crops typically consist of corn, beans, squash, and tobacco, as tobacco is used in ceremony and medicine.\textsuperscript{129,130} The Wabanaki used clay pottery for cooking, food storage, and hollowed stones to grind wheat and

\textsuperscript{124} Ne-Do-Ba, 2003, pp 3
\textsuperscript{125} Ibid.
\textsuperscript{126} Ne-Do-Ba, 2003, pp 4-5
\textsuperscript{127} Ne-Do-Ba, 2003, pp 5
\textsuperscript{128} Ibid.
\textsuperscript{129} Ne-Do-Ba, 2003, pp 5-6
\textsuperscript{130} Silliboy, Richard. Videoconference interview with the author. 27 Oct. 2022.
corn. We are told that our neighbor, the birch tree, has recently been utilized to make canoes. Ash trees are used for basket making, which are crucial in times of harvest. With our sap being an important reserve, the Wabanaki continue tap our trees seasonally, bearing delicious maple syrup.

*American Chestnut*

When lands are burned or disturbed, either by climatic forces or human influences, the American chestnut will quickly recover and come to dominate much of the disturbed land. Being an ecological generalist, and given that our northern range ends in the state of Maine, our species populates the southern areas where winters are not as biting. The chestnut is not dominant in forest canopies in this area, yet our populations still thrive, providing edibles to the Wabanaki and other woodland animal communities.

We photosynthesize homogeneously to all wooded bodies. We are a part of the deciduous tree family, meaning we drop our leaves with the fall seasons and regrow buds with the return of prolonged exposure to sunlight. Once our leaves sprout, photosynthesis begins. Carbon dioxide enters through the stomata as the chloroplasts inside of the cells absorb sunlight, making Adenosine Triphosphate. This charges the electrons in the chlorophyll, leaving free space “for the electrons of the hydrogen atoms inside the water molecules, which become attracted to the chlorophyll”. Chlorophyll, found in the chloroplasts within our leaves, contains carbon,

---

131 Ne-Do-Ba, 2003, pp 5
132 Ne-Do-Ba, 2003, pp 6
135 Ibid.
137 Ibid.
hydrogen, oxygen, and nitrogen atoms.\textsuperscript{138} The chloroplasts absorb carbon dioxide from the air, using sunlight as energy, and turn the CO\textsubscript{2} into sugar. Water molecules, which are transported from the roots, break apart their oxygen atoms, protons, and electrons and form free oxygen, then releasing the O\textsubscript{2} into the atmosphere through the stomata.\textsuperscript{139} The efficiency of this process is dependent on several factors, changing throughout seasons or with water availability. This process occurs within every plant, shaping the Earth and its organisms into its existence.

We breathe in harmony with all aerobic animals. There are certain Earth processes that may increase or decrease the amount of carbon dioxide outputted into the atmosphere: fires, volcanic eruptions, or decomposition. Trees understand that with the rise of human populations and agriculture, around 6,000 years ago now, there has been a total loss of 7\% of forest cover.\textsuperscript{140} The atmospheric CO\textsubscript{2} concentration at the end of the ice age was 260 ppm, which very slightly increased as human populations expanded.\textsuperscript{141} The “constancy in the global carbon cycle” reveals the equilibrium between biotic populations.\textsuperscript{142}

“Forests are responsible for about half of total terrestrial photosynthesis”.\textsuperscript{143} Carbon storage is shared between the soil and vegetation, creating an important relationship between the earth and the woodland. Forests act as communities, storing CO\textsubscript{2} in our “timber, branches, foliage and roots; and necromass, including litter, woody debris, soil, organic matter and forest products. Approximately 50\% of the dry biomass of trees is carbon”.\textsuperscript{144} Boreal forests, neighboring Maine’s temperate deciduous forests, store the most amount of carbon out of any

\textsuperscript{139} Ibid.
\textsuperscript{140} Malhi, Yadvinder, et al. 2002. pp 1568
\textsuperscript{141} Malhi, Yadvinder, et al. 2002. pp 1569
\textsuperscript{142} Ibid.
\textsuperscript{143} Ibid.
\textsuperscript{144} Malhi, Yadvinder, et al. 2002. pp 1571-72
other terrestrial ecosystem.\textsuperscript{145,146} Maine supports a transitional forest between these two biomes.\textsuperscript{147} Due to the lack of cold tolerance in the American chestnut, we do not interact with the Boreal forest, which can hold up to 90\% of its carbon in the soil: “The primary reason for this difference is temperature, which at high latitudes restricts oil-organic matter decomposition and nutrient recycling, but at low latitudes encourages rapid decomposition and subsequent recycling of nutrients”.\textsuperscript{148} The high-latitude broadleaf forests, which we commonly compose, are constrained by seasonality, meaning we are highly productive within the warmer months.\textsuperscript{149}

