(Making) Kin: Narratives of an Ash Tree

by

Milena Kocay

Submitted in partial fulfilment of the requirements
for the degree of Master of Architecture

at

Dalhousie University
Halifax, Nova Scotia
June 2022

Dalhousie University is located in Mi'kmaq'i,
the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

Contents

Abstract

Ash trees are facing extinction in North America from the accidental introduction of an invasive insect called the Emerald Ash Borer. The event is a disruption to the forest ecosystem as well as to relationships of care between local knowledge and action (craft) that have existed for generations. The thesis borrows from a multi-species methodology that recognizes that all bodies are kin, both human and not, enmeshed in a dense network of relations. It is also driven by a process of making that develops architectural and object scale strategies for the use of ash wood. By tracing the trajectory of ash trees over the course of their extinction, this thesis proposes architectural interventions and material explorations that renegotiate relationships of care and craft across disparate temporal intersections in the forests of Nova Scotia.

Acknowledgements

With sincere gratitude to my committee, supervisor Catherine Venart and advisors Ted Cavanagh and Eric Stotts, for the excellent conversations and speculative fabulations over the course of this thesis. A true dream team.

And to Laure, who tells me about all the trees she's met.

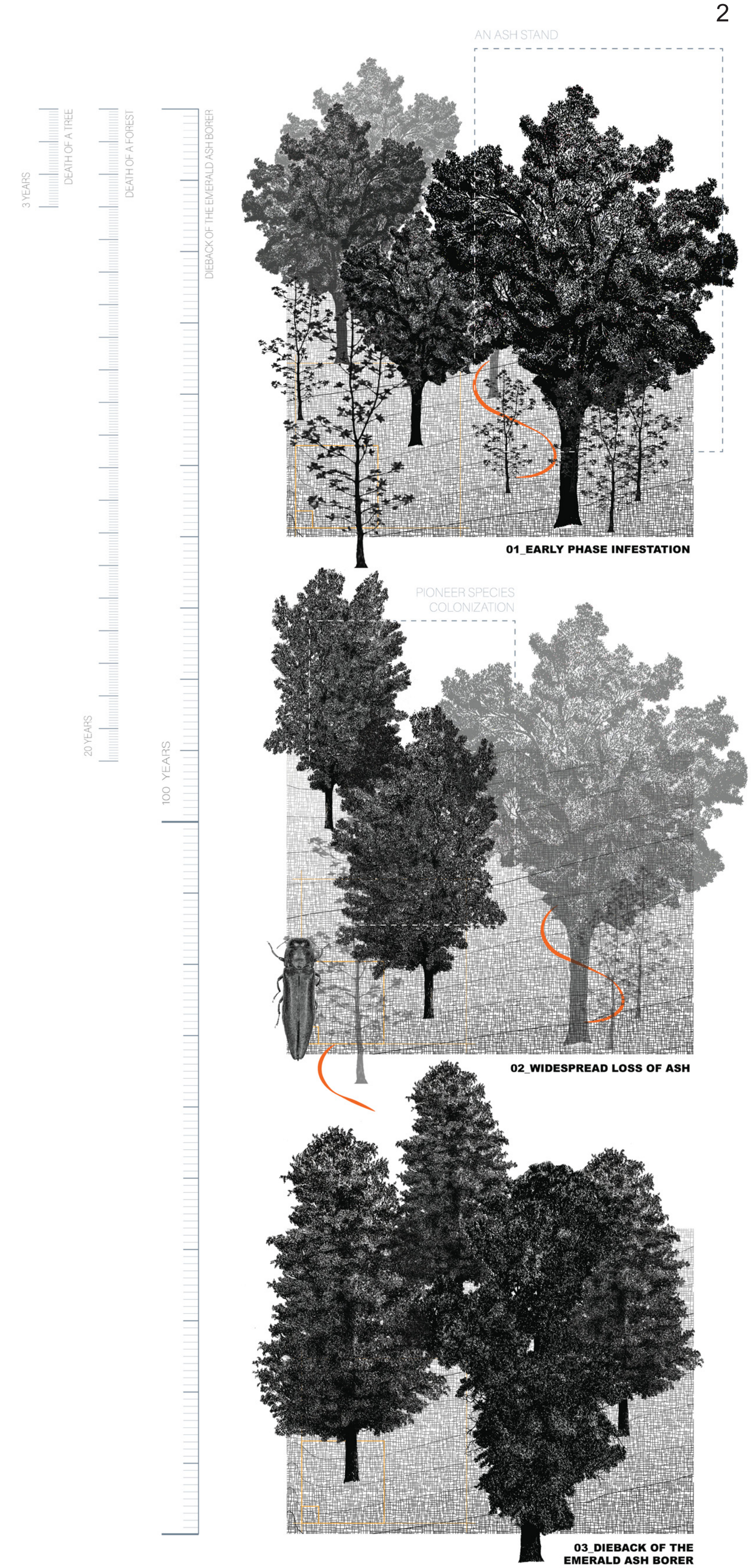
Chapter 1: Introduction

The Emerald Ash Borer is an invasive insect that was accidentally introduced to North America in the wood packaging material of global container ships. The insect feeds exclusively on ash trees, killing the tree by burrowing into its thin, outer layer of bark but leaving the rest of the wood intact. It has killed millions of ash trees in North America already and was first discovered in Nova Scotia in 2018. Given its velocity and its impact, current estimates indicate that nearly all of our ash trees will die within the next twenty years (MacDonald 2019).

The Emerald Ash Borer, however, is also a parasite. Without any natural predators in North America, it will eventually destroy its only host. At this point, the insect's populations will dwindle until it can no longer sustain itself and must either adapt or face its own extinction. The timeline of this sequence is merely a hypothesis, but researchers suggest that it could take as many as 200 years.

Within this larger timescale, human activities regularly intersect with those of the forest which, in turn, intersect with external systems such as the Emerald Ash Borer. The emergence of the Emerald Ash Borer will inevitably disrupt these patterns, but the question for this thesis is whether there are opportunities within this disruption for new rituals to emerge. By tracing the narratives of ash trees over the course of their extinction, this thesis proposes architectural interventions that engage with this discruption across disparate temporal scales in the forests of Nova Scotia.

2



Sequencing the extinction of ash trees and the dieback of the Emerald Ash Borer

Chapter 2: Making Kin

“To be kind is to be kin, but kin is not kind. Kin is often quite the opposite of kind. It’s not necessarily to be biologically related but in some consequential way to belong in the same category” (Paulson 2019). Science and feminist studies scholar Donna Haraway first started using the word kin when she was in a college Shakespeare class and she realized that Shakespeare punned with kin and kind. Kind in this framework refers to humans and their shared experiences as one species on this earth. Kin, then, defines a relationship to a constellation of other species, things, matter, physical forces or spiritual entities whose patterns of habitation intersect our own. Anthropocentrism has defined human kind as distinct from all other forms of non-human kind, yet critical approaches to such ideologies offer provocative new methods of reconfiguring our relations to the earth and all its non-human inhabitants. These approaches are, in themselves, an emerging discipline (albeit an inherently inter-disciplinary one) often referred to as multi-species theory (Raikhel 2010). Instead of the traditions of *self-making* inherited from the Anthropocene, multi-species theories posit a process of *making-with* that engages both geneological kin and oddkin which are unavoidably entangled.

This framework has both clarified and guided me throughout the course of this thesis. The event of the Emerald Ash Borer which serves as a catalyst is, in itself, a tangle of multi-species actors: an insect, native to northern Asia, accidentally introduced in the wood packaging material of global shipping containers, that feeds exclusively on a tree whose wood is intimately connected to the material culture and identity of North America. Donna Haraway offers some insight into the exploration of this tangled interaction:

> We live in disturbing times, mixed-up times, troubling and turbid times. The task is to become capable, with each other in all of our bumptious kinds, of response. The task is to make kin in lines of inventive connection as a practice of learning how to live and die well with each other in a thick present. Our task is to make trouble, to stir up potent response to devastating events, as well as to settle troubled waters and rebuild quiet places. (Haraway 2016, 1)

The loss of ash trees within this generation is, to be sure, a heartbreaking event, but the question for this thesis is whether there are opportunities within its disruption for new patterns of kinship to emerge. Or, more succinctly; how do we make kin with the Emerald Ash Borer?

This thesis expores two responses to this question that are related through distinct but connected spatial-temporal dimensions in the forests of Nova Scotia. They are guided by equally distinct but connected strands of ethical discourse (which would likely find kin alongside various multi-species theories); matters of craft and care. Craft is an inherently materialist practice; a back and forth between matter and maker that can lead to unexpected outcomes (Sennett 2008). Matter in this framework is not passive but “actant”: it has the capacity to “animate, to act, to produce effects dramatic and subtle” (Bennett 2010, 6). Care is “everything that we do to maintain, continue and repair our world so that we can live in it as well as possible. That world includes our bodies, our selves and our environment, all of which we seek to interweave in a complex, life-sustaining web” (de la Bellacasa 2017, 3). Craft and care are two avenues with which this thesis attempts to make kin.

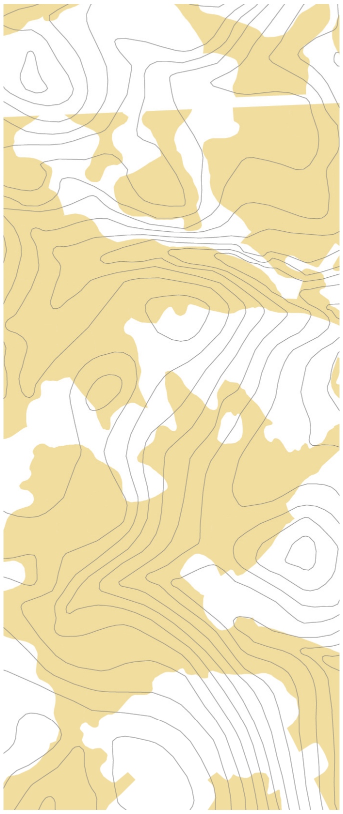
Within the next twenty years, the Emerald Ash Borer will generate an enormous surplus of matter. How this wood is harvested and worked, how the forest will change, and how to encourage surrounding communities to engage with it are the concerns of Splint Studios, a basket weaving studio and maker space in the valleys of the Wolfville Watershed Preserve. Within the next two hundred years, dieback of the Emerald Ash Borer will allow ash seeds harvested before the infestation to be safely planted. Seed House is both a seed bank, which investigates the techtonics of passive, long term seed storage, and a monument that can communicate to future generations what the building is holding. Situated on the ridge of the South Mountain Range far above Splint Studios, Seed House protects the genetic sequence of the tree while the tree itself disappears and the forest changes. Each project explores opportunities for the use of ash wood in anticipation of its extinction, investigated through my own processes of harvesting, storing, drying, soaking and making-with ash.

Chapter 3: Forests

> If only your mind were a slightly greener thing, we'd drown you in meaning. (Powers 2018, 4)

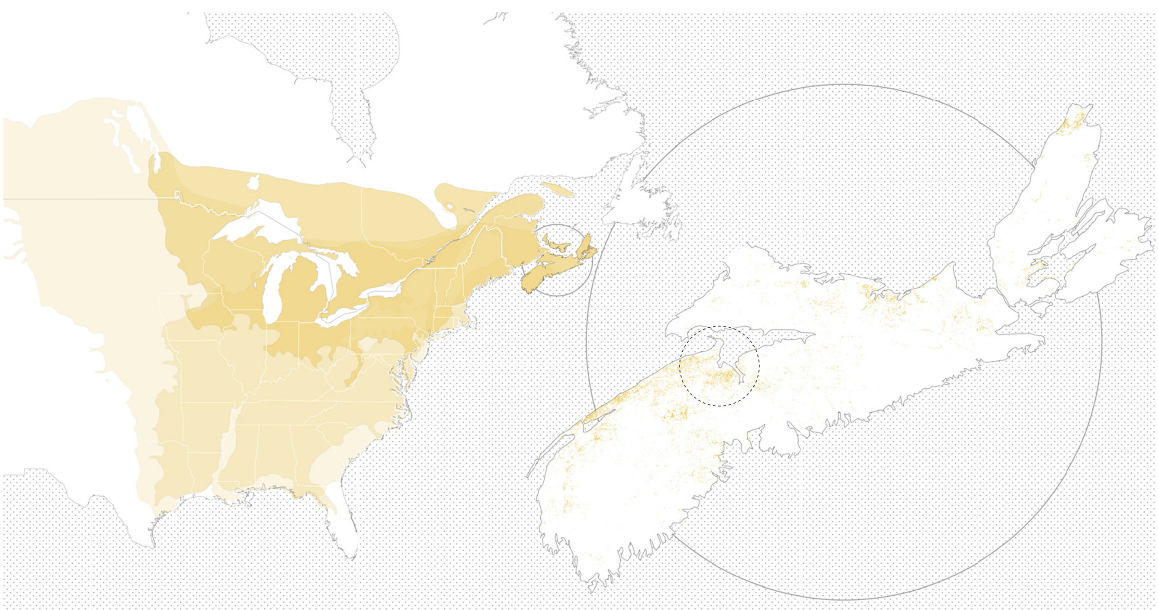
Forests are creative bodies. They exhibit emergent properties at a system-level that cannot be easily predicted by studying their individual parts. They have unclear system boundaries and are never at equilibrium, quasi-chaotic elements which have long made forests fascinating scenes of activity. These, together with the tendencies to create non-linear, cross-scalar feedback loops and to exhibit memory in how they can recall previous states, are characteristic of a complex, adaptive system (Puettmann, Coates, and Messier 2008, 110). Complexity emerges in systems such as forests from adaptation of and coevolution between organisms and their environments across multiple scales of species, space and time. Stability is maintained at a systems level while, at the individual level, adaptation as a response to disturbances generates the heterogeneity of the landscape.

These cycles of disturbance and adaptation repeat over millions of years, generating a process of natural selection that is responsible for the forests we are familiar with today. The first evidence of trees appears 360 million years ago at the start of the Carboniferous period. It wasn't until 125 million years ago that angiosperms appear, a flowering plant that hold their seeds in a protective fruit or envelope. These are the broadleaf trees which we are familiar with today: maples, oaks, ash, etc. The forests of Nova Scotia are characterized by a diverse mix of both broadleaf and evergreen trees, each of which have their own particular environmental needs that dictate where they grow.



Superimposing locations of ash with topographical data suggests that white and black ash follow the movement of water (data from NSDNRR 2021).

There are over 60 different species of ash scattered across every continent. Three of these species of ash grow natively in Nova Scotia: *Fraxinus americana* (white ash), *Fraxinus nigra* (black ash) and *Fraxinus pennsylvanica* (green ash). Green ash is mostly found planted in the urban forest canopies of cities such as Halifax. Black and white ash grow in the forests, sharing an inclination for wet and watery habitats. Black ash in particular grows in poorly drained areas along swampy woodland streams and is sometimes referred to as ‘swamp ash’. White ash is an upland tree species, typically occuring on mesic slopes alongside river streams. Black ash is the rarest of the three varieties primarily due to an increasing loss of habitat across the province. There are approximately 1000 known individuals of black ash left in Nova Scotia (NSDNR 2021). White ash is the most abundant species of ash in Nova Scotia.



