What is an Old-Growth Forest? The Shaping and Reshaping of Scientific Inquiry at the H.J. Andrews Experimental Forest

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Chapter One Introduction

I remember sitting inside the conference room in the back corner, taming the butterflies in my stomach, trying to convince myself that I wasn't nervous. I was sitting in the Pacific Northwest research station on the campus of Oregon State University in Corvallis, Oregon. I was at the "entering the gate" phase of my ethnography, attending my very first meeting with the people who have dedicated their lives to H.J. Andrews Experimental Forest. The forest is in the Western Cascades of Oregon and is one of the National Science Foundation's Long Term Ecological Research sites. It is a steep landscape that is covered by old-growth and second-growth forests with Douglas fir, hemlock, and western red cedar, all draped in moss and lichen. Like veins trickling into the landscape, cold streams bleed throughout the steep hills, circulating sediments and providing nourishment.

As the clock approached 9:00 am, scientists from the H.J. Andrews community trickled in, many of them dressed in forest green or khaki pants and durable hiking boots. I sat in my seat feeling both intimidated and curious. This was my first time participating in their monthly staff meeting which began with a series of science talks. Two of them were on the northern spotted owl, a protagonist character among these forest scientists. A fellow graduate student gave the third talk, which was on stream hydrology. After each talk, a discussion followed. I stayed quiet but jotted down notes on the conversation that circulated the room. Oftentimes, the scientists would preface their points with "you know, as a fish person, I think..." or "my thoughts as a tree person are." It seemed as if I was sitting in a room with human representatives of a more-than-human collective.

A year later, I sat in my home in California and prepared to craft my first ethnography. Over this past year, I found that this forest community is a living representative of several traditions of ecological inquiry. The traditions that I have encountered include scientific forestry, ecosystem ecology, and natural history. Although my ethnography chronologically traces these three traditions, in actuality, they do not unfold discretely and linearly. Rather, these different traditions are like a palimpsest where the existence of earlier traditions generates and influences the burgeoning of younger ones (West, 2020). Some of the ideas and practices of older traditions still linger; like ancestral ghosts that live in the body of trees, soil, and water, their existence has been written in the landscape. The different traditions are also in conversation with one another. In most cases, they contrast with one another, while in some instances they have blended making the conceptual lines between them unclear. Furthermore, each tradition of science at the H.J. Andrews is entangled with larger cultural, cosmological, political, and economic trends, which demonstrates how science is inextricably situated within culture. My role as an anthropologist has been to dig deep into the sedimented layers of time where cultural thoughts, beliefs, and customs crystallize as fossils and to trace the roots of the different ecological traditions that this community represents.

I join a greater wave of anthropologists who are choosing to "come home" from our far away research expeditions, which was the traditional role of our academic predecessors. Many of us have come to realize that our cultural lens influences our perception of the world and the way that we make sense of communities, both our own and distant. For this reason, we've redirected our attention toward Euro-American systems of knowledge to comprehend the intricacies of the production of knowledge and its relationship to culture. This is the intersection of both anthropology and science and technology studies where scholars are seeking to understand how science is inextricably entangled with political, economic, cosmological, and social landscapes (Haraway, 1985; Porter and Latour, 1993; Barad, 1999).

I'm particularly interested in how scientific knowledge influences the way that we interact with the more-than-human. By more-than-human, I'm referring to beings of the earth, plants, animals, fungi, microbes, and even beings that tradition has defined as inanimate, such as rocks and water (Kirskey and Helmreich, 2010). The more-than-human also extends beyond the material and encompasses spirits, ghosts, monsters, and other supernatural beings that haunt particular places. Contemporary science and its secularist mode of reason dismiss and distance themselves from "the spiritual, the cosmological, the magical, the ancestral" (Bubandt, 2018). This is one of many expressions of how scientific enterprise is driven by cultural and cosmological underpinnings. My time with the H.J. Andrews community has entailed a journey of understanding how culture shapes the practice of science at the Andrews as well as how science shapes our cultural perceptions of the Pacific Northwest Forest.