Disturbance regimes promote our growth in the forests of Maine. These disturbances, which release carbon dioxide into the atmosphere, will shift ecosystems depending on which biotic species recover first: “Sprouting from the root collar is an adaptation of the American chestnut to disturbances such as fire, wind, and ice storms”.\textsuperscript{150} As the Wabanaki people grow in numbers our species expands, stimulating the provisions and edibles we offer. The American chestnut will grow to cover over 200 million acres on the eastern coast, with around 3.5 billion trees in the eastern deciduous forest.\textsuperscript{151}

\textit{Black Ash}

There is a story related to our species, one of creation and beginnings. We are intertwined with the people of this land as the story is told and passed through Wabanaki generations. The

\textsuperscript{145} Ibid
\textsuperscript{146} Barton, Andrew M., et al., 2012. pp 156-157
\textsuperscript{147} Ibid.
\textsuperscript{148} Malhi, Yadvinder, et al. 2002. pp 1572
\textsuperscript{149} Malhi, Yadvinder, et al. 2002. pp 1573
\textsuperscript{151} Ibid.
story cites that Glooscap, the first human, was put on Earth by the Creator. The Earth was barren. Glooscap created the forests and grass and animals and all life. Realizing that he needed someone to take care of mother Earth, he shot his bow and arrow into a brown ash tree. “Out came the natives dancing and singing”. Since then, the forests have been sacred to the people who originate from this creation story.

The forest provides medicinals, edibles, and a home for life. Brown Ash grows in many different areas, thriving along rivers and in swamplands where there is running water. Our species grows only for three weeks around May, determining how thick the splints will be. This varies with climate, precipitation, and soil. Our species is abundant as Maine supports the conditions we need to flourish. The Wabanaki make baskets out of our splints. Although splints can be collected from other ash, birch, or cedar, our splints tend to be ideal due to their flexibility and hardiness. Every now and then we hear of individuals using white ash for their baskets, although it is typically much too difficult and rigid. As human populations grow and baskets making become increasingly popular, the Black ash, or brown ash, tree becomes an emblem for the Wabanaki people. The baskets will come to be a necessary tool in agricultural fields, as the Mi’kmaq and other tribes require our splints’ durability to carry and hold harvested crops. Brown ash will continue to support the indigenous communities and their culture as we live in unity.

---

153 Ibid.
154 Ibid.
155 Ibid.
156 Ibid.
157 Ibid.
158 Ibid.
159 Ibid.
160 Ibid.
161 Ibid.
162 Ibid.
163 Ibid.
164 Ibid.
165 Ibid.
166 Ibid.
167 Ibid.
168 Ibid.
169 Ibid.
170 Ibid.
171 Ibid.
172 Ibid.
173 Ibid.
174 Ibid.
175 Ibid.
Eastern White Pine

We stand wise and strong in the forests, living up to 450 years. We are not as abundant as other species in the area, such as spruce, yet we were among the first species to migrate into Maine. Our greatest abundance in the state was between 10,000 BP-6000 BP; a time of dry, fire-prone conditions. The white pine recovers well post-fire, unlike some of our other early neighbors. We prefer soil rich in minerals and are sensitive to cold and wet climates. The Eastern white pine is utilized in medicines, foods, timber, and is rich in cultural significance. Similar to all other species in the forest, our relationship with the Wabanaki people is unique. Our medicinal value is rich, as humans can use our “cones, roots, twigs with needles, and bark for] heart diseases, high blood pressure, tooth problems, muscle pain, wounds, and swellings”. Animals such as eagles, woodpeckers, ducks, black bears, martens, fishers, and wolverines rely on the Eastern white pine in their native habitats for shelter or food. Our species has supported other living beings for millennia.