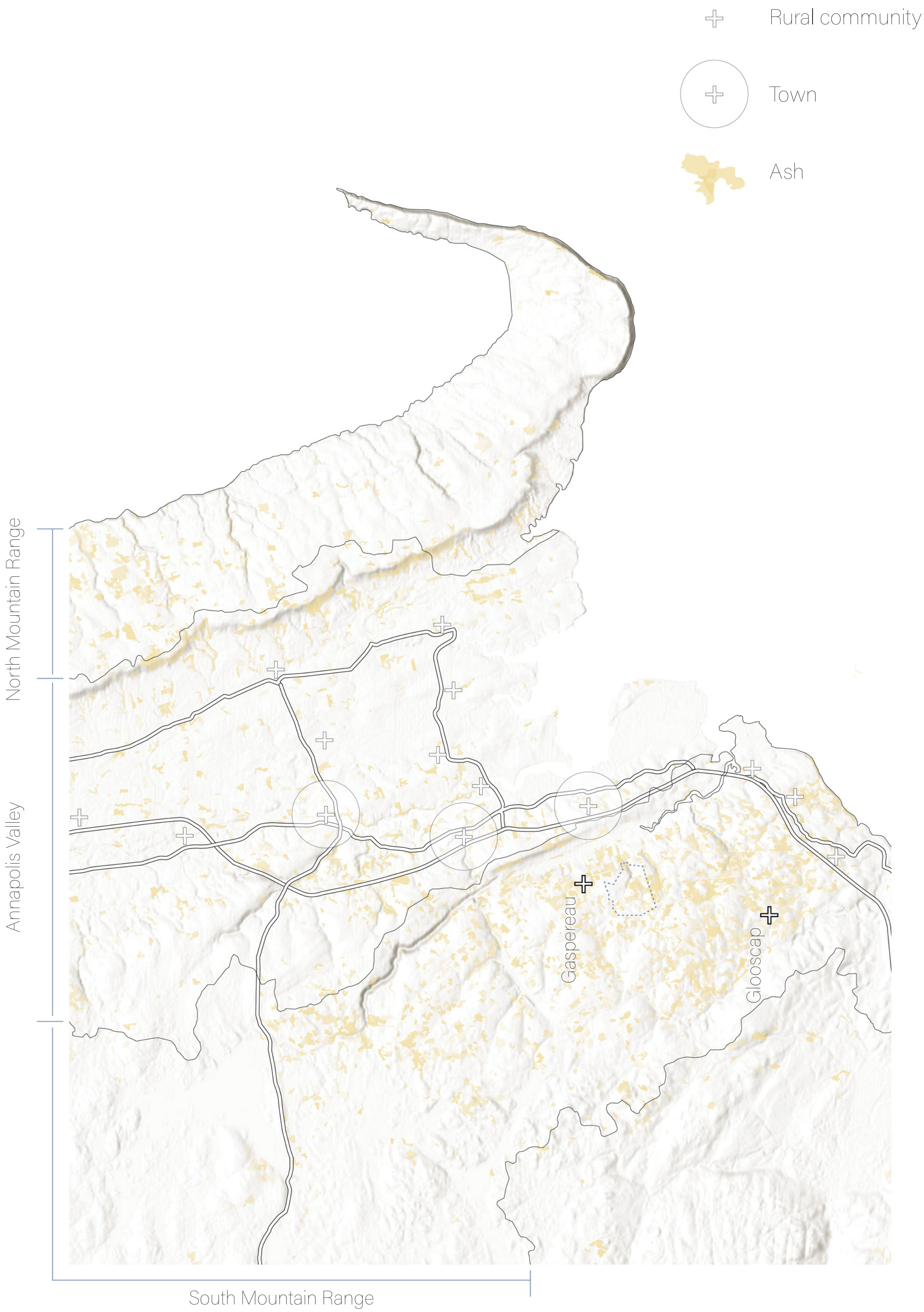
Native range of white, green and black ash in North America and Nova Scotia, with eastern tip of the north and south mountain ranges indicated in dashed circle (data from NSDNRR 2021).

Provincial Habitats

Ash is an upland tree species, preferring moist but well drained soils such as the steep inclines of riverbanks and valleys. Like most broadleaf trees, ash prefer richer soils and sheltered microclimates, rarely occuring alongside the rocky coastlines that border the province. Instead, ash trees in Nova Scotia are most abundantly found in either the Cape Breton Highlands or alongside the mountain ranges that border the Annapolis Valley. While the valley has been developed as the province's largest and most productive agricultural zone, the mountain ranges that create its microclimate are predominantly forested. In these areas, paved roads transition to dirt roads which transition to paths through forest stands which are interrupted occasionally by agricultural fields and small rural communities. Here, communities live alongside and within the forest. In these areas, the loss of ash will be deeply felt as ash makes up nearly 8% of the forest canopy.

Wolfville Watershed Preserve

The Wolfville Watershed Preserve is a protected park nestled in the South Mountain Range bordering the Annapolis Valley. It stretches across a wide range of topographical conditions, from the ridge of the mountain through several slopes and valleys which funnel water through the watershed. It is accessed from the North closest to the community of Gaspereau. Gaspereau, like many nearby towns, is a small agricultural community carved out from the forest that stretches across the mountain. These communities border the threshold between the mountain and the valley, while the range of the forest increases further up the mountain slopes. The community nearest the watershed on this

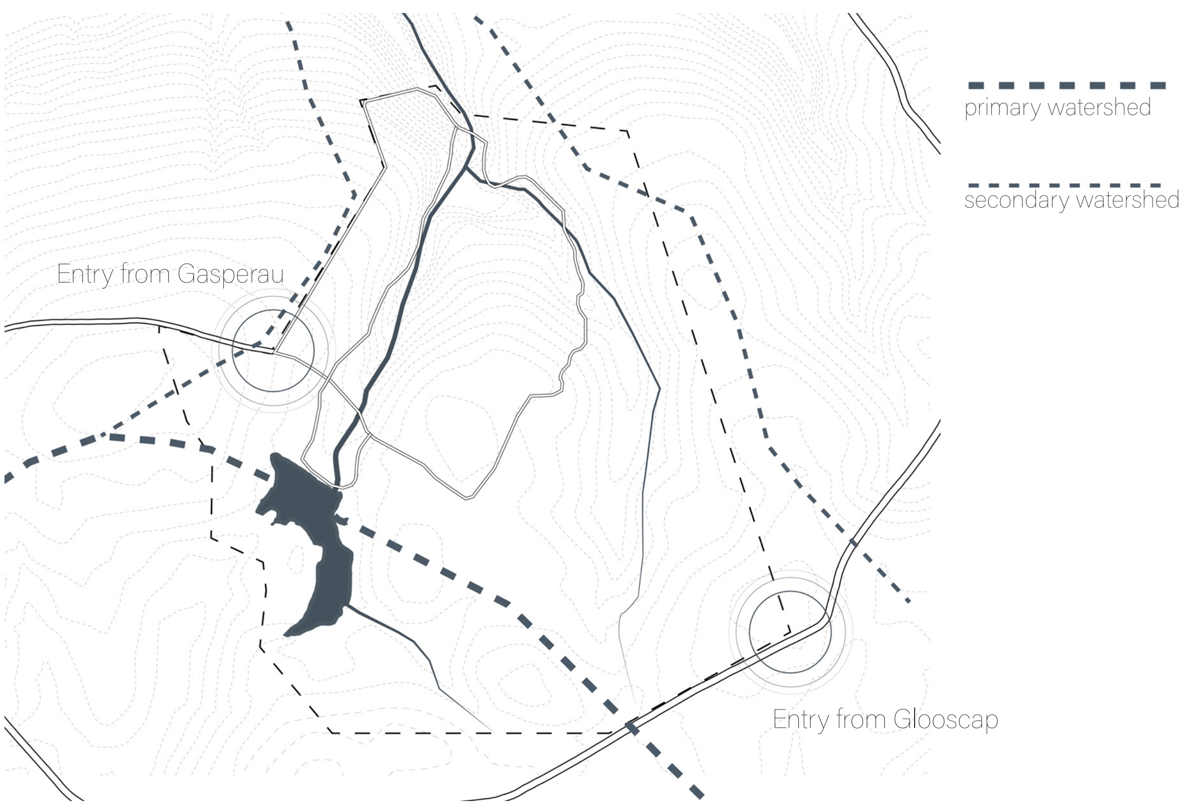


Eastern tip of the North and South Mountain Ranges bordering the Annapolis Valley, indicating communities closest to the Wolfville Watershed Preserve, Gaspereau and Glooscap First Nations (forest data from NSDNRR 2021).

The forest alongside the Gaspereau River, typical conditions of white and black ash. It is a popular walking trail for surrounding communities.

side of the mountain range is the Glooscap First Nations Reserve. Glooscap is a small Mi'kmaq community that practices indigenous forestry practices across much of its forested land.

The Wolfville Watershed Preserve serves as site for this thesis as it offers the widest range of environmental conditions suitable for ash. Nestled between the settled community of Gaspereau and the Mi'kmaq community of Glooscap, it also serves as a dialog amongst *kind* between two ways of thinking and working with the forest that are important for understanding the narratives of ash trees. While these communities are geographically close, there are no paved roads which cross the mountain from the north to the south. Instead, a series of logging roads and hiking paths are the only connection between these two communities.



Wolfville Watershed Preserve boundaries and existing trails, showing entry points from Gaspereau and Glooscap.

Chapter 4: An Ash Tree

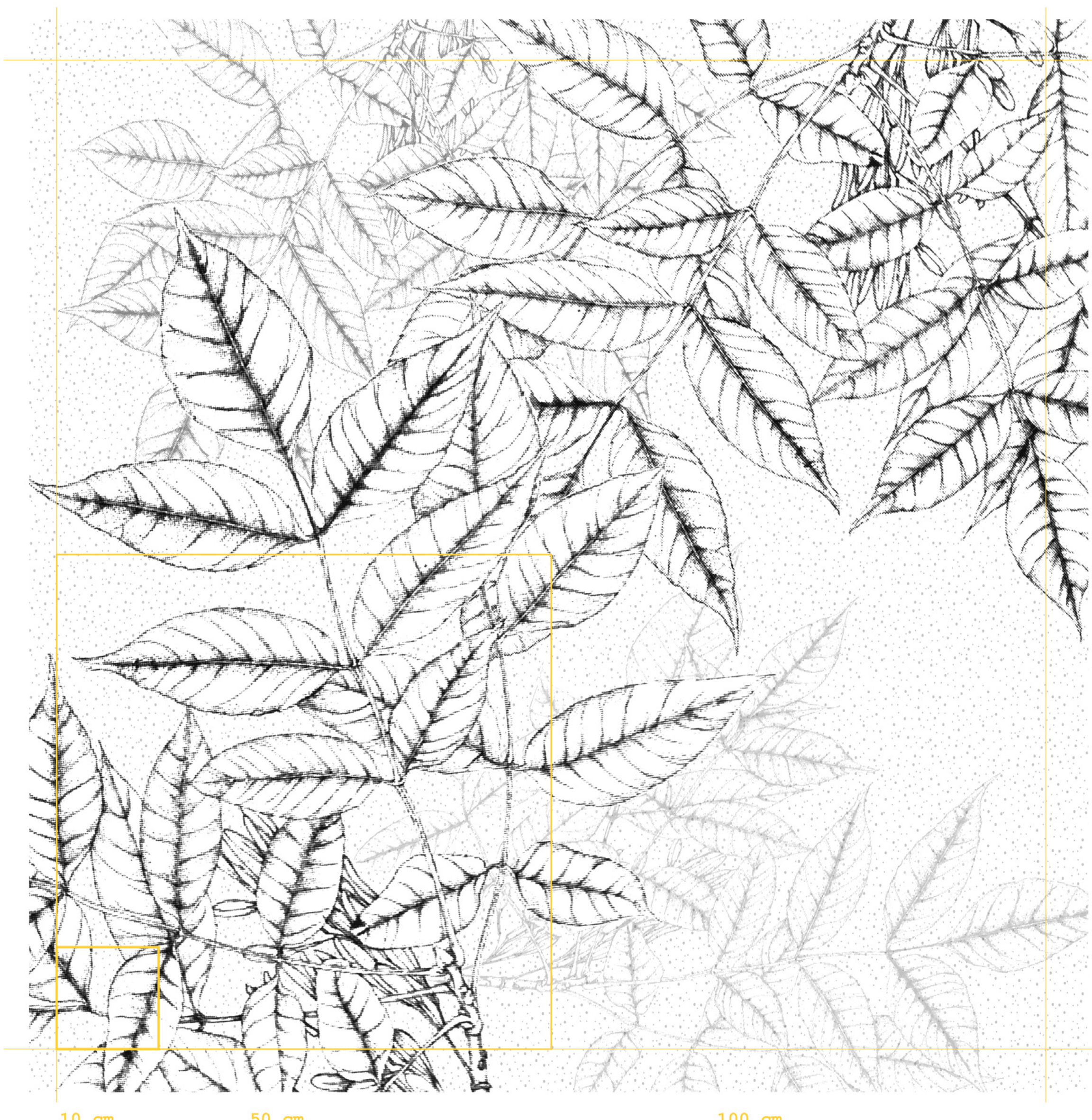
Fraxinus

Ash is the English name for the genus of flowering plant called *Fraxinus*, a tree steeped in mythology that has applealed to both poets and artists for its grace. In English folklore it is sometimes known as the ‘Venus of the Woods’, as the tree is almost instantly recognizable. It is both tall and soft, with outstretched limbs that taper towards the sky and thin, compound leaves which give it a delicate structure within the forest canopy. “There are no angles on a young ash tree-everything is rounded and covered in fluttering foliage, soft as the feathers in a boa or the fur of a chinchilla” (Stafford 2016). The softness of the ash has marked it out as a tree of comfort and healing. It has been credited with a wide range of medicinal properties that can ease pain and treat ailments such as jaundice or kidney stones. In Norse mythology, a vast, evergreen ash tree serves as axis mundi, sustaining the nine worlds of the cosmos in its roots and branches.

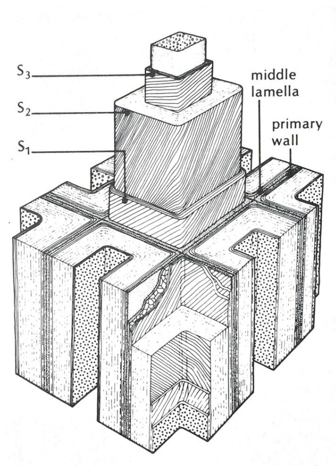
These properties evolved from the first introduction of broadleaf tree species 125 million years ago as adaptation strategies to suit a wide range of environmental conditions. While there is evidence to indicate that the first maple trees appeared 67 million years ago and the first oak trees 56 million years ago, it is uncertain how many million years ago ash trees first appeared in North American forests. The genetic sequence of ash trees, recently mapped by researchers in the United Kingdom as a response to the devastating effects of the Emerald Ash Borer, indicates both the deeply connected nature of all living things and the highly specified evolution of the genus of ash. It is, however, only a snapshot in time, as natural selection continues to generate adaptation into the following millenia.

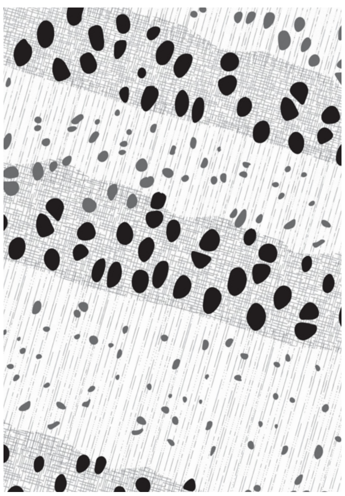
Canopy

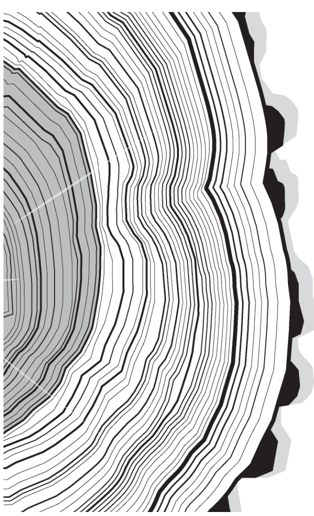
An ash is most acutely recognized by its canopy. The forest canopy generates energy for the entire system while sheltering the forest microclimate underneath. It is a volume composed of a hierarchy of structure and planes whose qualities and structure vary significantly with each



The canopy of an ash tree is a volume composed of a hierarchy of structure and planes.