Throughout my ethnography, it's been apparent that science is not value-free, but rather that it is steeped in value. I have found this to be the case with each of the different traditions of science at the H.J. Andrews. Not only do we as individuals carry certain subjectivities, but we do so also as a collective. Cultural worldviews are passed down from one generation to the next and those worldviews influence how we perceive the world and how we re-articulate it through knowledge-building practices (Haraway, 1988). We inherit certain ways of thinking that, more often than not, become socially ingrained and are left unquestioned through time. We can get more potential out of science when we analyze the cultural values that drive its motivations. This honest reflection can reveal to us how and why we practice science the way that we do. I invite scientists, and all allied thinkers, to join me as I attempt to enact a practice of self-reflexivity to explore the subjectivities of science at the H.J. Andrews Experimental Forest. Self-reflexivity asks us to examine how our particular identities as scholars have come to influence the way that we consume the world around us and reproduce it through various forms of knowledge production. I take myself as an example. As I write this thesis, I feel that it's important that I do not treat my voice as some distant, objective narrator, but rather recognize how my subjectivities shape my story of the Andrews.

I recognize that I write from both an insider and an outsider perspective. I write as an insider because I am a scholar, a participant in academia, was a resident of Oregon, and am familiar with Euro-American traditions of thought. However, I also write as an outsider because I am not a natural scientist and I have not worked with the Andrews forest community for nearly as long as some of the current members. There are both disadvantages and advantages to my positionality. The disadvantage is that I have not immersed myself long enough in the culture of the Andrews community to experience all of the nuances and comprehend the practice and philosophy of science from the inside out. However, the advantage of being an outsider is that certain insider customs that have become normalized and left unquestioned are observable to me. This motivated my drive to understand, "Why is the scientific inquiry of forest landscapes done in this way? Where do these traditions come from? And what are some alternative ways that we can practice science?"

While I've only recently been acquainted with the canon of natural science, I have been able to approach it from a different discipline. It's a similar experience to when someone crosses cultural borders. Comparisons and contrasts bring light to each of the two worlds. As a result, I've been able to detect some parallels between the two disciplines of anthropology and ecology. For instance, the rise of structural-functionalism emerged around the same time in both disciplines, popularized by Eugene Odum in ecology and A.R. Radcliffe-Brown in Anthropology. Structural-functionalism is a top-down theoretical framework that sees either ecosystems or cultures as holistic "systems", composed of interrelated parts with specific functions that contribute toward the behavior of the overall system. These top-down approaches brush over the individual, which in ecology includes biological diversity and individual species, and in anthropology includes the agency of individual people. Thus, theoretical ideas across social and natural sciences echo one another.

As a newcomer into the community, I relied on several different historical and ethnographic sources for my data. Initially, I planned to conduct on-site ethnographic fieldwork among the scientists during the summer of 2020. However, as a result of the COVID-19 pandemic, plans quickly changed. I was able to visit the forest once in February 2020 and I attended a couple of in-person monthly meetings. When the pandemic hit, the Andrews community continued to meet via zoom monthly. I attended those virtual meetings to learn about current research that was happening and the state of the community throughout the pandemic and the 2020 wildfires. Aside from the monthly meetings, I also conducted zoom interviews with seven different members of the H.J. Andrews science community. My interviews asked the scientists about their different approaches to science and how their different academic or professional backgrounds informed their particular style of science. I found that these interviews were not only informative for my research, but also validated the importance of cross-disciplinary conversations. That’s because many of the interviewees expressed the satisfaction of talking about their philosophy of science, which they normally don’t do with their day-to-day peers. I was able to think with these scientists about the different traditions of ecological inquiry, expanding both of our knowledge through our different disciplinary backgrounds. Finally, one of the most important sources for my work is an archive titled “Voices of the Forest, Voices of the Mills”. This archive, located in the Oregon State University Libraries

Special Collections and Archives center, contains oral histories collected from scientists who were working at the H.J. Andrews from its inception until today. This collection was very informative to my research because it gave me a detailed insight into how science changed through different stages of the site through people's first-hand experiences. The collection was also informative for the traditions that are more situated in the past, such as scientific forestry. Therefore, I was able to draw from a rich collection of stories and information, despite the pandemic's restriction of on site fieldwork.