…

On August 18, 1607, Captains George Popham and Raleigh Gilbert land Gift of God and Mary and John along the mouth of the Kennebec River. There are reports that other outsiders just two years prior had traversed the Maine coastline. Yet now the fleets bring over 100 humans. It is clear that these individuals are ill-prepared for the climate and extreme winters

---

164 Barton, Andrew M., et al., 2012. pp 38
165 Ibid.
166 Ibid.
167 Ibid.
168 Ibid.
169 Upety, Yadav & Asselin, Hugo & Bergeron, Yves. (2013). pp 547
170 Ibid.
171 Barton, Andrew M., et al., 2012. pp 48
172 Ibid.
173 Ibid.
Maine can bear.\textsuperscript{174} The seasons shift as usual while the newcomers suffer, losing multiple individuals in their settlement, including George Popham.\textsuperscript{175} The land seemed to have satisfied their hunger for timber as they forged a new ship from the very wood our forests provide. Trees enjoy our relationships with humans, and we understood that this colony was suffering and relying upon the forest’s resources. We provide our wood along with oaks, spruces, and other pines.\textsuperscript{176}

The first of our trees had been removed two years prior by Captain Weymouth.\textsuperscript{177} The member of the British Royal Navy brought our timber aboard his ship, along with our seeds.\textsuperscript{178} It is in the next few years that we notice striking changes in the land and our relations. Outsiders arrive throughout the coastal regions and along the St. Lawrence River, admiring and utilizing all timber the land provides.\textsuperscript{179} These individuals infrequently traverse Maine throughout the century as conflict and warfare breaks out between the English, French, and Indigenous, prolonging any colonist from extensive exploration.\textsuperscript{180}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{coastal_forests_camden_hills_maine.png}
\caption{Coastal forests of Camden Hills, ME. A region that hosted early colonial expeditions and logging.\textsuperscript{181}}
\end{figure}

\textsuperscript{174} Ibid.
\textsuperscript{175} Barton, Andrew M., et al., 2012. pp 49
\textsuperscript{176} Barton, Andrew M., et al., 2012. pp 50-51
\textsuperscript{178} Ibid.
\textsuperscript{179} Barton, Andrew M., et al., 2012. pp 54
\textsuperscript{180} Barton, Andrew M., et al., 2012. pp 55
\textsuperscript{181} Ibid.
The outsiders offer more than just ships and settlements. With their populations come pathogens and epidemics: “The most severe of these, between 1616 and 1619, is thought to have killed up to 75 percent of the estimated 20,000 Maine Indians”.182 This decreases the hunting and foraging pressures in the land, something the ecosystem has grown accustomed to over the past thousands of years. Indigenous farmland turns to forest as the necessity for agriculture diminishes in the southern regions. Soon after, the first sawmill is built in 1623 in what will soon become Berwick, Maine.183 Our species is logged to supply lumbar for the colonizers ships and settlements with complete disregard for our cultural and historical past. As wood is taken from the landscape, “the first successful European settlements in southern Maine (English) [are] established in the 1620s and 1630s. Extensive harvesting of big white pines for ship masts and lumbar followed soon thereafter, along the lower parts of rivers such as the Piscataqua, Saco, and Presumpscot”.184 The Eastern white pine witnesses a complete restructuring of the southern coast, unlike anything we have previously experienced. Although the logging is slow and sporadic due to warfare between the Wabanaki and the French, the English seem to push forward with their economic agenda:

By 1700 the British [are] so concerned over the supply of white pine mast trees that they [try] to reserve them. Pines 24 inches or more in diameter in the accessible coastal region [are] marked with the King’s Broad Arrow, and severe penalties [are] imposed on any who cut them.185

The 1600s bring new landscapes, settlements, and destruction to the Wabanaki peoples of Maine. We soon experience an attitude shift in our human relations. The King’s Broad Arrow that marks

---

182 Barton, Andrew M., et al., 2012. pp 105
183 Ibid.
184 Barton, Andrew M., et al., 2012. pp 3
185 Wilson, Robert W., and William Everett McQuilkin. 1963. pp 1
our trunks claims ownership over our species. The Eastern white pines heritage is nearly forgotten to the value of ship construction. Never before have the forests been divided and conquered. This is just the beginning.

*American Chestnut*

The indigenous people of our land begin to suffer. Smallpox and diphtheria destroy Wabanaki populations.\(^{186}\) The trees and plants notice a “decline in global atmospheric CO₂ concentration by 7-10 ppm in the late 1500s and early 1600s”\(^{187}\) The first European contact in 1492 “led to the abandonment and secondary succession of 56 million hectares of land” which grew extremely apparent between 1520-1610.\(^{188}\) It is estimated that 55 million indigenous people died due to settlement, warfare, and the introduction of foreign diseases leading to extensive land abandonment.\(^{189}\) This brings a decline in global temperatures; marking the beginning of an exhaustive colonial period that will forever shift ecological systems. The American chestnut feels the loss of atmospheric CO₂ along with other tree and plant species. It is the first sign of great change.