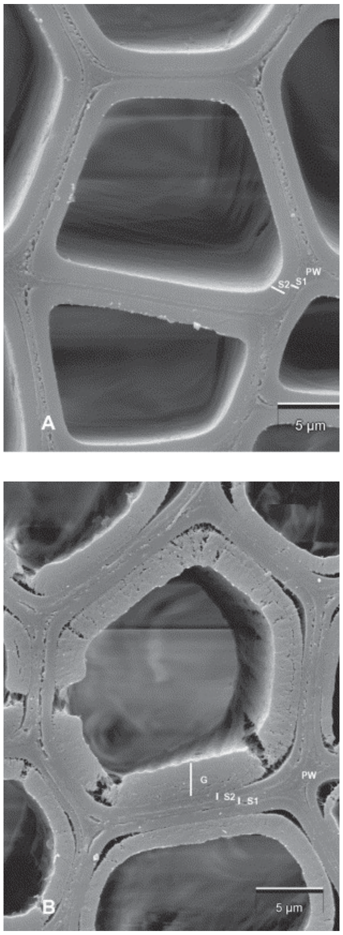


Top: cell wall structure (McKnight and Mullins 1981)
Middle: differential growth patterns in spring and summer growth
Bottom: growth rings

tree. Conditions above and below the canopy can differ vastly, often resulting in a vertical gradient of microclimate conditions. Ash trees have a compound leaf structure typically arranged in a series of 7 to 11 narrowly angled leaves. This leaf structure allows some sunlight to penetrate the forest floor underneath, creating a distinct microclimate. Saplings that grow within this microclimate are capable of experiencing long periods of suppression below the canopy as they wait for a gap in the canopy to open. Typically this occurs when a larger, older tree dies, generating a pattern of succession that sustains the forest through generations. As ash disappears from the existing forest, the gaps in the forest canopy will allow other existing tree species to take its place. These trees will likely be pioneer species - tree species that grow quickly in open, full sun conditions such as red maple, paper birch or white spruce.

Structure

A tree's cellular structure consist of long, layered fibres which make up the tree's biomass and vasular cells which transport water and nutrients through the tree. Ash has an open grain structure meaning that it is comparatively porous; the vascular cells which hold water are larger and opened compared to closed grain hardwoods. This distinction, however, is seasonal. In the spring, when the ground is wet, the tree goes through a rapid growth phase and it absorbs more water, increasing the size of the cells. As this growth tapers off towards the beginning of summer, the diameter of the cells shrink as the tree reduces its intake of water. In the case of ash, the distinction is clearly evident. Early growth vascular cells are visibly large compared to its summer growth. The relationship between spring and summer growth is visible in the tree's growth rings, where one year's



Normal wood (top) and
tension wood (bottom)
(Pilate et al 2004)

growth is equal to one ring. The tree experiences more or less growth depending on the climactic circumstances of the particular season, making that particular year’s ring either smaller or larger. In this way, we are capable of reading information on past events, such as floods or forest fires, by looking at the growth patterns of tree rings.

Reaction Wood

Certain environmental conditions induce mechanical stresses in the tree caused by gravity. A branch that leans too far in one direction towards the sun, for example, then produces abnormal wood formation to reorient itself called reaction wood. Reaction wood is a normal adaptive strategy towards the tree’s growth that influences the structure of the tree itself. It has a higher concentration of cellulose than normal wood, making it denser. Hardwood trees such as ash produce a type of reaction wood that works in tension to support the individual branch or part of the trunk against the forces of gravity. This is called tension wood: mass is built up on the upper side of the branch, pulling it towards the affecting force (usually, upwards in the case of a branch). Softwoods produce compression wood, which lenghtens or straightens the bend. Reaction wood alters the uniform properties of wood and is significantly more prone to warping, cupping and twisting.

Supplying local ash over the course of this thesis revealed a network of local arborists, woodworkers and independent sawmill contractors that operated outside of conventional hardwood supply chains.

Chapter 5: Making

> Rarely has there been a gift from the creator that has given so much to so many. (Plaque underneath a Wisqoq (Black Ash) in the Halifax Public Gardens)

Making is an act of making kin; a back and forth between matter and maker that can lead to unexpected outcomes. Furniture makers and basket weavers, craft traditions which have worked extensively with ash wood, understood these relationships well. Each craft has developed countless methods of working with wood's strengths and its weaknesses, its movement and its grain. The English word ash, in fact, comes from the old English *aesce*, meaning *spear*, indicative of its use in the making of traditional tools.

My own experiences in working with ash wood over the course of this thesis developed from a study of these traditional crafts of furniture and baskets. Because most hardwood suppliers in Nova Scotia import their wood from the United States or Germany, local wood for this thesis was supplied through a network of local arborists, independent sawmill operators and woodworkers that operated outside of conventional hardwood supply chains.

Furniture Making

Ash has been used extensively throughout the history of furniture making because of its strength, density and grain. Most wood used in furniture applications has been dried, or even kiln dried. Kiln drying wood reduces its moisture content below the average moisture content of its environment (around 7 to 9%). It is more dimensionally stable but harder to work. Green or air dried wood is significantly heavier but more easily workable. Some furniture making, such as traditional windsor chairmaking, utilizes both strategies and

Air dried board acquired for this project through an arborist and woodworker in Fall River, Nova Scotia. This particular board had been infested with the Emerald Ash Borer, evident in the pattern of bore holes left in its bark (right).

often different wood species for different applications within the chair.

Ash Furniture

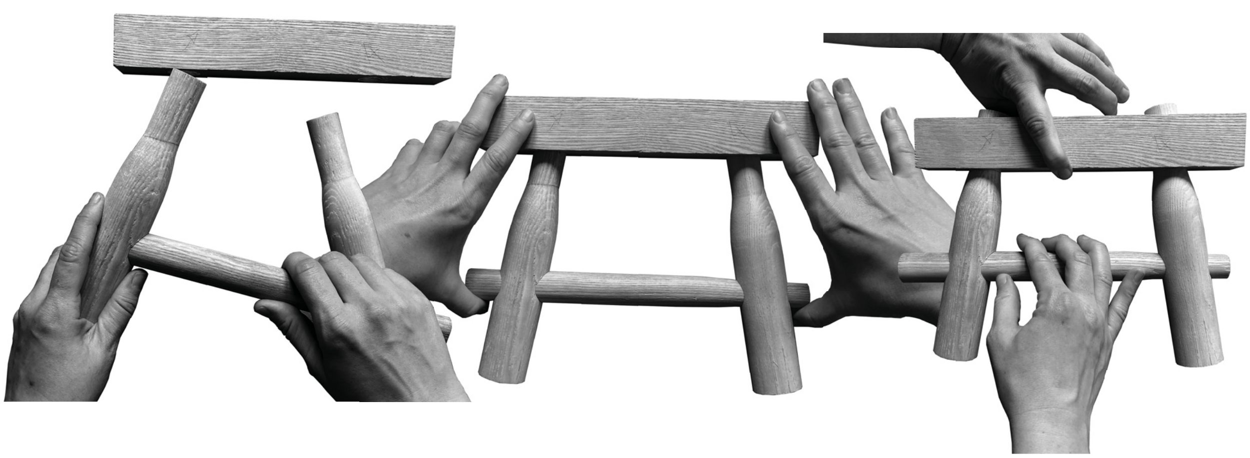
The Windsor chair is a 300 year old tradition that takes its name from the English town of Windsor where it is thought to have originated. There are many variations of Windsor chairs, but they are characterized by their use of slender, turned spindles anchored into a solid, wooden seat. The compound angle of the legs increases the structural stability of their connection, allowing the legs to be more slender than earlier methods of chairmaking. Chairs built in this fashion

High backed Windsor chair by Christopher Shwartz
(Shwartz 2016)

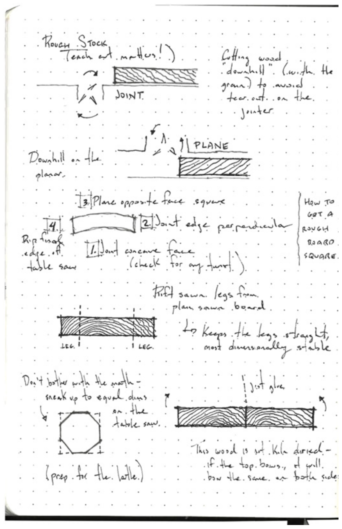
Straightest grain stock is selected for the legs, which are then ripped into octagons and turned on a lathe.

are capable of lasting hundreds of years given appropriate use and occasional maintenance.

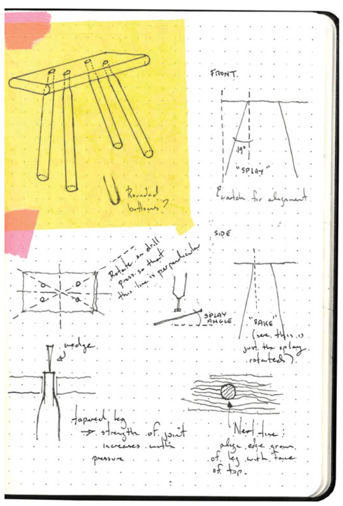
My own studies in furniture making started with a solid ash stool that uses the compound angle of Windsor chairmaking to connect the legs and seat. It was sourced from a locally grown ash tree that was milled in Blockhouse, Nova Scotia. The wood had not been kiln dried, but had been air drying outside for approximately 1 year with a moisture content between 12 and 18%. As wood dries, it warps tangentially along its grain. To accommodate this, I planed a fraction of the seat's material off each day over the course of two weeks. With each cut, more and more moisture was released until eventually the boards no longer wanted to cup and it could be cut to its final dimension. If the seat did eventually cup, the mirrored grain of both boards that comprise the seat would encourage the seat to cup symmetrically. Similarly, the bottoms of the legs are rounded off to account for any angling from the legs that would occur if the seat cupped.



Connection detail examining the effectiveness of compound angle joinery. Once assembled, the joint becomes an interlocking system.

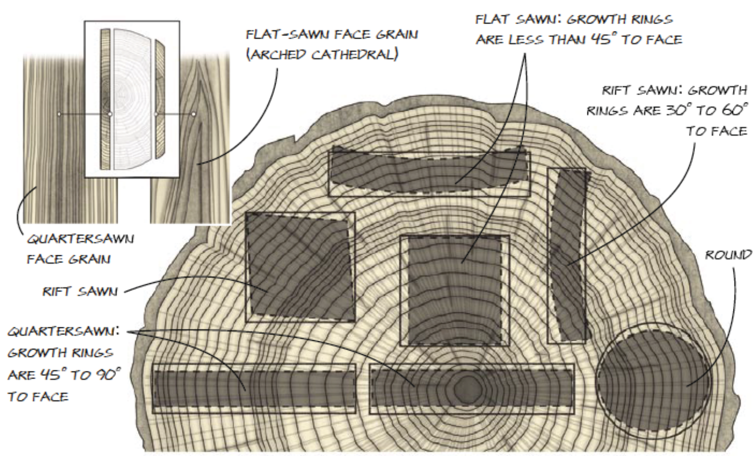


For making legs, chairmakers will always insist on using wood with the straightest grain running through its length to avoid any warping or twisting as the wood invariably absorbs and releases moisture. Because the wood used for this project was plain sawn lumber (the log is milled into boards regardless of grain direction), the ends of each board were selected for leg stock as the grain ran straight through the length of the board (this achieves an effect similar to rift sawn wood, a more dimensionally stable form of milled lumber).



Process sketches and notes, describing techniques used in making the ash stool

The legs of the stool are rounded on a lathe and are both splayed (angled from the front) and raked (angled from the side). The tenon of the leg extends through the full material



Type of lumber cuts and shrinkage

The stool’s seat cupped after one day of observation.

of the seat and is wedged from the top perpendicular to the direction of the seat's grain. Because of the compound angle, more pressure exerted on the seat of the stool only increases the strength of the joint. The wedge, tenon and seat would move in different directions, decreasing the chances of loosening the joint.

My own studies in furniture making were influenced by Windsor chairmaking and used wedged, compound angle joinery with rounded legs turned on a lathe.

Basket Making

Basket making in Nova Scotia is another tradition of craft with deeply historical roots. Many communities which settled in the province brought their own traditions of basketry with them, adopting traditional materials and techniques to suit the material climate of Nova Scotia. The legacy of basketry in Nova Scotia is thus rich and diverse. It is both a historical tradition and a contemporary craft.

European round witherod basketry by Joleen Gordon (top left); African Nova Scotian ribbed red maple basket by Edith Clayton; Black ash splint basket by Rita and Abe Smith (right)

Splint Ash Baskets

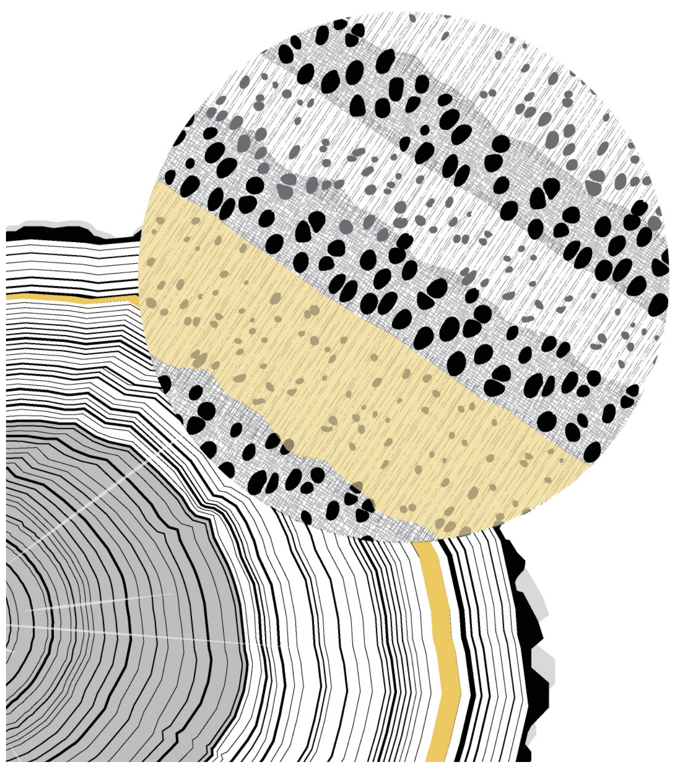
Indigenous communities across Eastern North America made their baskets out of ash. In the Mi'kmaq language, the tree is called Wisqoq (pronounced wis-koh). Its historical use in the making of baskets is intimately tied to the material culture and identity of Mi'kmaqi (Nova Scotia). Most commonly, it is the black ash which is used to make baskets although my own research indicates that white and brown ash are used as well (Maguire 2016). The knowledge of the tree and its methods of harvesting and weaving have been passed down through generations of makers.

Instead of milled lumber, basket makers work with splints. Splints are made by pounding a freshly felled ash log with the back of an axe. Black and white ash grow in wet and swampy environments so they absorb significantly more water in the spring, when the ground is wet. By the summer,

Mi'kmaq Splint Ash Potato Basket by Noel and Rita Smith from Glooscap First Nation, Nova Scotia (Smith, Rita and Noel. n.d.)

its water absorption and its rate of growth taper off to a more stable level, generating a unique pattern of growth rings that is both dense in its summer growth and porous in its spring growth. Pounding the log crushes its porous, spring growth, leaving the denser, summer growth to be peeled off the log in thin strips called splints.

Splints are a uniquely different material than milled ash. The selection of the tree is vital as not all ash trees are appropriate trees for basketry. Basketmaker Della Macguire recalls lessons from her parents and master basket makers Rita and Abe Smith, who learned from their own parents the “secret powers of the ash tree.” She writes, “If the woods are too thick the grain of the wood will be too thin. You need to go to the open woods and if the woods are too open,



Cross section of an ash tree and micro structure of spring and summer growth, indicating how one splint equals one summer’s growth.

then the ash will have thick grains because the ash will grow faster" (Maguire 2016). The tree itself must be straight and tall: "First you cut a little notch in the bottom of the tree to see the grains. Look to see how thick they are and if they are too thick you don't cut it down" (Maguire 2016). Harvesting too many trees from one environment would allow the wind to alter the trees' structure. These trees are left to seed the next generation of basket trees.

Making splints is a labour intensive process; a single log can take many days of pounding before it can be worked into splints, the sound of the pounding reverberating through the forest like the pounding of a drum. The splints are then peeled into even smaller thickenesses. The water content of the splints increases their elasticity, making them ideal material for basketry. Not only is the resultant splint more stable because the summer growth has more mass than its spring growth, any issues of grain are easily resolved as one splint equals exactly one year's growth ring.