So why the forest? I grew up in Southern California, where coastal land is relatively flat, facilitating urban and suburban development. Growing up, I watched as developers built suburbs and shopping malls at breakneck speeds, obliterating the biodiverse sage scrub that made my home special. As the pastel desert sand, Torrey pine trees, and coastal California gnatcatcher were replaced by paved roads, cookie-cutter suburban houses, and concrete boxed buildings, I grew grim over my surroundings. I observed humanity achieving its desire to control natural landscapes by replacing them with "orderly" and "tidy" built environments.

During the summers, however, my parents took us on road trips up the West Coast. We started from our home in San Diego and made our way to the Olympic Peninsula via the 101 highway, spending most of our time in the forest landscapes of the Pacific Northwest. As a young girl, I recall immersing myself in these forests, perceiving them as a different dimension of reality. These forests were different from the suburbs that raised me—material reality was flipped on its head, and order was nowhere to be found.

When I walked across a path bordered by sword fern and found myself immersed among ancient cathedral trees, I could sense the presence of spirits. The douglas fir reached to the heavens, and the red cedar and western hemlock stretched close behind, their branches decorated with moss and lichen. As a young girl, I stood only slightly taller than the saplings that reached where the sun broke through the canopy and illuminated the sparkling forest dust. With every step I took, vibrations rippled beneath my feet and into the underground realm of mycorrhizal fungi, roots, microbes, and arthropods. I took a minute to sit on top of a decomposing log, which fed the arthropods and fungi and provided the seedbeds for new saplings, portraying the continuous cycles of life and death.

I continue to appreciate these forests because I see them as irrational; that is where a great deal of their beauty comes from. It's as if I walked into a Dr. Suess book and suddenly I'm surrounded by creatures beyond my imagination. Their unruly nature has led toward resistance against the order and control that we've tried to impose onto them. I find it refreshing and amusing how old-growth landscapes continue to bewilder us, defying old traditions of thought; they challenge us and the assumptions that we carry, over and over again. These forests resist old paradigms and modernist illusions of time and space. These whimsical spaces with their ancient trees whose branches twist and turn, more-than-human beings that lurk in the shadows, and the streams that swirl throughout the landscape, demand that we overthrow dichotomies, such as life/death, terrestrial/aquatic, and material/immaterial. This is what lures me to write about the forests and how they continue to shape and reshape our epistemological and ontological traditions.

I'm drawn into this site not only because of my desire to think with forest landscapes of the Pacific Northwest but also because of the nimble character of the science community at the H.J. Andrews. Scientists in this community have a history of shaping and reshaping the scientific enterprise, at times transforming our perception of old-growth forests. For this reason, I have hopes of sparking dialogue with scientists and creating imaginative futures for forest research. I hope to move beyond the idea that the arts and humanities can "interact" with science, to a place where the science-arts-humanities can transform one another. One potential that I discuss is reintroducing embodied knowledge and subjective experience as sources of knowledge rather than relying solely on reason and logic.

Modernist forms of thinking base themselves on the natural attitude, which is the idea that there is an objective reality that lies beyond us, and our only access to that reality is via quantifiable measure and rational reasoning (Heelan, 1987). This belief stems as far back as Western Antiquity and is a modern representation of Plato's concept of ideal forms. However, other philosophies, such as Edmund Husserl's phenomenological reduction take a different approach. It argues that there may not be such a thing as an objective reality beyond our bodies, but rather our subjective experiences are reality (Heelan, 1987). When subjective experience is understood as reality and embodied knowledge as a source of credible knowledge, this allows for greater inclusivity in the knowledge production process. That is because we move away from this idea that knowledge and facts are exclusively produced by an authoritative academic habitus and marginalized forms of inquiry become understood as credible sources for understanding forest landscapes.