Colonists begin permanently settling in southern Maine, the only region of the state we populate. These landscapes were once transformed with indigenous agricultural and cultural practices and techniques. Now, as colonists push and eradicate Wabanaki populations, our species feel different pressures: “During the early and middle 1600s epidemics and warfare with neighboring Indians devastated the Abenakis and prompted geographic population shifts among


\(^{188}\) Alexander Koch et al. (2019) pp 30

\(^{189}\) Ibid.
them, but scant demographic information was recorded”.\textsuperscript{190} From 1675-1725, the land experiences four different wars, the disappearance of indigenous villages, “large-scale migrations or relocations (the ‘Algonquian diaspora’), and the merging of refugees with other groups”.\textsuperscript{191} The mid-1700s are followed by increased logging, warfare, and settlement populations.\textsuperscript{192} These settlers are quick to appreciate our edible nuts and the timber our forested bodies provide. The nuts and wood we bear are exploited, turning our species into products fit for the white man's market.

\textit{Sugar maple}

There is rumor of a great war between the settlers and the British. Our forests witness gore and horror as both indigenous and settler populations are slaughtered. 1781 brings an end to these hostilities, only to introduce new complications for the land:

... the colonial property system taught settlers and especially the new class of proprietors to view land as a means to profit by utilization, improvement, and speculation rather than subsistence, a value framework that [will drive] the relationship of humans with forests [for centuries].\textsuperscript{193}

The end of the 1700s introduce a wave of settlement, timber harvesting, and land ownership.\textsuperscript{194} 5.5 million acres of land are sold across the state after Massachusetts, a developing colonial state, needed to sell off its war debt.\textsuperscript{195} Forests experience new dynamics with these populations, ones of classism, racism and slavery, sexism, and a drive towards capital. Our lands gain relations

\textsuperscript{191} Ghere, David L. (1997). pp 515
\textsuperscript{192} Ibid.
\textsuperscript{193} Barton, Andrew M., et al., 2012. pp 106
\textsuperscript{194} Ibid.
\textsuperscript{195} Barton, Andrew M., et al., 2012. pp 108
with money and market economies. The settler populations are now five times that of pre-contact indigenous populations.\textsuperscript{196} The turn of the century will attract 500,000 new colonists, with permanent settlements growing along the coast and up river valleys.\textsuperscript{197}

\textbf{1820 - 1900}

As towns and populations increase, the white men rapidly clear our forests “as most of the pioneers [draw] their sustenance from farming”.\textsuperscript{198} By 1820 about 650,000 acres have been cleared, increasing to one million by 1840.\textsuperscript{199} As land is transformed to farm crops, hay, and animals, our species is left in the graveyards of old forests. Settlers have adopted new techniques in tapping our maple product. The sugar maple is prized for our sugar and syrup. Policies grow to eradicate cultural heritage in Wabanaki peoples and sugar maples become an icon of the northern colonizers. The demand for maple syrup grows throughout the United States and Europe: “In many places, the buckets traditionally used to collect sap were replaced by tubing systems, and shallow evaporators were introduced to reduce processing time”.\textsuperscript{200} Ancient techniques used in syrup production are forgotten. First used as a gift to the new settlers as a resource of survival, the new populations are quick to claim the product as their own. Similar to the proprietorship of our forested neighbor, the Eastern white pine, our species is transformed into a colonial symbol of wealth and power.

\footnotesize
\textsuperscript{196} Ibid.
\textsuperscript{197} Ibid.
\textsuperscript{198} Ibid.
\textsuperscript{199} Ibid.
While the Eastern white pine dwindles in numbers, our species is hit next. The increase in settlements brings an “unprecedented exploitation of [Maine’s] vast forestlands, both by settlers and by the new class of New England entrepreneurs living in the growing cities of southern New England”. Mills spring into action along rivers, exporting white pine masts. Saco hosts the original mill sites, which slowly make their way up north to the Presumpscot River and Brunswick area as pine populations are depleted. The exhaustion and consumption of the forest is felt everywhere. Large, mature trees are ideal for the white man’s lumber. These trees feed vital soil networks, dropping seedlings and expanding their forested mosaics. They sequester carbon, provide habitat, and give unique medicinal and culinary resources to the people of this land. As these wooded giants are stripped from the land, the Maine forests transform into young, small woodlands.