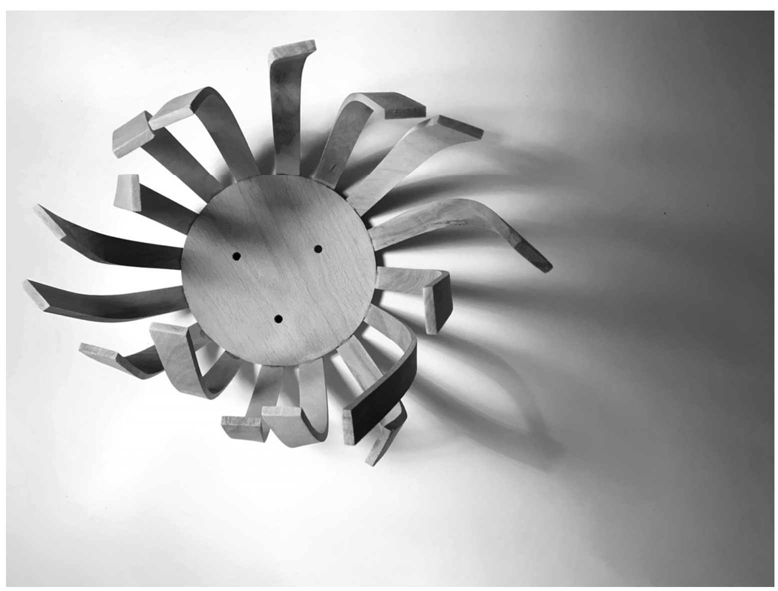
Ash splints. Each splint equals exactly one summer's growth.

Splints are pounded, halved and finished to be woven into baskets (base images from Fine Woodworking Magazine 1984).

Steam Bent Ash Basket

I was not able to access splints or a freshly felled ash log over the course of this thesis. Instead, I worked with dimensionally similar milled ash as a corollary material that was then steamed to achieve an elasticity similar to a splint. Over the course of this thesis, I experimented with bending wood using a range of different variables, such as the type of formwork used, degree of bend, duration the formwork is used and the thickness of the material itself.

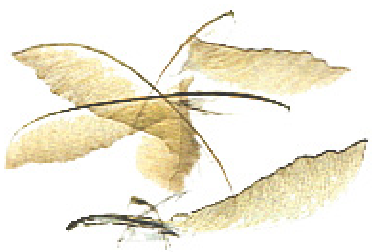
At a thickness of 1/8”, the wood was too rigid to weave but structure and strength could still be achieved through patterning and geometry. Alternating the base geometry and patterning generated a series of different three dimensional forms. Connections are made through small dowels into a base, using precise dimensions and forms to create a series of three dimensional objects.



First steam bent object examined how varying the degree and formwork used in bending can create a series of unique forms. Assembled around a radial base, the unpredictability of the wood becomes a pattern in the finished object.

Processes of steam bending using a kitchen pot as simple formwork.

Early examples of three dimensional objects generated by steam bending experiments.



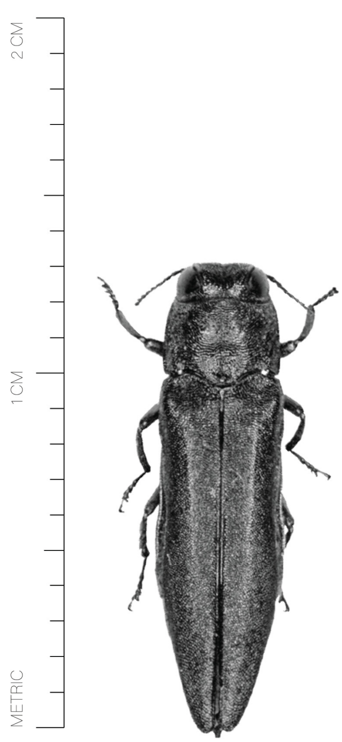
Steam bent ash basket layers 3/32” milled components whose bends are incrementally offset and connected with threaded brass hardware.

Chapter 6: An Insect

The Emerald Ash Borer

In its native range of northeastern Asia, the Emerald Ash Borer is an effectively benign organism typically found in low densities within a stable forest system. It is a small, bright emerald insect which lays its eggs exclusively on ash trees. Its larvae then burrow into the tree's thin, outer layer of bark, killing the tree by cutting off its supply of nutrients. Natural predators act as a balancing force against the exponential growth that could occur if the insect populations grew unchecked, and its impact is mitigated by a degree of resistance to the insect exhibited by species of ash trees native to northeastern Asia.

Once this insect is introduced into new ecosystems, however, it has the capacity to dramatically shift the stability of that system. In the mid 1990s, the Emerald Ash Borer was accidentally introduced to North America in the wood packaging material of container ships. It was first identified in Michigan in 2002 and has since spread rapidly, escalated by the transportation of wood across municipalities. In 2018, it was discovered in Bedford, Nova Scotia, 2400 km from its point of departure, having travelled at a speed of about 150 km/ year. Without any natural predators and with little resistance capable from North American ash trees, the Emerald Ash Borer has destroyed almost 8 million trees to date. Given its velocity and its impact, it is estimated that the insect will destroy nearly all the Ash trees in Nova Scotia within the next 20 years.

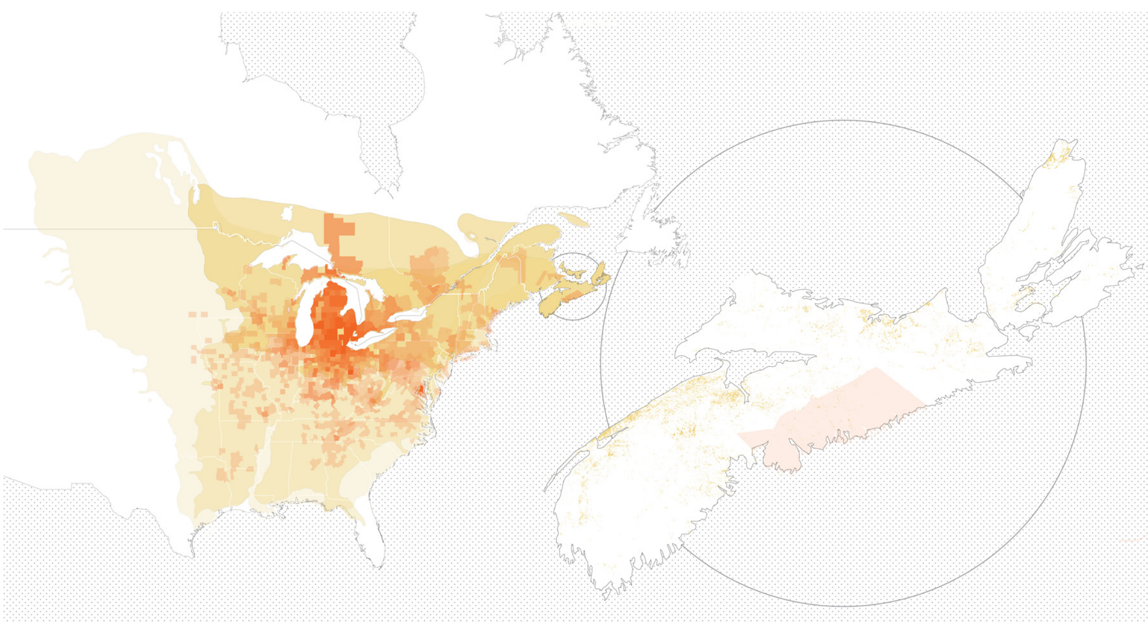


Emerald Ash Borer

Invasive species such as the Emerald Ash Borer are capable of altering the tipping points of ecosystem collapse and recovery. Invasive species populations are expected to be exacerbated with climate change, while indigenous species ranges and populations continue to be reduced. Ash trees are not the only tree to have faced extinction within the last century: eastern hemlock, American beech and American elm are currently facing similar predicaments while other continents inadvertently introduce regime shifting pathogens from North America. As science journalist Stephanie Pain writes, “Every part of the world has experienced a loss so traumatic that it’s left a permanent scar on the public consciousness” (Pain 2020).

Ash Conservation

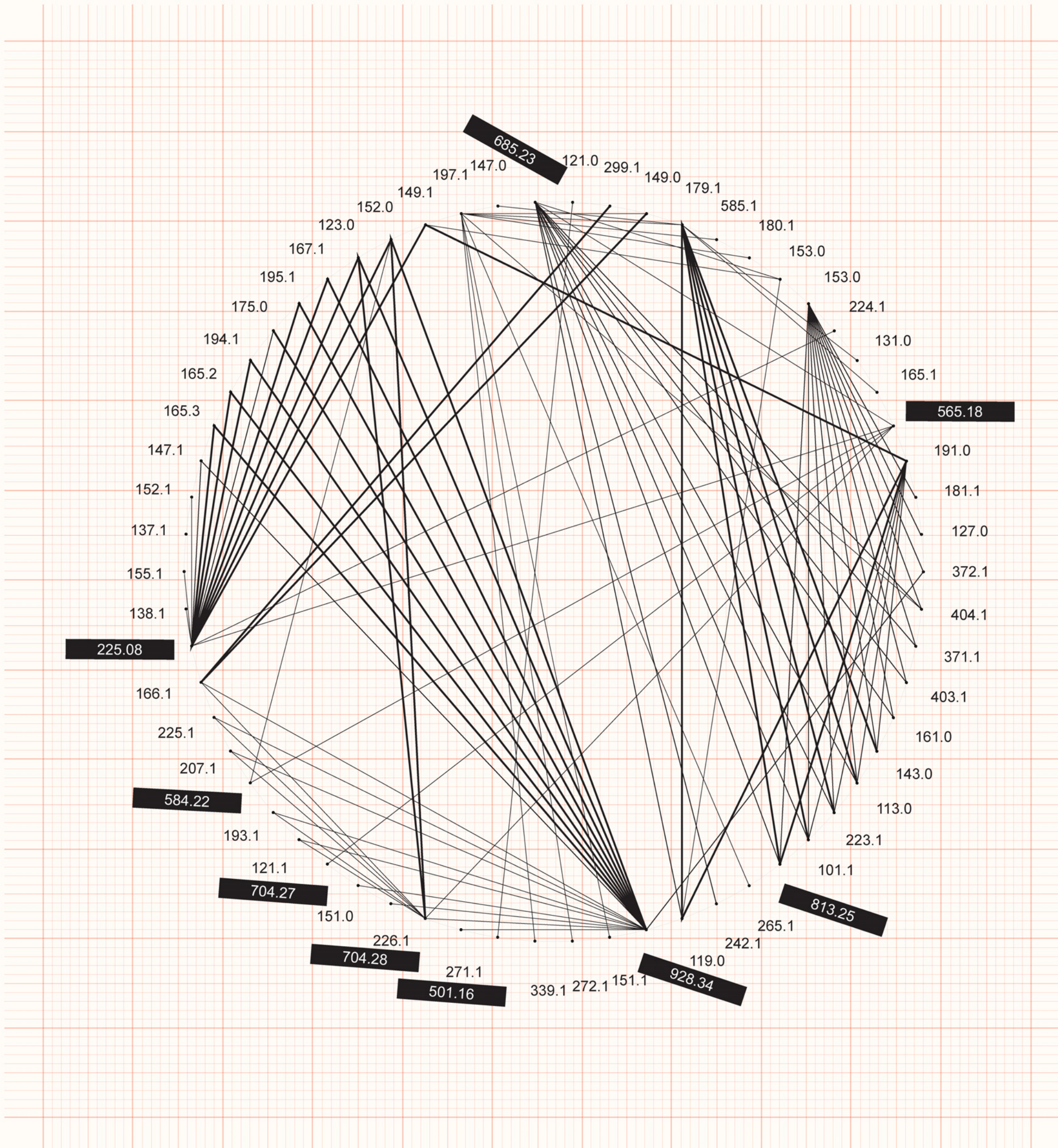
There are a handful of strategies for the recovery of ash with respect to the Emerald Ash Borer, each of which is actively being pursued in both North America and Europe. Introducing natural predators where the insect has been introduced is one method that scientists are researching.



Map indicating spread of Emerald Ash Borer (red) across native range of ash (yellow) (forestry data from NSDNRR 2021).

While this approach has its own potential for initiating unforeseen feedback loops, it could, if successful, reduce populations of the Emerald Ash Borer to a more manageable level. An even more radical approach is being tested in the UK, where ash trees face yet another threat from ash dieback, a fungal disease that infects native ash trees. Scientists have sequenced the ash genome to locate and isolate a genetic sequence that is resistant to the beetle's effect. If successful, they could continue to clone and breed disease resistant ash trees, mitigating the insect's effect.

A more passive approach to the recovery of ash trees would be to harvest their seeds and store them until they are able to be planted. The seed is life embedded in a mathematical sequence, capable of preserving the genetic sequence of ash while the tree itself disappears. The Emerald Ash Borer is a parasite and will eventually destroy its only host. At this point, the insect's populations will dwindle. Most likely, the Emerald Ash Borer is now part of our ecosystem and will never be truly gone. However, there will come a time when the populations of trees and insects will have depleted to such an extent that it will be safe to replant these seeds harvested before the infection. The timelines of this sequence are merely a hypothesis, but researchers suggest that it could take several hundred years.



Fragmentation Network of an Ash Genome

Fraxinus excelsior
white ash

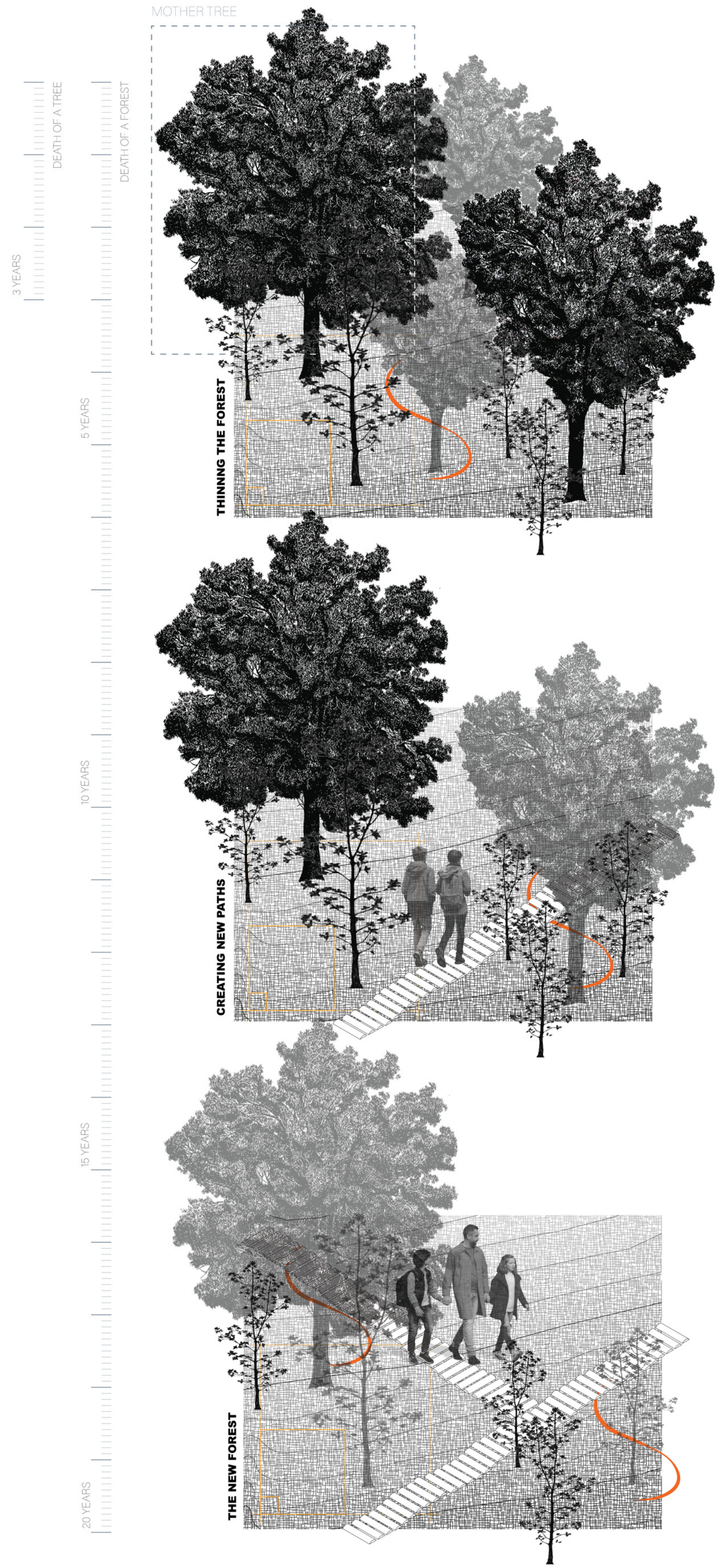
The genetic sequence of ash has recently been mapped by researchers in the United Kingdom. The fragmentation network above indicates the relationship between different ions which generate the unique qualities of the ash tree (data from Sollars et al 2017).