Let's take the name of the site H.J. Andrews Experimental Forest to expand on this notion of embodied knowledge. The word Experimental is from the Latin term experimentalis, which translates to "having a personal experience". However, the word experimental also relates to the word experiment, which has roots in old French from the word esperment, which translates to "enchantment, magic spell, lesson, sign, indication". Here we see two aspects of the origin of this word. One aspect is personal experience, subjectivity, phenomenological knowledge. In contrast, the second aspect is a practice of testing one's experience, through manipulation, like a sorcerer or magician who plays with the experience of reality to reveal its different forms. I imagine that a pedologist experiences this forest quite differently from a geologist, a member of the Kalapuya tribe, a poet, western redcedar, or a pacific salamander. With different subjective experiences, these different bodies conjure different definitions of what a forest is. However, what's most important is that they are all considered credible sources for our understanding of these forest landscapes.

Writing is my form of sorcery. It is my direct engagement with the various lifeworlds that interweave, fold and unfold, in the making and remaking of this forest research site. For a community as enthralling as the H.J. Andrews Experimental Forest, I believe I must do it justice by not writing about it in a flat, dis-embodied, traditional academic tone; rather, I attempt to breathe life into the people, conversations, and interactions through experimental critical writing. By combining academic scholarship with literary creativity, I hope to stretch our understanding and perception of the H.J. Andrews Experimental Forest.

While dominant academic traditions attempt to document the world in an "accurate" and authoritative manner, experimental critical writing attempts to embrace doubt and uncertainty, which arguably brings us closer to truth (Crumbled Paper Boat Collective, 2020). Reality is not static nor universal. Each moment we engage with what we perceive to be "real". However, what we see as real is inextricably entangled with the intangible or the unknown. This unknown might even be beyond the grasp of reason. Experimental critical writing allows us to explore the mysteries that lie beyond our reason but are felt through sensory and embodied experiences. Therefore, I see it as an appropriate tool to engage with the real, but also to experiment and stretch our imaginations beyond the real, the tangible, and the known.

In this case, my ethnography includes interspersed stories that I recreate through imaginative and fictional thinking. My stories are about real people and events, but I did not personally witness every event I write about. I italicize the historical stories that I recreate through imaginative thinking to demarcate them from the non-fictional ethnographic and historical writing. I based some of my stories on an oral history archive titled "Voices of the Forest, Voices of the Mills", and some on recorded interviews that I conducted with various members of the science community. Following several of the leading figures in experimental critical writing (Torgovnick, 1990; Hecht, 2017; Crumbled Paper Boat Collective, 2020), I aim to break through academic conventional modes to breathe life into these stories that I have encountered.

With the tools of ethnographic storytelling, I will take us through the various layers of the palimpsest that make up the H.J. Andrews Experimental Forest. The Post-War economic boom and its rising demand for timber fueled the first layer of the palimpsest, scientific forestry. Scientific forestry relies on scientific inquiry to study the conversion of old-growth forests into Douglas Fir tree plantations. The 1970s marked an important turning point at the H.J. Andrews and the emergence of a new layer of the palimpsest—ecosystem ecology. While scientific forestry perceives forests as a stockhouse for resources, ecosystem ecology depicts forests as mechanical systems with interrelated parts that serve the function of the whole. This tradition is a product of postwar modernization, mechanization, and industrialization. Finally, I will conclude with natural history, whose essence is about place-based knowledge and understanding diversity and nuance within a forest community. This bottom-up tradition rooted as far back as pre-Christian animism understands the forest not merely as a mechanistic system, but rather as a community of sentient beings with pulsating life. In this tradition, scientists practice experiential learning and long-term dedication to place. As I explore each layer of the palimpsest, I will discuss how each tradition has materialized into the landscape at the H.J. Andrews. I will also talk about how these traditions are driven by different ontological perceptions of forests, and different ideas surrounding the nature of knowledge. Lastly, after having contextualized each tradition, I will conclude with the imagined future for forest ecology, which includes the transformation of science through its encounters with the arts and humanities.