Maine currently supports 248 tanneries. Pressure to harvest the Eastern hemlock increases as the demand for leather skyrockets. Our bark holds “8% -14% tannin content”, creating a unique amber tone in the animal hides. Eastern hemlock bark is filled with astringents that soften and preserve the animal proteins found in hides. Although our bark has processed hides for different indigenous communities for centuries, this new wave of industrialization and settler population growth leads to extensive logging. European colonizers disregard our unique properties, only to increase our species in market value as leather is needed for farmsteads and war. Rumor has it that our populations in Massachusetts have severely
diminished, causing tanning mills to relocate to areas with adequate supplies of bark.\footnote{Riley, George Archibald, "History of Tanning in the State of Maine" (1935). Electronic Theses and Dissertations. 2419. http://digitalcommons.library.umaine.edu/etd/2419. pp 41} The reckless destruction of forests and new methods of tanning leather leads to a decline in Maine’s leather production. A settler in 1896 states:

‘The immense tracks of hemlock which have been stripped during the last forty years with such a reckless hand can never be reproduced, and the area yet remaining will, in a very few decades at most, be left barren of this valuable growth, when other materials for tanning purposes must be sought or else the industry will disappear from our midst’.\footnote{Riley, George Archibald. (1935). pp 101} The leather industry moves as industrialization rapidly evolves. As logging pressures dwindle and our species is reduced, we are left static in a forever changed ecosystem. With the Wabanaki, we disappear and are forgotten. Soon we will be harvested for pulp and invaluable lumber.

\textit{American Chestnut}

15\% of Maine’s land is now open farmland.\footnote{Barton, Andrew M., et al., 2012. pp 112} Nearly 3.5 million acres of forests are lost.\footnote{Ibid.} Railroads and road systems allow for migrations larger than ever before. Tree harvesting grows in efficiency as the ax is replaced with the cross-cut saw.\footnote{Ibid.} Rivers shift alongside the interior ecosystems as settlers dam and redirect water flow.\footnote{Ibid.} Stands of the Eastern white pine is said to exist only in areas that humans have difficulty accessing.\footnote{Ibid.} In 1850 we witness the first spruce trees being sent down the Kennebec river due to the overconsumption of white pine: “By 1880, spruce constituted 80 percent of the lumber harvest”.\footnote{Ibid.} As land is cleared, succession
species populate. European grasses are introduced and will exist in the area for centuries.\textsuperscript{213} Animal species we once supported now flee the state.\textsuperscript{214} The late 1800s faced extirpations of “the eastern gray wolf, mountain lion, beaver, American marten, Canada lynx, caribou, otter, wild turkey, puffins, great auk, Labrador duck, and passenger pigeon”.\textsuperscript{215} Other common animal species severely deteriorate. The decline in animals creates intense ecological shifts. Never before have our forests witnessed populations suffer with such intensity.

It is at this time, though, that our forests experience a new shift. It does not represent hope, yet an eerie sense that colonial societies are shifting: “In the 1880s, more than 400,000 acres reverted from fields to regenerating forest, followed by another 600,000 in the 1890s”.\textsuperscript{216} Land is rapidly abandoned.\textsuperscript{217} The stone walls that once marked property lines, fields, and pastures are now relics. The meadows recover and native tree species repopulate, turning the land into young, small forests. Since our species recovers well in disturbed landscapes, the American chestnut will prevail throughout the recovering forests in southern Maine. Logging continues throughout the landscape, supplying economies with pulp for the paper industry.\textsuperscript{218} The Great Northern Paper Company develops their business in Millinocket, an area of unique northern forests, and will eventually own “about one-tenth of Maine’s timberlands”.\textsuperscript{219} Since many different tree species can provide adequate pulp for paper, forests are thinned. The fall of the lumber industry is celebrated to only be replaced with a new, harsher incentive to clear forests for pulp. The paper industry will influence Maine’s forests greatly, clearing trees of all sizes.

\textsuperscript{213} Ibid.
\textsuperscript{214} Barton, Andrew M., et al., 2012. pp 117
\textsuperscript{215} Barton, Andrew M., et al., 2012. pp 118
\textsuperscript{216} Ibid.
\textsuperscript{217} Barton, Andrew M., et al., 2012. pp 119
\textsuperscript{218} Barton, Andrew M., et al., 2012. pp 120
\textsuperscript{219} Barton, Andrew M., et al., 2012. pp 121
**Young American chestnut growing in solitude. Bonney Woods, Farmington, ME.**

**1900 - 2000**

We have now experienced a complete alteration of the land. Relations change between the forested species and the humans. Human populations rise to more than 700,000 throughout the first decade, and it is clear that the white settlers prize our species as our nuts feed communities that span from Mississippi to southern Maine.²²⁰ There is rumor that a certain parasite has dwindled our populations in New York. The blight, Cryphonectria parasitica, traveled from Asia just twelve years prior.²²¹