Chapter 7: The Studios

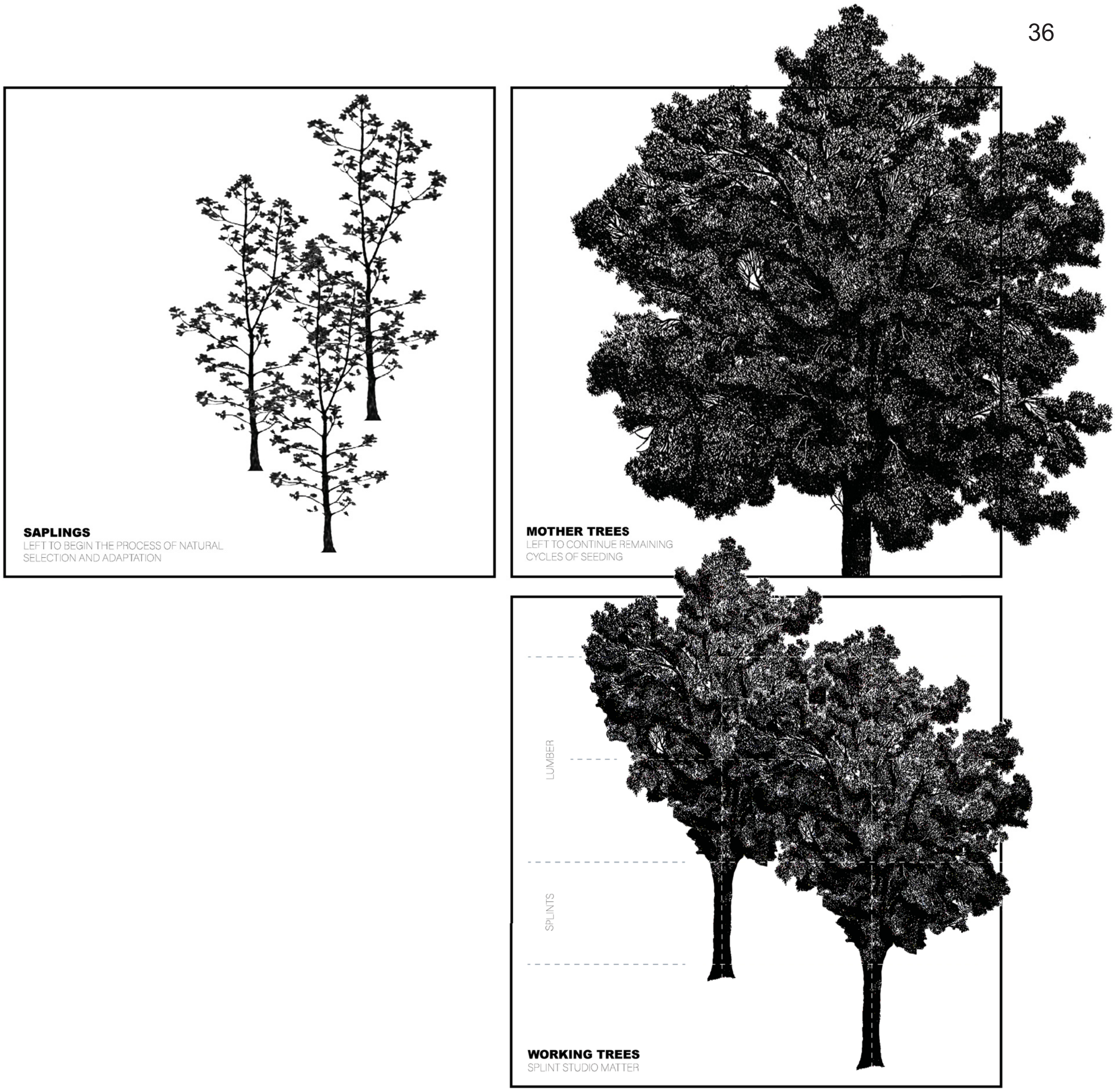
Thinning the Forest

Splint Studios engages with the surplus of matter generated by the Emerald Ash Borer. The more ash trees there are for the insect to infest, the faster it will spread. For this reason, thinning the forest of ash slows the spread of the Emerald Ash Borer, which can be strategically implemented to protect certain trees and harvest others. Mother trees are the “biggest, oldest trees in the forest. They are the glue that holds the forest together, acting as central hubs for vast below ground mycorrhizal networks” (Schiffman 2021). These trees are left in the forest to continue their cycles of seeding. Saplings are also left in the forest to begin the processes of natural adaptation to the Emerald Ash Borer. An existing series of paths throught the Wolfville Watershed Preserve is used to access the trees chosen for harvest, while, over time, new pathways are created through the forest to access more and more ash. This new system of paths allows greater access to the forest for surrounding communities as the structure of the forest changes with the loss of ash trees.

The architecture developed within this temporal realm of the forest is derived from the material qualities of freshly harvested ash wood. This wood is green, sappy and wet, with elastic properties that lend themselves towards tensile based structures. The architecture of the Bent Wood Pavilion and of Splint Studios were generated through studies into both bent wood structures and the architectural application of splints, studies which were informed by earlier experiments into bent wood baskets (see Chapter 5: Making). They also



Mapping the temporal sequence of the forest as ash trees are thinned and new paths are created.

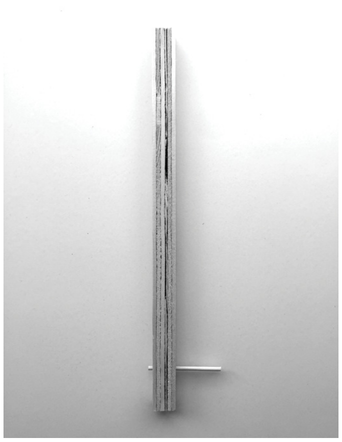


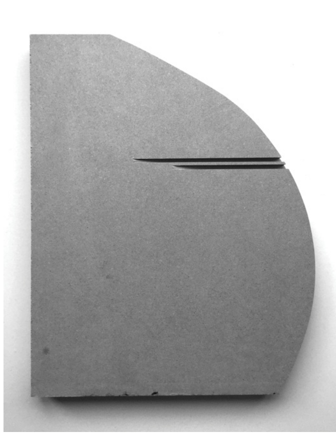
Thinning the forest strategically omits mother trees and saplings, while developing strategies for the greatest use of those trees which are harvested.

develop from the strategic use of ash trees harvested during the thinning of the forest.

Bent Wood Pavilion

The Bent Wood Pavilion exploits the elastic potential of wet, sappy, freshly thinned ash to create a structure of bent, laminated ash wood. Identical components are laminated together to create columns which fan outwards towards a canopy. Here, these members are connected through





Formwork and jigs used to create the Bent Wood Pavilion. Bending formwork allows for airflow while the components dry. Jigs used to measure and cut the components ensure they are all identical.

Connection details for Bent Wood Pavilion. Half lapped joints (top) and pin connections (bottom right) hold identical components in tension. Each component is laminated to a column which is connected to the ground via an embedded stake. Triangular grid is marked out on the pavilion's base.

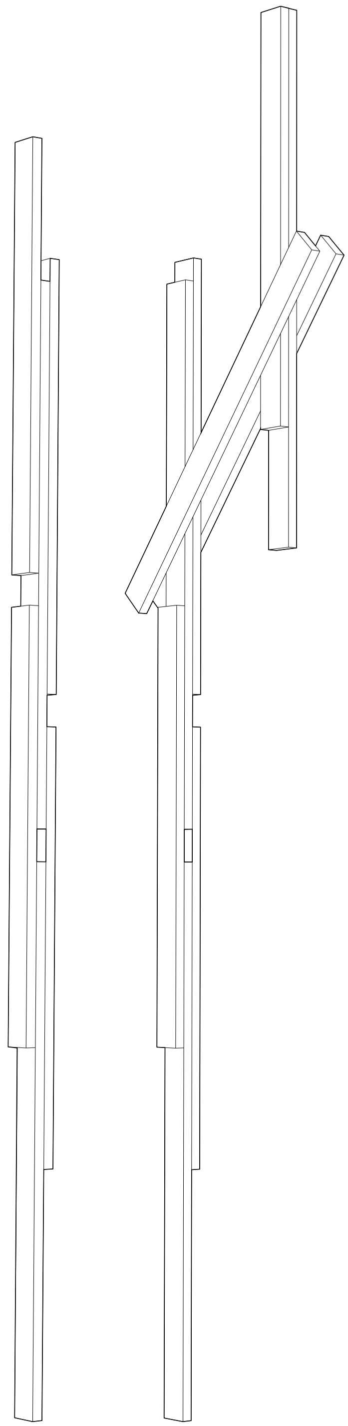
a series of lapped and pin joints, generating its structure through the tensile strength of the system as a whole. The triangular grid can be reconfigured or expanded to create a series of different arrangements. Its most basic triangular configuration as modelled can be used to mark a specific circumstance of the forest, such as the location of a Mother Tree or the creation of a new path. Repeated across a larger configuration, the pavilion can became a place of gathering in the forest for community members participating in the harvest of seeds and wood.

Top view of Bent Wood Pavilion, using a triangular grid of identical, bent components.

Ash wood model of the Bent Wood Pavilion, which generates its strength through the connections in its canopy and rests lightly on the forest floor so as not to disrupt the trees' underground

Rendering of Bent Wood Pavilion expanded into a larger configuration along a triangular grid.

Splint Studios

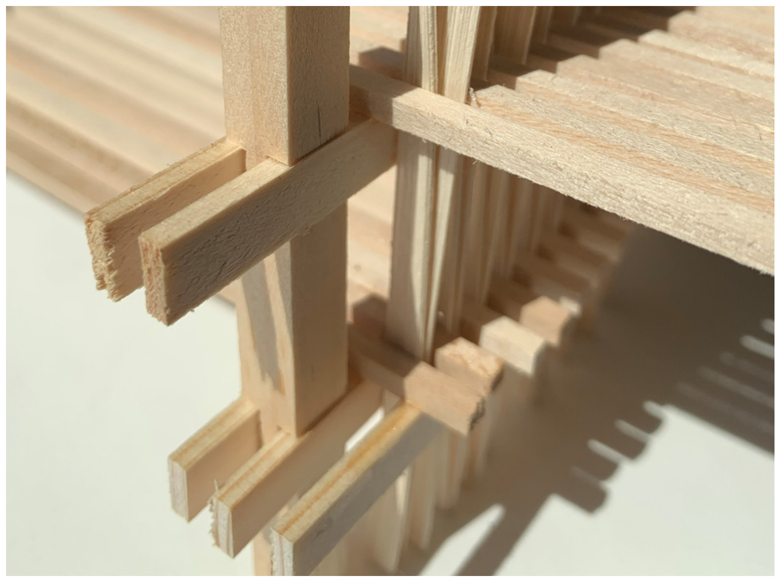


Small dimensional lumber assembled to create modular columns. The columns are embedded with a series of notches to support horizontal members at various configurations.

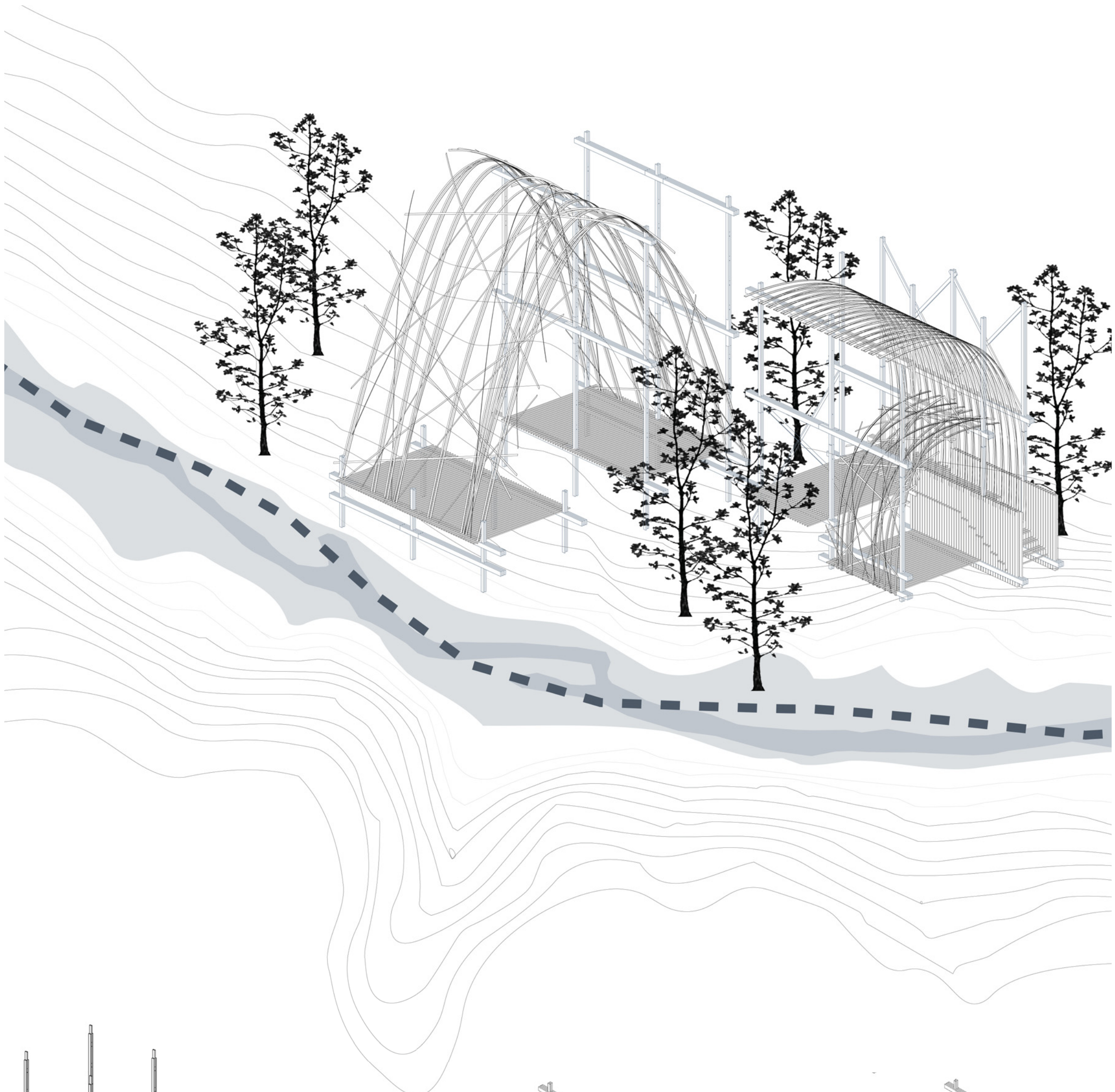
Splint Studios introduces a basket weaving studio along the watery valleys of the Wolfville Watershed Preserve to support the traditions of splint ash basket making while ash trees still remain. The Studios are strategically situated between the Mi’kmaq community of Glooscap and the settled town of Gaspereau as a way to bridge the knowledge of working with these trees across distinct communities. Glooscap First Nations Reserve has been home to many basket makers, including former chief, Rita Smith, her husband, Abe Smith, and their daughter Della Maguire, two generations of basket makers and teachers.