Chapter Two Scientific Forestry

During the mid-20th century, when World War II brought several countries into conflict, the forests of the United States were extensively cut to try and keep up with wartime demand for timber. During the war, clear-cutting was the dominant means of harvesting timber, which led to a ravaging of the forest (Yeager, 1977). Rather than a living entity with cyclic patterns, the U.S. government and the working timbermen perceived the forest as an infinite resource for material progress. It was a time when the sound of chainsaws filled the air, ancient cathedral trees came tumbling down, and lumber mills roared throughout the Pacific Northwest: the cacophonous melody of progress. As the years of the war came to a close, timber scarcity became an issue and public attention turned towards the national forests.

The timber scarcity that resulted from the war's economic boom, led the USDA Forest Service to rethink its strategies of resource extraction. Following the philosophy of Gifford Pinchot, there was a shift away from the cut and run strategy and toward an agricultural model for forestry. Pinchot pushed for scientific management to improve conditions on the national forest and produce more timber for a longer period. This meant clear-cutting old-growth forests and replacing them with Douglas Fir tree plantations. This quote encapsulates the sentiment of this era, "Trees may be grown as a crop just as corn may be grown as a crop [ ] the farmer gets crop after crop of corn [ ] the forester gets crop after crop of trees" (Luoma, 1999, p. 38). Pinchot came to be the founder of this new tradition, known as scientific forestry. Scientific forestry is the first tradition of ecological inquiry at the H.J. Andrews Experimental Forest.

In this chapter, I will explore how scientific forestry is inextricably tied to the political and economic landscape during the post-world war economic boom. I will also take a look at the cosmological underpinnings of this tradition, which stem back to the enlightenment. Finally, I will discuss how this tradition materialized into the H.J. Andrews physical and ideational landscape throughout the 1950s and 1960s. Since this tradition is situated in the past, I rely primarily on historical texts and the oral histories archives titled, “Voices of the Forest, Voices of the Mills”[1]. These archives consist of several individuals who were present at the Andrews during this time period. From these sources, I learned that there were three main agendas that characterize scientific research during this time period. The first agenda was to study tree regeneration in order to optimally plant Douglas Fir saplings and develop plantations. Another important imprint of this regime is road development and transforming the landscape with infrastructure that would enhance accessibility to the forest. With road development, came an increase of timber being moved from the site and circulated into nearby timber mills. Finally, a lasting mark is the watershed experiments that the scientists established during this era. I will discuss these agendas to delineate how scientific forestry shaped the H.J. Andrews Experimental Forest.

Scientific inquiry has a history of being closely coupled to the market economy, which has led to the inevitable shaping of the scientific enterprise. Research goes where the funding is, and the funding comes from powerful top-down institutions. As a result, the production of knowledge is highly coupled with power in our society. Due to the entanglements between scientific forestry and the capitalistic economy, Donald Worster argues that scientific forestry is part of the imperial tradition in ecological inquiry (1994).

The imperial tradition harkens back to the rise of capitalism and modern science. It stems from the Euro-American cosmological beliefs that nature is inert and lifeless and that Euro-American descendants have a manifest destiny to exploit nature for the sake of material

[1] “Voices of the Forest, Voices of the Mills” is a collection of oral histories located in Oregon State University Libraries Special Collections and Archives Research Center http://scarc.library.oregonstate.edu/

progress. This worldview emerges from the transition away from pre-Christian animism where people perceived the divine to be immanent in nature, rather than a centralized male figure that is distant and apart from the natural world (Merchant, 1980; Worster, 1994). With the rise of Christian theology and modern science, people perceive nature as an object produced by the divine, and humans as exceptional for our ability of rational and intellectual thought (Foster, 1934).