The year of 1916 brings the fungus to Maine: “Spores enter wounds in the bark, and the growing fungus kills cambial tissues, constricting the flow of food. Although chestnuts occurred only in scattered populations in southern and central Maine, its near-total disappearance… [causes] effects on wildlife utilizing its abundant nut crop”.²²² In the 1920s and 1930s, the United States Department of Agriculture encourages “owners to cut their chestnut trees before they [become] too deteriorated to use. If cut within a year or so of death, blighted trees could be

---

²²¹ Barton, Andrew M., et al., 2012. pp 124
²²² Barton, Andrew M., et al., 2012. pp 124-125
harvested for utility poles, which brought the best price.”223 If our species is not harvested, the landscape we populate transforms into a “‘graveyard of giant trees’”.224

The chestnut blight will cause the species near extinction throughout the 1900s. The fungus does not kill our roots, resulting in occasional sproutings from old stumps. Since our species cannot self-pollinate, it is especially difficult for isolated chestnut trees to produce adequate seeds. The American chestnut will persist as understory shoots for the next century, occasionally growing into a canopy tree before getting struck with Cryphonectria parasitica. The fungi latches to the bark of our wooded neighbors, patiently waiting to attack.225 Our disappearance shakes the American people. There is rumor that copious amounts of money are raised in an effort to save our species. Still, nature moves on. We survive underneath the soil, awaiting our chance of joining the forests once again.

The bark of an American chestnut. Bonney Woods, Farmington, ME.

224 Freinkel, Susan, 2007. pp 78
225 Freinkel, Susan, 2007. pp 91
Sugar maple

There are obvious changes in the land. Various animal species are extinct, native plant species are endangered, invasive species populations increase, logging machinery becomes more efficient, forests are clear-cut, and wood increases in economic value. Sugar maple wood is logged for various purposes, and is typically swept by the clear-cuts that dominate the logging industry. Large companies now control the forests.\textsuperscript{226} We witness the American chestnut’s death, followed by severe declines in American elms and American beeches due to two other pathogenic fungi.\textsuperscript{227} The state of the forests spurs efforts of conservation, creating new protected areas that will fortify small pockets of land. The 20th century pushes forward and forestry practices turn harsh:

From 1975 to 1984, Maine was struck with the worst spruce budworm outbreak on record. The timber industry responded with aerial insecticide spraying — 3.5 million acres in 1976 — and salvage harvesting of spruce-fir forests, mainly with clear-cutting… By 1988, 60 percent of all harvesting by industrial landowners was carried out with clear-cutting, often followed by herbicide spraying to suppress hardwoods, which compete with the desired spruce and fir.\textsuperscript{228}

Maple growth is depressed. Although we are favored for our syrup and cultural representation, our wood is not as desired as spruce, fir, or white pine. Maples are logged for various products, yet our regrowth is not supported. The spruce budworm outbreak turns forests into young, uniform stands “vulnerable to insufficient regeneration”.\textsuperscript{229} The state now faces extreme losses in

\textsuperscript{226} Barton, Andrew M., et al., 2012. pp 124
\textsuperscript{227} Ibid.
\textsuperscript{228} Barton, Andrew M., et al., 2012. pp 127
\textsuperscript{229} Barton, Andrew M., et al., 2012. pp 129
forests, increases in pollution and acid rain, and a general “anxiety about running out of trees”.

Harvests increase, yet the demand for jobs decreases as machines out-compete human labor. The generations that preceded the settlers who invaded our lands begin to witness what happens when our forests are valued only in the context of economic products.

Similar to logging practices, the production of maple syrup increases in efficiency and scale. Maple syrup producers adopt plastic tubing as a way to increase their yields, sourcing from thousands of trees each year. Maple syrup increases in demand, resulting in the need for greater sugar maple reserves. Those who own different parts of our forest will begin leasing land that holds an abundance of sugar maple. Never before has our species experienced such demand for our sap. We are grateful that our species is not commercially harvested like our other forested neighbors. Still, our ecosystems behave as communities. When one member is hurt, we too sense their pain.

As the years pass, the Maine forests begin to feel a shift in the atmosphere. The past thousands of years had been relatively stable, with various shifts in climate and temperatures. The changes were never too drastic; always something our species could persist through. We would witness near-extinction events every so often, such as the disappearance of hemlock, but great ecosystem shifts have been rare. The termination of the Laurentide Ice Sheet brought favorable climates for tree and animal species. It was not until industrialization that the stability of our climate collapsed.

Until recently, the Holocene maintained an atmospheric CO2 level of around 280 ppm.