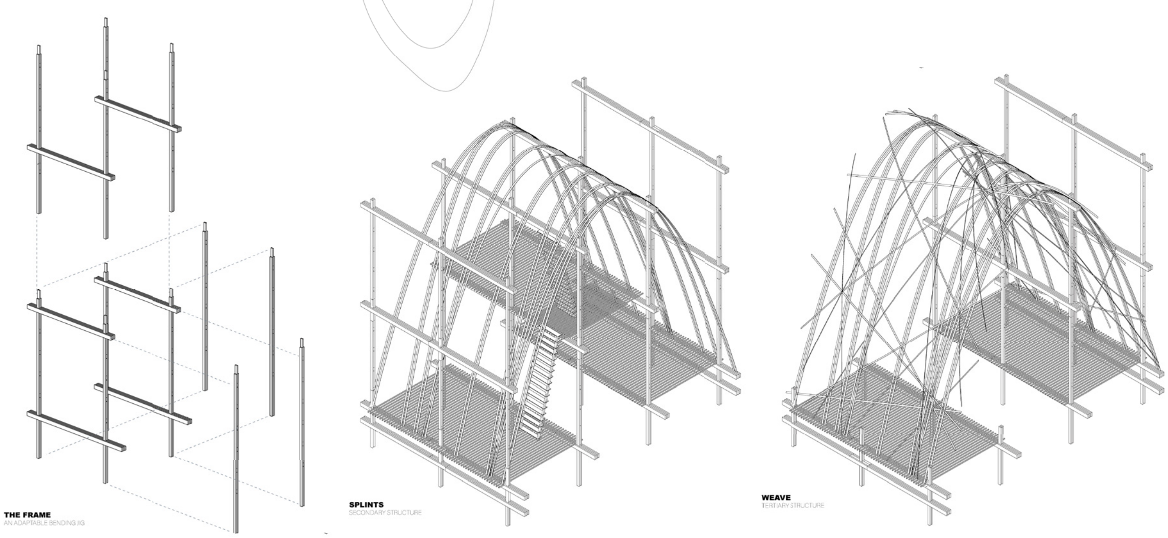
The architecture of Splint Studios is derived from a study into the architectural application of ash splints. Unlike the Bent Wood Pavilion, which utilizes milled ash that is steam bent into form and then assembled into a pavilion, splints can be bent without steaming with the use of a modular form. Splint Studios expresses both the form and the bend in a modular construction that can be continuously made and remade. The form is made from small dimensional lumber that is assembled to create a notched column that can be arranged in different configurations to suit various applications of floor, wall and roof. Splints are connected to the frame (see modelled connection details on next page) and bent to create walls and canopy. Finally, another layer of splints are woven which gives structure to the entire system. The frame can be removed or left in place as the program changes and expands.

Within the next twenty years, there will be very little ash to support the program of the space. Accordingly, the architecture of Splint Studios is not meant to be permanent but to correspond with the temporal realities of the extinction of ash. The green wood of Splint Studios will eventually decay, returning into the soil of the forest floor from which it emerged. The material limits of Splint Studios reflects the restraints of working with natural materials - restraints that mass production and global lumber markets conceals. Once there are no more ash trees able to be harvested from the florest, baskets made at Splint Studios will be all there is left of the trees.



Sketch model exploration of splint to frame connections, using flat reed as a modelling material as a corollary for splints.





Top: Axonometric view of Splint Studios relative to topography.
Bottom: Construction sequence of Splint Studios, showing the modular frame which can be removed or left in place as the system of bent and woven splints becomes structural.

Perspective view of Splint Studios. The stochastic weave pattern references the fragmentation network of the ash genome and creates various conditions of shading for activities below.

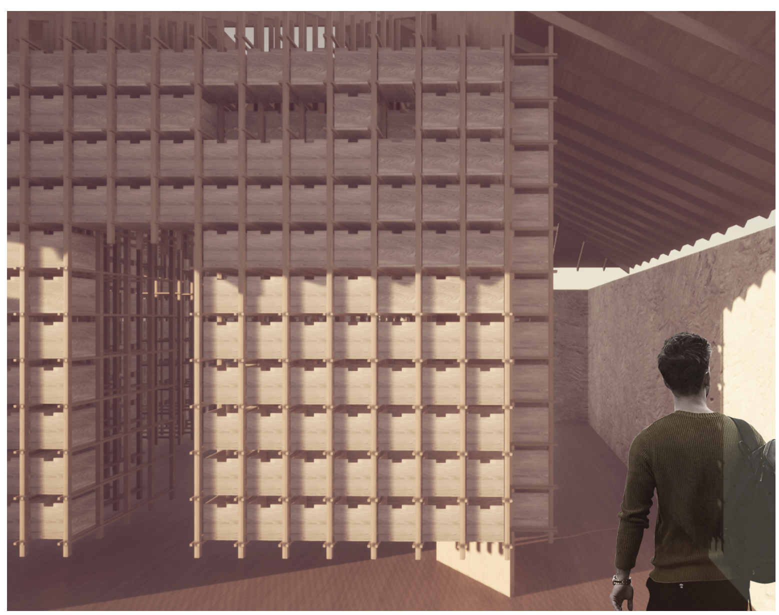
Chapter 8: Seed House

Seeds harvested before and during the infestation are stored at Seed House. Seed House stores the genetic sequence of ash trees until dieback of the Emerald Ash Borer makes it safe to plant them, a temporal sequence that sets up the architectural requirements of the building. The studies of this program explore the passive thermodynamic potential of a thermal mass to minimize maintenance or mechanical systems that might be disrupted over the following 200 years. It explores also the limits of material decay and the challenges of communicating to future users what the building stores within it, after the narratives of ash trees and their extinction have likely been forgotten. In this way, Seed House is both a monument above ground that memorializes a loss and, below ground, a time capsule that stores the potential for future life.

Storing Seeds

Storing seeds would have been a familiar if forgotten ritual in the agricultural communities bordering the Annapolis Valley. Farmers would have harvested their seeds for use the following season, storing the seeds in a seed cabinet, a vernacular piece of solid wood furniture of wood rails, drawer slides and panels. The word cabinet comes from the French, “cabinet”, a diminutive of the word cabin which describes a small house.

Deconstructing the seed cabinet reveals a skeleton grid of wood rails and drawer slides. This system is expanded into a room that is wrapped in a mass wall and buried below the ground. Long term preservation of seeds requires specific environmental conditions that keep the seeds



Deconstructing a traditional seed bank reveals a skeleton grid of wood rails and drawer slides (top left). Bottom image explores expanded this system into a room, where seeds are stored in drawers.

Seed Lot Identification

Collector's ID

Seed Lot Number

Date of Collection

Collector's Name

Species ☐ Black ☐ White ☐ Green

Province County

GPS Coordinates: LAT LONG ELEVATION

Accuracy +/- FT

Number of ash trees within 20 to 40 ft of this tree

☐ 0 ☐ 1 ☐ 2 ☐ 3 or more

Number of other trees (not ash) within 100 ft of this tree

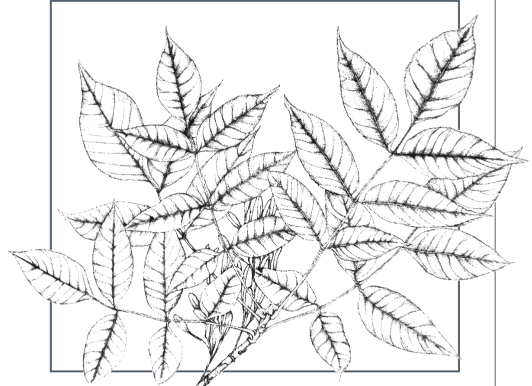
☐ 0 ☐ 1 ☐ 2 ☐ 3 or more

Distance between this tree and nearest other ash tree from which seeds were collected

☐ 100 ft (min) ☐ 200 ft ☐ more than 200 ft

SOIL

☐ Rocky
☐ Gravel
☐ Sand
☐ Loam
☐ Clay



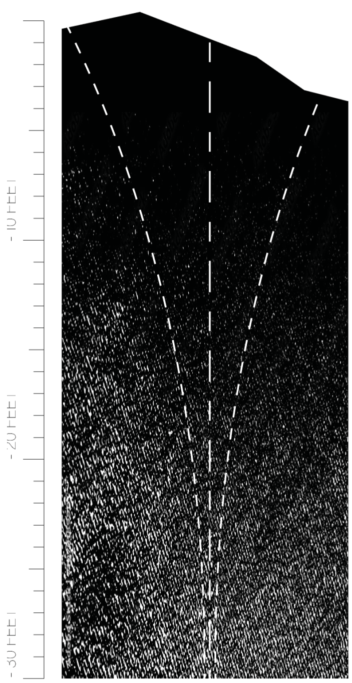
Tree Photos

Twig Sample

Data sheet for collecting seeds includes information relevant to the quality of each seed (data from Lady Bird Johnson Wildflower Centre 2003).

at a cool temperature and protect them from moisture. Mechanical systems and engineered skins are costly and require continuous maintenance. The National Archives of Canada serves as a case study for Seed House as it engages both mechanical systems and passive methods for

National Archives of Canada (IKOY Architects n.d.)

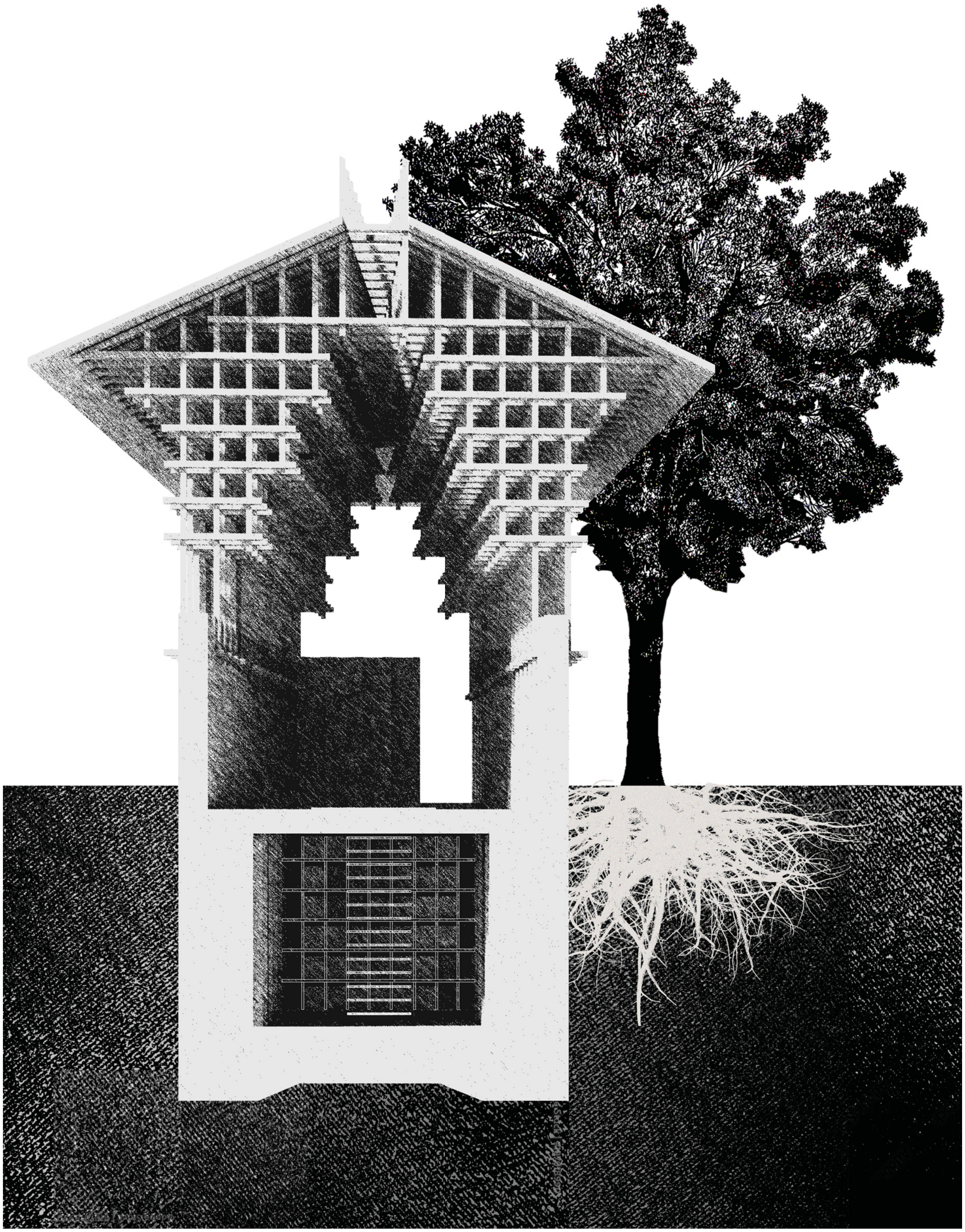


The temperature of the earth 20 to 30 ft below grade is a relatively constant number year-round, somewhere between 8 and 10 degrees Celsius.

tuning materials in conjunction with natural environments. An interior concrete bunker acts as a thermal mass that maintains its interior temperature at the ground's steady temperature, while a glass skin is a thermodynamic buffer. Concrete landscaping around the structure deters any natural plant life or insect from approaching.

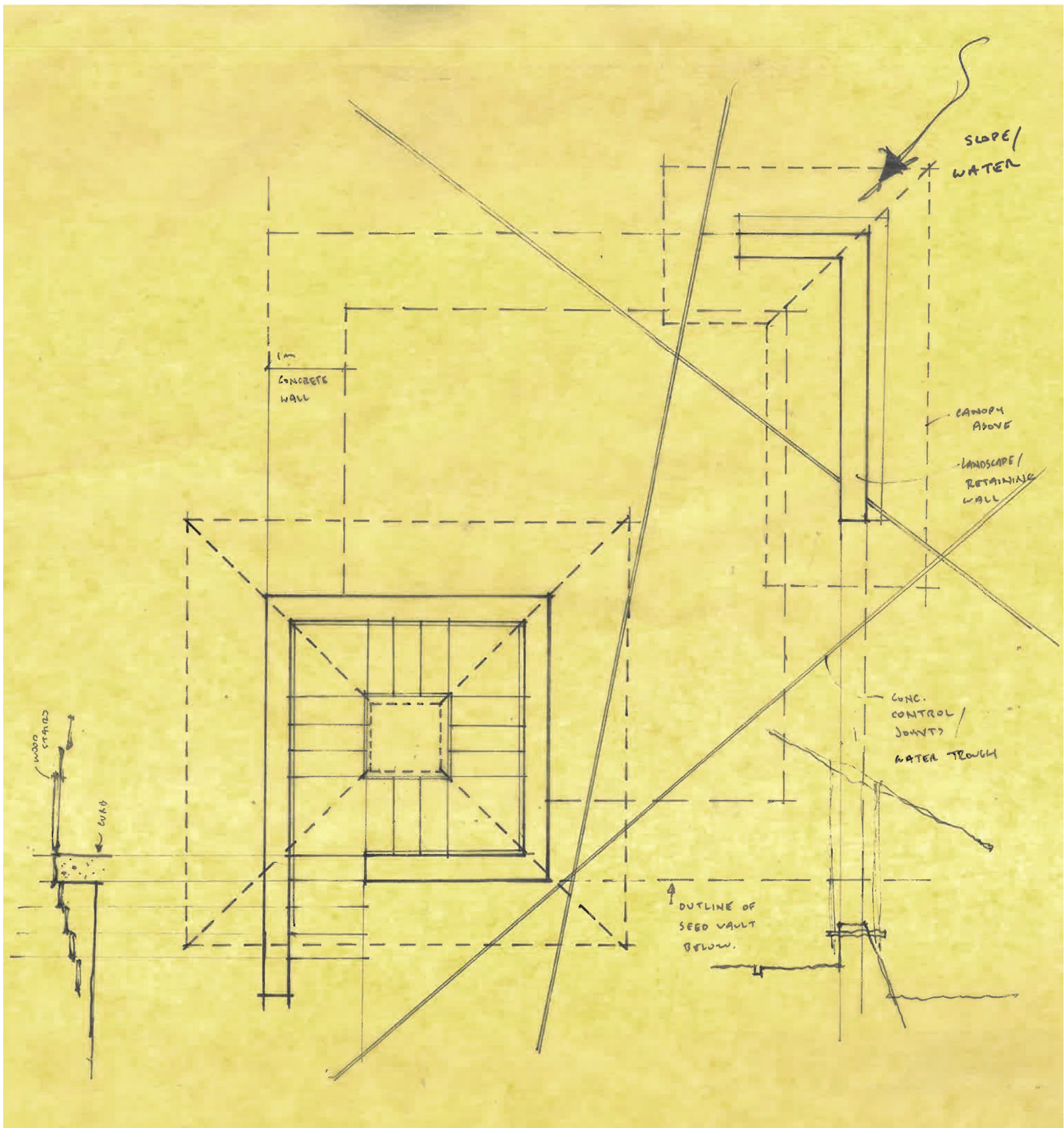
The walls of Seed House are constructed from a thick, concrete wall which keeps the interior vault within it tuned to the constant ground temperature, around 10 degrees Celsius. The language of wood framing within the underground vault is extended into the framing of the roof above, angled to reveal a thin wedge of glazing in the roof which allows light to guide users into and through the building.