Worster describes Francis Bacon as the ideal representation of the imperial tradition of ecological inquiry. Many know Bacon as the father of the scientific method, but he is also the leading figure of an ideology that sought human advancement over the natural world. He didn't believe you can learn merely by observing; nature doesn't let her secrets lay bare. Rather, knowledge requires experimental science that includes the control and manipulation of nature. As an early proponent of empirical science, Bacon argued that "only 'by digging further and further into the mine of natural knowledge'; could the human race extend 'the narrow limits of man's dominion over the universe' to their 'promised bounds.'" (Bacon, as quoted by Merchant, 1980, p. 170). He promised a man-made paradise rendered fertile by science and management (Worster, 1994). Later philosophers, including the Royal Society, adopted the Baconian program of dominion over nature. Joseph Glanvill, a Platonist and religious writer for the Society claimed that the new philosophy was to provide "'ways of captivating Nature, and making her subserve our purposes and designments' leading to the restoration of 'the Empire of Man over Nature.' Nature, he was to remark elsewhere, was to be 'mastered, managed, and used in the Services of Humane life.'" (Glanvill 1668, as cited by Harrison, 1999, p.98). The ideology of man's dominion over nature is the underlying belief system that has allowed for capitalistic and colonial expansion across the United States. It is this worldview that has led to the harvesting of resources at unsustainable rates and the replacement of entire landscapes with plantations. There is an underlying worldview, which believes mankind is improving and advancing through time through the exploitation of natural landscapes. Furthermore, this worldview equates knowledge with the ability to have greater control over natural landscapes. This narrative of progress materialized as the foundational infrastructure of the H.J. Andrews Experimental research site.

The stories of industrial forestry that I've encountered are inside the recordings of interviews that I've conducted, they inhabit the landscape, and they are hidden in an oral histories collection titled "Voices of the Forest, Voices of the Mills". I see the oral history archives as enchanting musical boxes, which are locked up until someone is curious enough to open them and listen to the different narratives, notes, voices, and cadences that are released into the present moment. I, as the ethnographer, have become a part of these stories. As a mediator, I take them in and try to bring life to the texts that I encounter. I do this by creating (re) imaginations of particular scenes and narratives that are released when I've opened the lid to the box. I rely on the archives to bring scientific forestry to life and imagine the embodied experiences that allowed this tradition to thrive and dominate for the first twenty years of the H.J. Andrew's existence. I demarcate these imagined stories with an italicized font. I've interpreted these stories through the rest of the chapter, which consists of non-fictional ethnographic and historical writing. I also rely on storytelling to move away from the fixation with reason and logic as our only means to knowledge and to demonstrate how all knowledge comes from embodied experiences (West, 2020). By re-imagining stories I find in the archives, I hope to remind people that the ideas, production of knowledge, and co-interactions with the more-than-human are not abstract, logical, and dis-embodied occurrences. Rather, they emerge through the lived experiences of people, their partial perspectives, and situated knowledge (Haraway, 1988).

While most of my experience with this tradition comes from these historical archives, the tradition is also written onto the landscape of the H.J. Andrews and in ways continues to haunt current epistemologies. Therefore, the idea of past and present are blurred in my explorations of the different traditions that have existed and continue to exist at the H.J. Andrews. For this reason, I see the scientific forestry regime and the other traditions that follow more like a palimpsest (West, 2020). The community continues to create new traditions of science from existing infrastructures and these infrastructures are both material and ideational. Therefore, understanding each tradition of science entails understanding their entanglements with the cosmological, cultural, political, and economic underpinnings that drive them. The first layer that we begin with is scientific forestry.

Gifford Pinchot and the Narrative of Progress

It is the late 1940's on a warm summer day when Horace J. Andrews followed Philip Brieglib on horseback through the narrow trail. Old-growth forests with ancient trees bordered the path. Both of the men and their horses feel tired and weary but continue forth on their 5,000 feet climb toward the summit of Lookout Creek. As they walk through the forested landscape, Philip looks out and doesn't see the intricate web of multi-species interactions, but rather all of the unharvested timber that's just waiting to be cut.

"Look at this virgin landscape", Philip says to Horace. They both continue riding up the watershed, which is not "virgin" at all, but was historically inhabited by indigenous communities that were pushed to the peripheries due to colonial expansion.

Horace nods in approval, "Yeah, there's a good amount of timber to be cut. How much longer do you think we have?"

Sweat drips down Philip's hat as he shouts back to Horace, "We're getting pretty close, the treeline is starting to thin out". Finally, the trees on the trail start to dwindle, the view starts opening up and they arrive at the summit of the Lookout Creek drainage basin nestled in the Western Cascades of Oregon.