By the end of the 20th century, carbon dioxide levels reach 370 ppm. The northern hardwood

---

230 Ibid.
232 Ibid.
forests we compose store 50% of total ecosystem carbon within the soils. When these forests are clear-cut and soil is disturbed, carbon is mobilized. Sugar maple trees, like all those in our ecosystems, maintain this crucial habitat. As forests become young and uniform and are hit with various pathogens, the rate at which we store carbon decreases:

The annual rate of increase in atmospheric carbon dioxide over the past 60 years is about 100 times faster than previous natural increases, such as those that occurred at the end of the last ice age 11,000-17,000 years ago.

The entire planet is warming, and Maine and its forests are just beginning to feel the grave impact of climate change.

Present

Eastern Hemlock

Today, the once 18.2 million acres of forest have decreased to about 17.7 million acres. Only 10,000 acres are remnant old-growth forests, while most forests in the northern unorganized territories have been harvested several times. It is said that only 3% of the 17.7 million acres is protected from logging. Our species has witnessed economies shift, once favoring our wood for tanning animal hides, to now utilizing us for pulp. Forests are thin, small wood systems compared to what they once were. Old growth once governed the land. As time ticks onward, much of the forest's ancient knowledge is lost. The humans that log our wood, traverse our forests, research our ecosystems, and live amongst our bodies do not know what

235 Ibid.
236 Lindsey, Rebecca. 23 June 2022.
238 Barton, Andrew M., et al., 2012. pp 134
239 Ibid.
presettlement species “were extirpated by the past four centuries of land use…”240 We are among
the species in current decline. The Eastern hemlock has experienced an extinction event once
before, one that took two thousand years to recover. We understand what is happening.

The Hemlock Wooly Adelgid was first felt in the 1950s in our southern ranges of
Virginia.241 Imported from Asia, the small insect sources food from our phloem, eating at our
sugars made during photosynthesis.242 When our needles are eaten and killed, we lose our vital
nutrients leading to an eventual death within a few years of the initial attack.243 The decades
leading to today have brought the adelgid into Maine’s parameters, now killing hemlocks of all
ages.244 In some areas of our southern ranges, up to 80% of our species have died.245 It is unclear
what the Hemlock Wooly Adelgid will bring for our foreseeable future. Climates are currently
too cold in our northern regions to support the adelgids, yet this may all change as winters
warm.246 The loss of our species in Maine will bring lasting effects, similar to those felt with our
demise in 3500 BP. The Eastern hemlock pushes onwards with all of our forested friends. We all
endure the lasting effects of anthropogenic climate change.

240 Ibid.
242 Barton, Andrew M., et al., 2012. pp 199
%20hemlock%20woolly%20adelgid%20feeds,years%20of%20the%20initial%20attack.
Conclusion

The futures of Maine’s forests are filled with uncertainty. Red maples and other hardwoods are currently at risk due to the Asian longhorned beetle.\(^{247}\) Warmer winters support the beetle’s migration into the state, and the northern hardwood forests host the ideal habitat for their northward movements.\(^{248}\) A handful of other invasive plant and insect species pose great risks to the forests. The emerald ash borer is among the greatest threat.

The beetle traveled into Michigan and began severely damaging ash trees in 2002.\(^{249}\) In 2012, the emerald ash borer had killed upwards of forty million trees throughout the northeast.\(^{250}\) Different Wabanaki nations are heavily involved in research, protection, and remediation efforts. I had the pleasure of speaking with Richard Silliboy, the Vice Chief of the Aroostook Band of Mi’kmaqs, about the current state of the brown ash species. Silliboy has traveled to Michigan, New York, Vermont, and across the state of Maine to spread awareness and research how exactly the insect is causing mass mortality events. These trees are extremely culturally significant to the Mi’kmaq people, supplying the wooden splints that create their baskets.

The art and trade of basket making has surrounded the Maine area for millennia, changing in utility as colonization increased agricultural pressures.\(^{251}\) Richard learned how to construct brown ash baskets from his mother, who sold her baskets to potato farmers throughout Aroostook County.\(^{252}\) Since then, Silliboy has witnessed great declines in the craft and has spent the past decades revitalizing the practice throughout his communities.\(^{253}\) To weave a basket, one

\(^{247}\) Barton, Andrew M., et al., 2012. pp 199  
\(^{250}\) Barton, Andrew M., et al., 2012. pp 199  
\(^{252}\) Ibid.  
\(^{253}\) Ibid.  