In addition to being kept at a cool, stable temperature, long term preservation of seeds requires strategies for diverting water. Siting Seed House on the ridge of the South Mountain Range is the first strategy used to prevent moisture from



Seed House section, showing the relationship between the underground vault and the building above. Thick, concrete walls maintain a constant temperature within the vault, while the canopy above shades the concrete and diverts water.

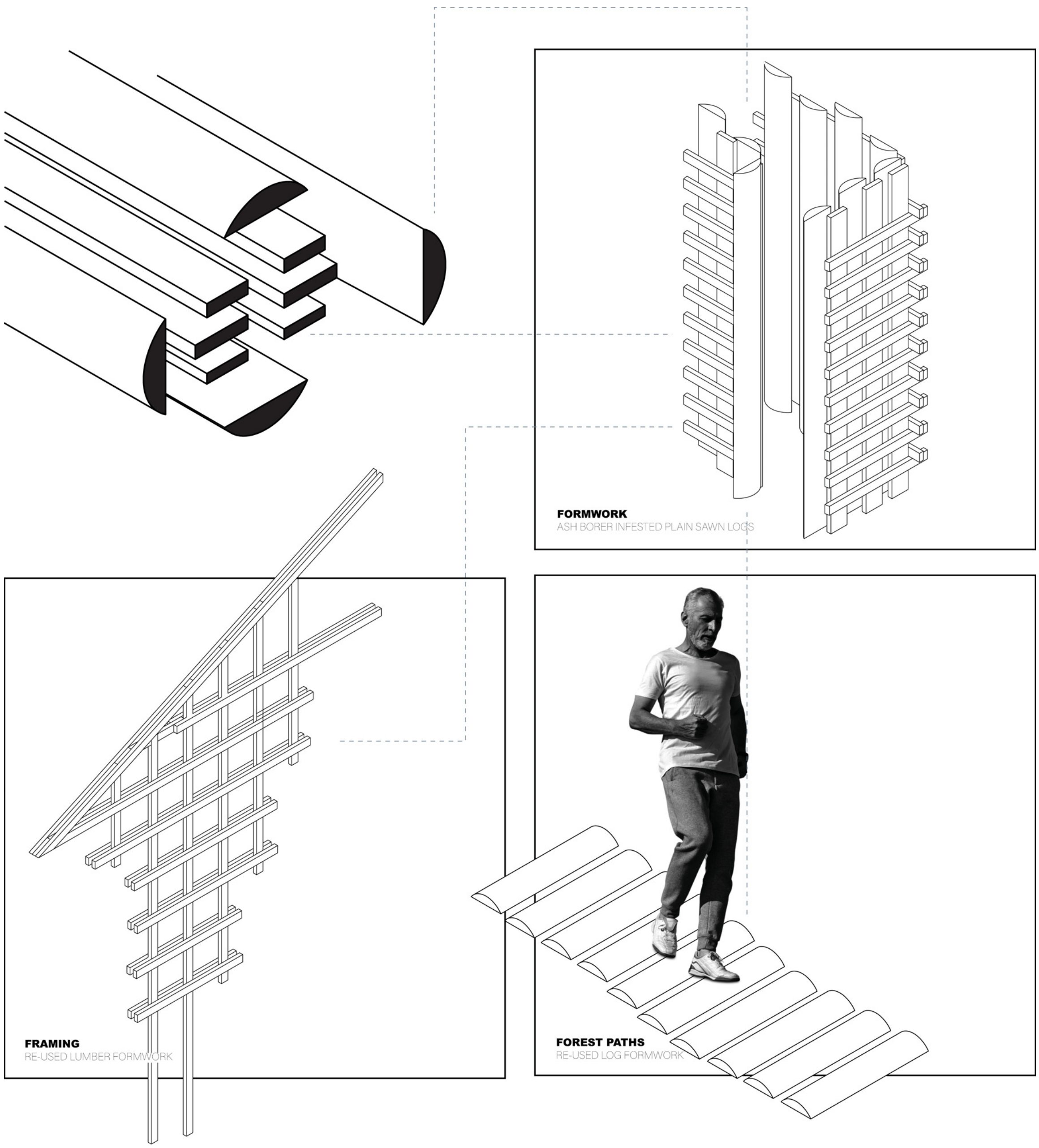
penetrating the underground vault. Concrete is used as a curb at the entrances to the building as well as to create secondary retaining walls that divert water away from those entrances, while the roof's overhang channels water away from the building and shades the concrete below.



Sketch indicating water diversion strategies explored in plan view, including directed water catchments and concrete retaining walls

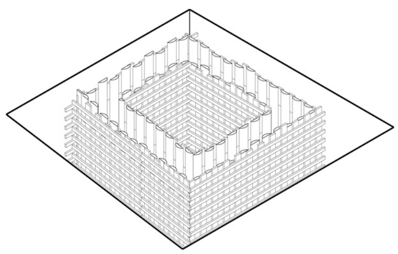
Emerald Ash Borer Formed Concrete

The Emerald Ash Borer channels through the tree's inner bark, leaving a distinct pattern on the outside edges of the wood. To use this wood, Seed House adopts standard plain sawn milling techniques in creating the formwork for its walls and the framing of its canopy. The infested outer

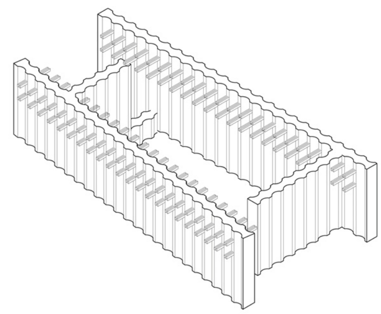


Emerald Ash Borer infested wood is used to construct formwork for the building's walls and framing for its roof. Formwork is then laid on the forest floor to create a series of paths.

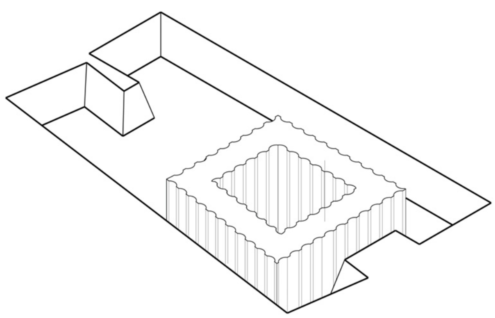
edges of the wood are used to create concrete formwork, creating a wall that imprints both the curvature of the logs and the pattern of the emerald ash borer. Horizontal framing members are embedded in the concrete wall to connect the framing (see construction sequence drawings below).



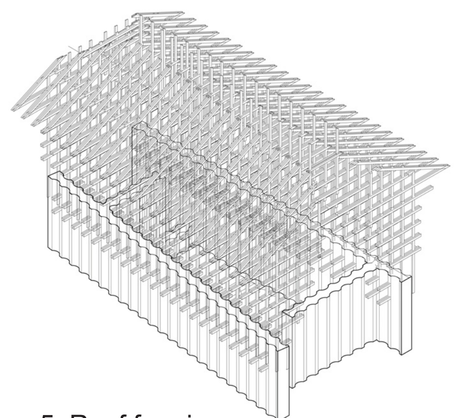
1. Below grade vault formwork



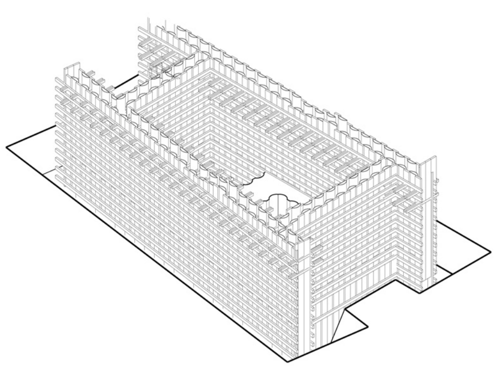
4. Above grade walls



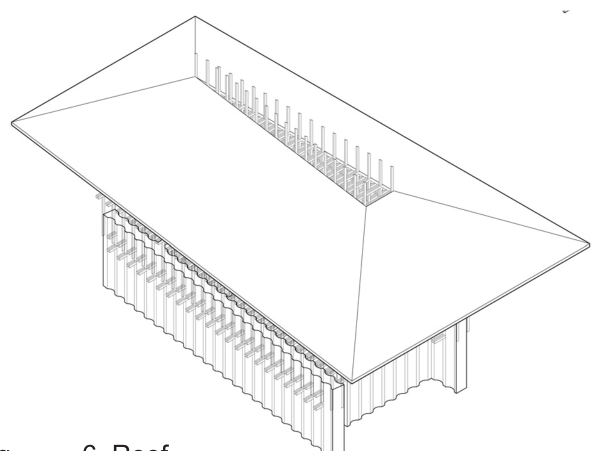
2. Above grade walls sitework



5. Roof framing



3. Wall formwork with embedded framing

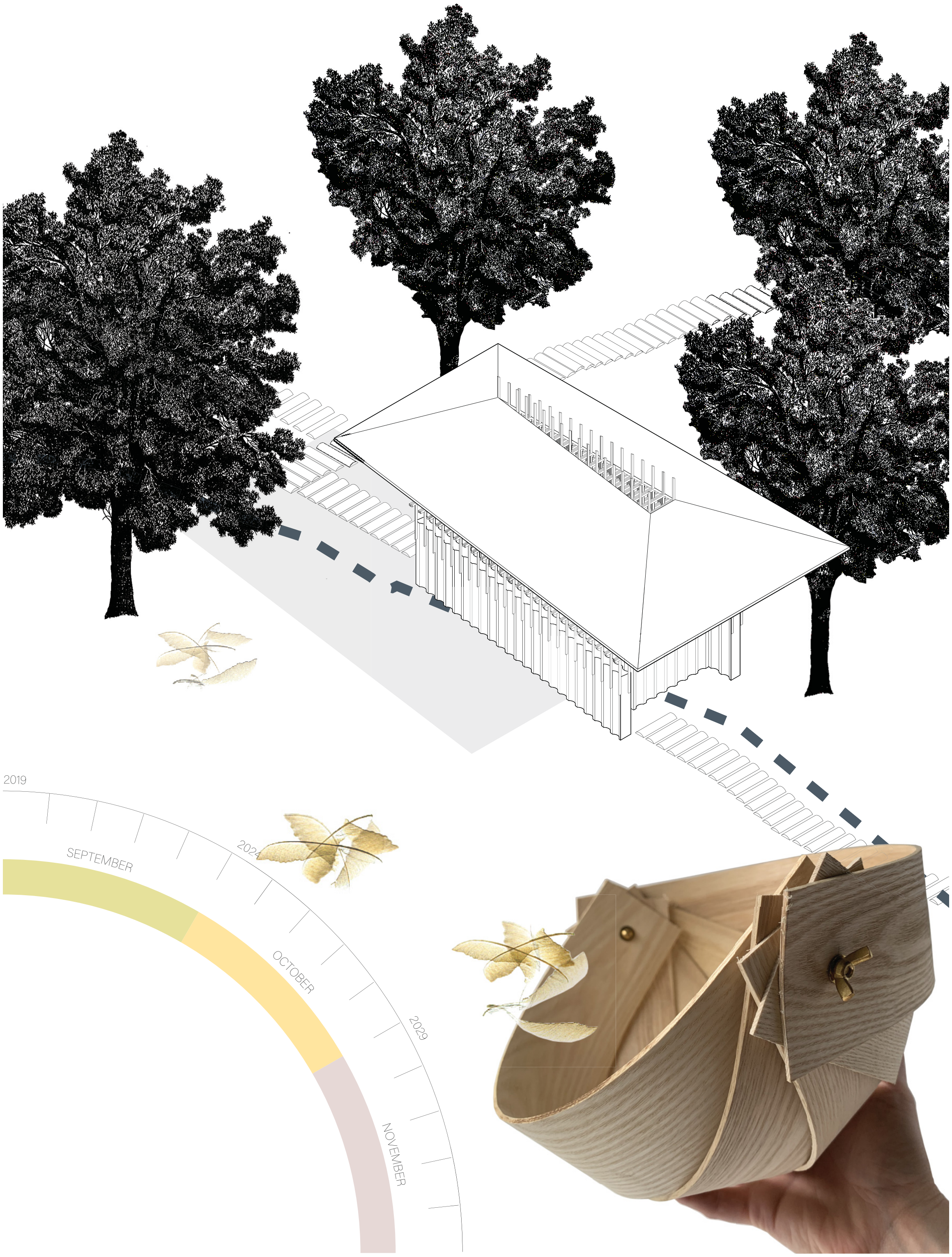


6. Roof

Sequence of construction for Seed House, using wood infested by the Emerald Ash Borer to create walls and roof framing.

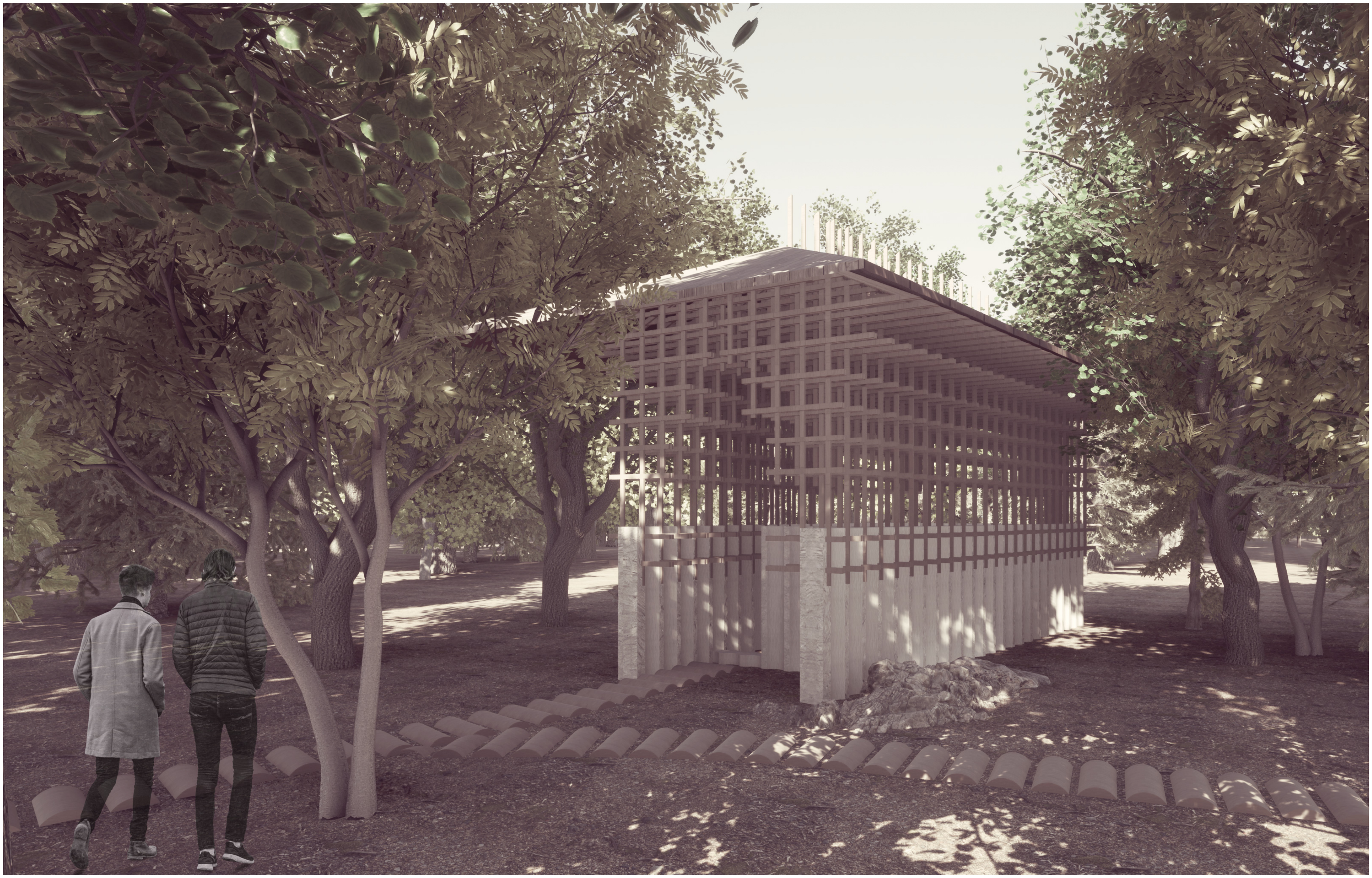
Modelling formed concrete walls with Emerald Ash Borer infested wood.