The two men get off their horses and stand there with their rugged boots, suspenders, white cotton shirts, and brim hats. They each take a turn drinking a large gulp of water from a canteen then stare out to the panoramic view of the rolling steep hills covered in dense old-growth Douglas Fir stands.

"Well, here we are," Philip says to Horace as the two of them continue looking out onto the landscape. The two men stand there excited about the possibility of scientific advancement, progress, and development. Motivated by Gifford Pinchot's push for scientific forestry, they both aim to study techniques of commercial-scale logging, and the conversion of old-growth landscapes into fast-growing tree plantations. Both trauma of the great depression still lingered in the bodies of these two men as well as the ideology of manifest destiny. The two of them made a decision, and this drainage basin would soon be one of the USDA Forest service's Experimental research sites.[2]

Gifford Pinchot's leadership and philosophy toward the U.S.'s forest landscapes led to the establishment of the H.J. Andrews Experimental Forest. As an American forester and politician, William Mckinley appointed him as the head of the division of Forestry in 1898 and became the first chief of the U.S. Forest Service after its establishment in 1905 (Yeager, 1977). Pinchot believed that nature was inefficient and that scientific forestry can work to improve the

[2] This story is a historical imagination. The contextual information about the establishment of the H.J. Andrews comes from Geier (2007) and Robbins (2020)

efficiency of resource extraction. As a result, he believed in governmental regulation of public lands and supporting scientific inquiry of resource management. He did this by attempting to improve efficiency by imposing an agricultural model onto forestry (Yeager, 1977). While some remember Pinchot for his legacy in conservation, a closer look at his contribution demonstrates a legacy centered on utilitarianism and specifically, utilitarianism for white settler communities.

Pinchot opposed preserving wilderness for the sake of scenery and emphasized conservation for many different forms of utility. This ideology manifested into his multi-use policy, which sought to utilize natural landscapes for as many uses as possible. He noted the different needs of resources from cattle ranchers, shepherds, miners, loggers, homesteaders, developers of water for drinking, irrigation, and hydropower and wanted to find a way that natural resources can serve these different communities and their different motives of resource extraction (Yeager, 1977; Worster, 1994). His way of doing so was cutting down forests to serve his primary goal of extracting timber for the market economy and making more land for agriculture and homesteaders. This demonstrates how Pinchot's multi-use philosophy serves the needs of a capitalist economy and white settler communities. Pinchot's philosophy fails to consider utility for marginalized communities, including tribes who've inhabited the forests since time immemorial. Furthermore, his philosophy fails to recognize the needs and desires of more-than-human beings.

I found a report published 10 years after the establishment of H.J. Andrews, which echoes Pinchot's ideology and demonstrates his influence in the establishment of the site. The report cites the US Census Bureau to demonstrate that populations are increasing exponentially and that it is the Forest Service's responsibility to ensure that the forest is utilized in as many ways as possible. The report argues that extracting timber from forests can increase forage for livestock and big game animals, improve conditions for hunting, and make campgrounds "safer" places. The report introduces the H.J. Andrews and its intention to serve as "a pilot plant where the most promising timber-growing and watershed-management practices could be tested on a commercial scale" (USDA Forest Service, 1959, p. 5). The Forest Service dedicated the research program toward converting old-growth forests into "productive young forests". Ultimately, this report unequivocally supports the conclusion that logging (as much as possible) is an unmitigated good, even though clear-cut logging and unrestrained logging have detrimental consequences. This suggests that by "multi-use", the writers of the report mean dominant use by the timber industry and attempt to advertise for additional benefits to logging.