51
must understand how to identify, harvest, and splint the brown ash tree.\textsuperscript{254} Richard brings an offering to each harvest, typically containing tobacco.\textsuperscript{255} He then explained the importance of the Wabanaki creation story, detailed in the second chapter. Brown ash has hence supported the indigenous peoples of this region for thousands of years. The decline of this tree species is entangled with a certain cultural loss for human beings. Not only will this bring great changes to ecosystems, but it will also forever shift the way in which the Wabanaki peoples pursue the art and tradition of basket weaving. This intimate relationship between forests and the people is made apparent through this practice.

As new, efficient agricultural technologies took footholds in the Aroostook potato fields, the demand for brown ash baskets diminished.\textsuperscript{256} The tree is currently at great risk of extinction due to the emerald ash borer. Typically, Maine’s climate would not supply warm enough conditions for the insect:

When I was young… there would be so much snow out in the field and out in the woods… We used to be able to run on the crust in late February and the month of March. We would haul brown ash logs on sleds. You can’t do that today… Climate change has changed a lot of things… and it’ll probably only get worse.\textsuperscript{257}

As of recently, the emerald ash borer is currently restricted to southern and central Maine.\textsuperscript{258} Given that the beetle “kills most of the ash trees they attack… The Maine Indian Basketmakers Alliance is already preparing for the possible demise of brown ash”.\textsuperscript{259} The extinction of the species will send rippling effects through their ecosystems. The tree directly related to the

\begin{footnotesize}
\begin{itemize}
    \item \textsuperscript{254} Ibid.
    \item \textsuperscript{255} Ibid.
    \item \textsuperscript{256} Ibid.
    \item \textsuperscript{257} Ibid.
    \item \textsuperscript{258} Ibid.
    \item \textsuperscript{259} Barton, Andrew M., et al., 2012. pp 199
\end{itemize}
\end{footnotesize}
Wabanaki creation will soon disappear from the landscape. Insect outbreaks are projected to increase and grow more violent as winters warm, causing deaths throughout Maine’s forests.

Climate change, dangerous invasives, acid rain, land development, and timber harvests all work in unison to harm the state’s ecosystems. Global conditions are pushing all forests to their limit. When trees are stressed, they reach a tipping point. Hot, dry conditions will challenge each species. White pine, oak, and shagbark hickory are among the few tree species in Maine that might respond well to a dry, warming forest. The other dominant species that compose the northern coniferous and northern hardwood forests will shrink throughout the region, moving their ranges into higher elevations. The changing climate is happening too fast for these forests to migrate northward, a movement that took species thousands of years as illustrated in Chapter 1. These regions might soon be replaced by oak-hickory hardwood forests.

Maine’s short-lived period of stability ends abruptly as colonization and industrialization abruptly shift climatic conditions. The forests will soon become temperate. Animal species have already begun their northward migration, seeking refuge in areas that may hold apt environments. It is unclear at what rate we will witness severe declines in forested species across the state. Many say that grave threats are on the horizon, yet are we not experiencing them now? Chakrabarty states “we normally envisage the future with the help of the same faculty that allows us to picture the past”. This thesis works to deconstruct our current constructs of environmental history: that the past and future lie within an anthropocentric framework. Instead,
imagining environments at some larger scale provides context to what could really happen to our forests and planet. These ecosystems are ones of great history, migrating into the state thousands of years ago and establishing complex relationships with other organisms. They have supported animal and human populations for thousands of years. To now imagine forests dying due to a rise in temperature and an outbreak of invasive pathogens from destructive human activity is quite terrifying. Applying the lens of big history towards our thoughts of the future may completely reconstruct current positionalities on what the climate crisis truly is. Those already entangled and worried about the changing planet often fear the climatic conditions for the next few generations to come. I argue that it is also powerful and necessary to envision the future hundreds, if not thousands, of years from today. It is difficult to perceive this from our narrow, anthropocentric lens. Removing this framework and working towards visualizing the world in a more general sense, perhaps from the perspective of trees, might destabilize current sentiments in how the Earth will move forward amidst anthropogenic climate change. These may seem like immense timescales, yet this is but a short period of time for the Earth and all species. To imagine this in a timescale apt to the planet instead of human existence, while shifting our human-centric narrative, may then evoke a sense of empathy, hope, and agency.
Bibliography


Twelfth Census of the United States (1900). Population of Maine by Counties and Minor Civil Divisions. Retrieved from
https://www2.census.gov/library/publications/decennial/1900/bulletins/demographic/27-population-me.pdf


---. "Wildflowers of the Adirondacks: Goldthread (Coptis trifolia)." *Wild Adirondacks,* wildadirondacks.org/adirondack-wildflowers-goldthread-coptis-trifolia.html#:~:text=Uses%20of%20Goldthread&text=The%20rhizome%20and%20roots%20are,for%20use%20as%20an%20eyewash.