Rendering of Seed House’s formed concrete walls.



Axonometric view of Seed House superimposed with methods of harvesting seeds. Ash trees produce seeds for harvest once every 5 to 7 years and are ready to be harvested by the fall, around the middle of September for white ash and the middle of October for black ash.

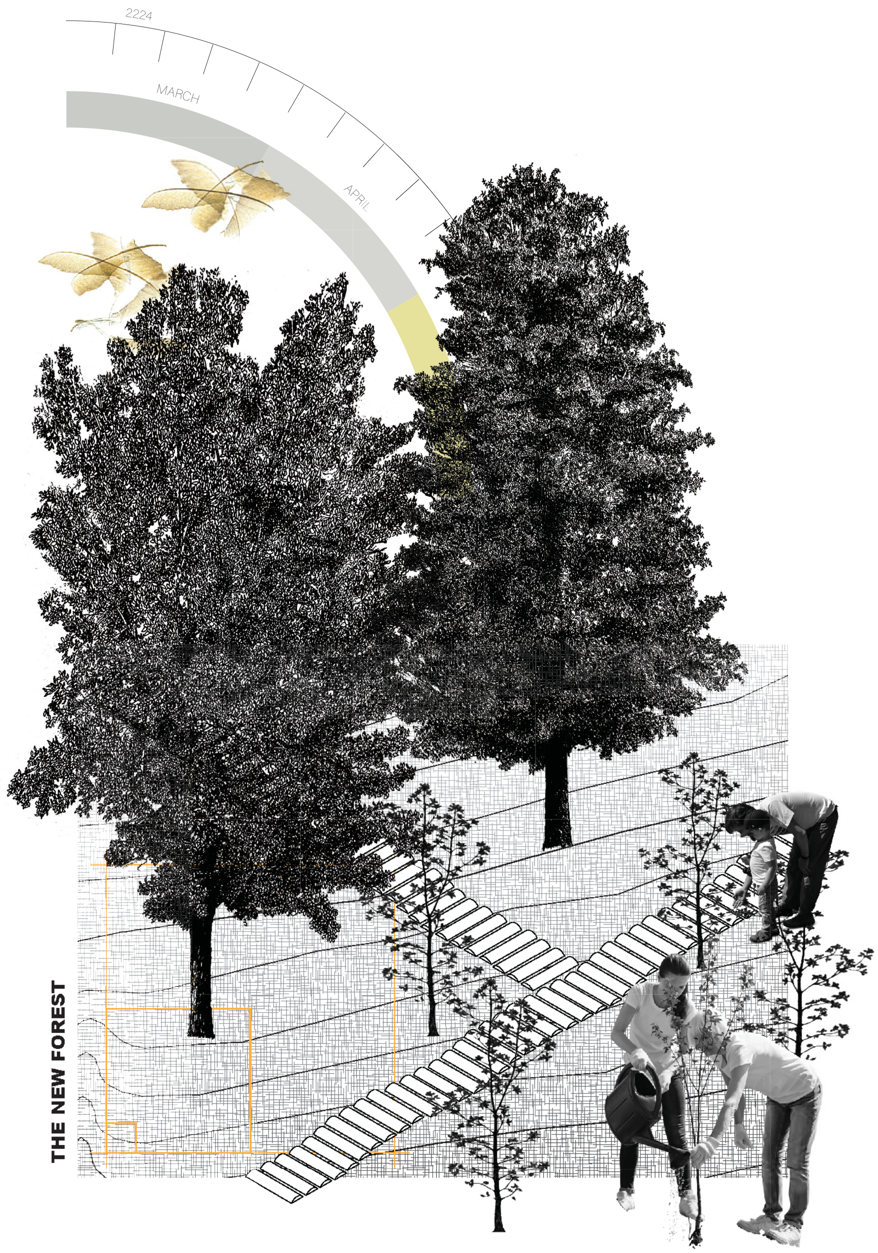
Interior rendering of Seed House, showing ground plane and access door to concrete vault below.



Rendering of the approach to Seed House, nestled on the ridge of the South Mountain Range in the Wolfville Watershed Nature Preserve.

Planting Seeds

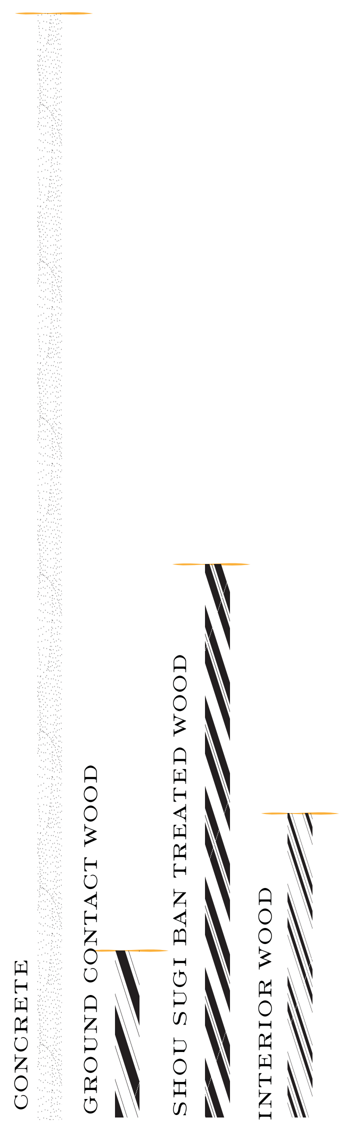
Assuming a 200 year timeline for the dieback of the Emerald Ash Borer means that it will be the year 2222 by the time the seeds stored at Seed House can be safely planted in the forest. At this point, the building itself will be no more than a ruin of the monument it once was. Materials decay at



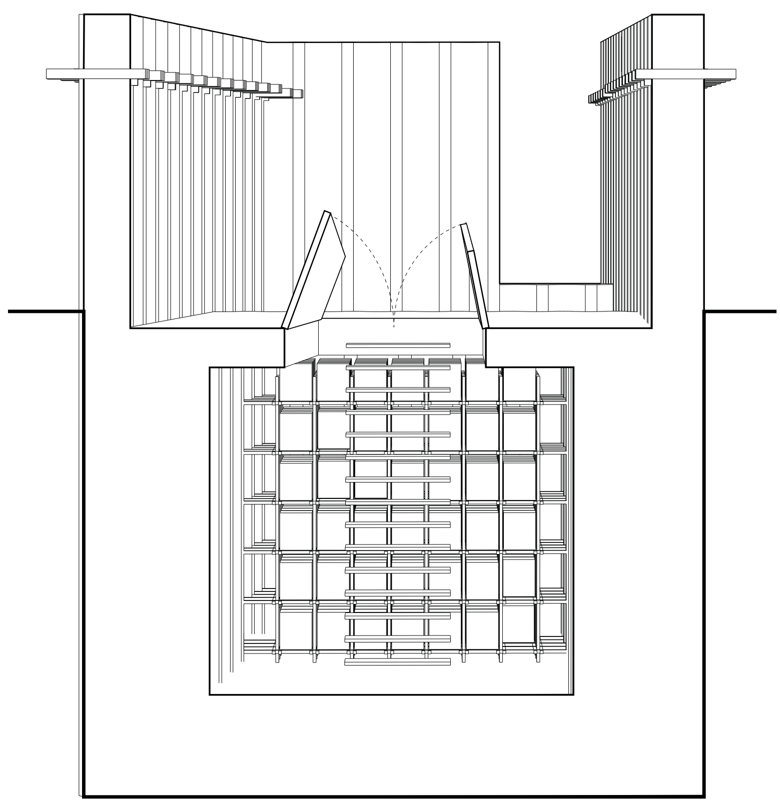
Speculating towards the planting and caring of ash seeds stored at Seed House in the year 2222.

differing rates. The concrete walls that protect the seed vault below would likely last, although the wood framing members would degrade at a much quicker rate.

Over time, the ruin is discovered by passersby walking through the forest along a series of paths that had been created to access the trees. Its program, over time, would likely be obscured as the narratives of ash trees and their extinction are themselves obscured. The ruins of Seed House are an anchor to this particular narrative of ash, an insect and an accidental introduction, offering clues in its strangely patterned concrete and hidden chamber to the origins of its myth.



Comparative analysis of materials' rates of decay



Partial section showing access to the seed vault below

Rendering of the approach to Seed House in the year 2222, when the building is merely a ruin of the monument it once was

Discovery of the ruins of Seed House in the year 2222. Concrete door handles formed in the replica of the ash seed’s singular samara attempt to communicate what lies below.

Chapter 9: Conclusion

Memories, like matter, decay; they twist, distort or fade alltogether from our consciousness. Researchers suggest that this, too, is a form of adaptation as organisms adapt their memories to suit their cognitive and emotional goals (Anderson and Hulbert 2021). Just as the forest will adapt to the disruption of the Emerald Ash Borer by introducing new tree species to replace ash, we adapt the fragments of collective memories and turn them into stories. Stories are powerful and provocative engines. They mythologize our past and mould the actions of our future. As Donna Haraway states, “it matters what stories we tell to tell other stories with” (Haraway 2016, 12).

Architecture itself is a form of storytelling; a means of extending unseen phenomena of interaction into three dimensional form and space. The design research of this thesis emerged from an understanding of the many different actors, both human and nonhuman, involved in this particular phenomena of interaction. The accidental introduction of an insect has catalysed the deaths of many millions of ash trees, fragments of which have been cast in the board formed concrete that will sustain its form long after the woody mass of formwork has decomposed. Iterations of a bent ash basket may ebb and flow from a material standpoint, responding to the changes in the forest as the abundance of matter sparked by the Emerald Ash Borer recedes into sparser and sparser iterations.

The extinction of ash trees within our generations is, to be sure, a heartbreaking event. But disturbances in general are not unfamiliar to forests. Disturbances are, in fact, ordinary events which generate the heterogeneity of the landscape.

Adopting agility and curiosity as we bear witness to such extraordinary moments in history invites participation in what is yet to come. The extinction of ash trees is but a microcosm of the spiralling ecological devastations we will continue to face. Learning to “stay with the trouble of living and dying together on a damaged earth” will prove more conducive to the kind of thinking that would engender more livable futures (Haraway 2016, 1). We may not be able to stop events such as this one, but we can be a part of it.

References

Anderson, Michael C., and Justin C. Hulbert. 2021. “Active Forgetting: Adaptation of Memory by Prefrontal Control.” *Annual Revue Psychology* 72 (January): 1-36.

Bennett, Jane. 2010. *Vibrant Matter: A Political Ecology of Things*. Durham, NC: Duke University Press.

De la Bellacasa, Maria Puig. 2017. *Matters of Care: Speculative Ethics in More Than Human Worlds*. Minneapolis, MN: University of Minnesota Press.

Fine Woodworking Magazine. 1984. “Fine Woodworking on Bending Wood.” Newtown, Connecticut: Taunton Press.

Forman, Richard T., and Michel Godron. 1986. *Landscape Ecology*. New York: Wiley.

Haraway, Donna. 2016. *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, NC: Duke University Press.

Ibanez, Daniel, Jane Hutton, and Kiel Moe. 2019. *Wood Urbanism: From the Molecular to the Territorial*. Barcelona: Actar Publishers.

IKOY Architects. n.d. “National Archives of Canada.” https://www.ikoy.com/project/national-archives-of-canada/.

Kerr, Quentin. 2018. “Wisqoq - A Story of Mi’kmaq Conservation.” *The Nova Scotia Advocate*. https://nsadvocate.org/2018/10/31/wisqoq-a-story-of-mikmaq-conservation/.

Lady Bird Johnson Wildflower Centre. 2003. “Green Ash Seed Collection Procedure.” November 14, 2003. http://txmn.org/glc/files/2014/01/Green-Ash-Seed-Collection-Procedure-Rev1.pdf.

Loo, J., and N. Ives. 2003. “The Acadian Forest: Historical Conditions and Human Impacts.” *The Forest Chronicle* 79, no. 3: 462–474.

MacDonald, Michael. 2019. “Canadians asked to find ash trees in a bid to preserve the species.” *The Canadian Press*. August 28, 2019. https://atlantic.ctvnews.ca/canadians-asked-to-find-ash-trees-in-a-bid-to-preserve-the-species-1.4568217.

Maguire, Della. 2016. “Secret Powers of the Ash Tree.” http://wisqoq.ca/wp-content/uploads/2016/04/Secret-Powers-of-the-Ash-Della.pdf.

McKnight, T. S., and E. J. Mullins. 1981. *Canadian Woods: Their Properties and Uses*. Toronto, ON: University of Toronto Press.

NSDNR (Nova Scotia Department of Natural Resources). 2015. “Recovery and Action Plan for Black Ash (Fraxinus nigra) in Nova Scotia.”

NSDNRR (Nova Scotia Department of Natural Resources and Renewables). 2021. “Nova Scotia Interpreted Forest Inventory - Current Forest Data.” https://novascotia.ca/natr/forestry/gis/forest-inventory.asp.

Pain, Stephanie. 2020. “Why Tree-Killing Epidemics are on the Rise.” *Smithsonian Magazine*. September 28, 2020. https://www.smithsonianmag.com/science-nature/why-tree-killing-epidemics-are-rise-180975917/.

Paulson, Steve. 2019. “Making Kin: An Interview with Donna Haraway.” *Los Angeles Review of Books*. December 6, 2019. https://lareviewofbooks.org/article/making-kin-an-interview-with-donna-haraway/.

Pilate, Gills, Brigitte Chabbert, Bernard Cathala, et al. 2004. “Lignification and Tension Wood.” *Comptes Rendus Biologies* 342, no. 9-10 (September-October): 889-901.

Powers, Richard. 2018. *The Overstory: A Novel*. New York: W.W. Norton & Company.

Puettmann, Klaus J., K. David Coates, and Christian C. Messier. 2008. *A Critique of Silviculture: Managing for Complexity*. Washington, DC: Island Press.

Raikhel, Eugene. 2010. “Multispecies Ethnography: A special issue of Cultural Anthopology.” *Somatosphere*. October 27, 2010. http://somatosphere.net/2010/multispecies-ethnography-special-issue.html/.

Sennett, Richard. 2008. *The Craftsman*. New Haven, CT: Yale University Press.

Schiffman, Richard. 2021. “Mother Trees are Intelligent: They Learn and Remember.” *Scientific American*. May 4, 2021. https://www.scientificamerican.com/article/mother-trees-are-intelligent-they-learn-and-remember/.

Shwarz, Christopher. 2016. *The Anarchist’s Design Book*. Covington, KY: Lost Art Press.

Smith, Rita and Noel. n.d. Mi’kmaq Ash Splint Potato Basket. Ethnology Collection, Nova Scotia Museum.

Sollars, E., A. Harper, L. Kelly, et al. 2017. “Genome sequence and genetic diversity of European ash trees.” *Nature* 541: 212–216. https://doi.org/10.1038/nature20786.

Stafford, Fiona. 2016. “Venus of the Woods.” *The Paris Review*. October 4, 2016. https://www.theparisreview.org/blog/2016/10/04/venus-of-the-woods/.

Tsing, Anna Lowenhaupt. 2015. T*he Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton, NJ: Princeton University Press.