Gifford Pinchot wanted to bring order to nature, by converting what he saw as unruly landscapes into orderly and thrifty plantations (Yeager, 1977; Worster, 1994). This perception of the more-than-human has roots that tap back to the Enlightenment, which marks the rise of modern science and the dawn of capitalist expansion. During this era, people expressed a nostalgic sentiment for the Garden of Eden. They believed the Garden of Eden to be a literal garden and a perfect version of the current world. When God kicked Adam out of the garden, humanity fell into this imperfect and wretched world: "Cursed is the ground because of you," the Lord says to Adam, "In toil, you shall eat of it all the days of your life; thorns and thistles it shall bring forth to you, and you shall eat the plants of the field" (Gen. 4:17b-18). During the fall of man, humanity lost its dominion over nature, and the term dominion took on an interpretation to mean restoring land to a previous Edenic state. People perceived managed landscapes, such as plantations, as a reconstruction of paradise on earth. The rise of the protestant ethic also played a role in the transformation of land, as labor became not just about subsistence, but also about subduing the earth (plowing, tilling, and making use of it), as a sanctified activity and an intrinsic good (Harrison, 1999). This is where the narrative of progress originates, where humanity is on a mission to recover what was lost during the fall from Eden. Dominion over nature was sought through the physical transformation of natural landscapes into simplified plantations and other forms of development (Merchant, 2008). It is this continuity with the narrative of progress that led to the emergence of Pinchot's tradition of scientific forestry and the establishment of the H.J. Andrews Experimental Research site.

If you ask a 1950s timberman "what is a forest?”, he would respond that a forest is a collection of trees that you manage for lumber (Franklin, Interview, 2020). The timbermen perceived old-growth landscapes as wretched wastelands. When Mike Kerrick, the forest director during the mid-1950s reflects on the time, he states that the goal was to "convert those big, old 'biological deserts' into plantations," continuing, "Can you imagine, we were calling them 'biological deserts' at that time?" (Kerrick, Oral History, 2014). Kerrick along with other timbermen referred to old-growth forests as "biological deserts," meaning that they were low in value because they were full of rot, not adding valuable wood, and had a paucity of deer and elk for hunting (Starker, 1943; Luoma, 1999; Geier, 2007; Kerrick, Oral history, 2016). The foresters believed they were helping by "subduing" a decadent wasteland into "orderly" and "vigorous" plantations. This philosophy wasn't an indifference toward nature, but rather the desire to return it to an orderly state. This reflects the narrative of progress, giving hope for the betterment of humanity through the control of nature.

Before the USDA Forest Service's occupation, old-growth forests and ancient multispecies assemblages covered the H.J. Andrews. With its structural complexity, high biodiversity, and continuity to ancient times, the old-growth forest represents the antithesis of the

Plantationocene[3]. However, district rangers, timbermen, and research personnel would soon occupy the site, ready to serve the USDA Forest Service and colonial and capitalistic expansion.

From Forest to Agricultural Plots through the Manipulation of Time and Space

During a warm day in 1956, Roy Silen, one of the research personnel at the H.J. Andrews, approaches a plot of land that has recently been parceled out for research. The land was once covered by the heterogeneous landscape of old-growth, but now it is barren and desert-like. He kneels on the scorching floor, which faces the summer sun. Sweat drips from his brim hat and down his face. He places a temperature pellet by a Douglas fir tree sapling and then scribbles notes down on his clipboard.

There are plenty of trees far off in the distance, where the forest canopy blocks the summer sun and the floor looks quite different. It looks shaded, cool, and moist. The trees serve as a shelter for the understory, but on the plot of land where Silen is working the trees are gone and the ground is fully exposed.

"How hot can these seedlings get before they die off?" is the question driving Silen and his research on the Andrews. He carries with him visions of transforming this clear-cut landscape into a plantation, but Silen faces challenges as many of the saplings have died from heat exposure. They've lost their forest womb that would have sheltered them.[4]

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[3] Plantationocene is a term from Donna Haraway. She uses it to describe theAnthropocene, which consists of wide-scope expansion of plantations and the simplification of landscapes (Haraway, 2015)

[4] This historical imagination is based on Roy Silen's oral history, which is located in the Oregon State University archives collection titled, "Voices of the Forest, Voices of the Mills". In his oral history he talks about conducting this type of research for the H.J. Andrews Experimental Forest

Seventy years after Silen's plot-based research studies, I drove along the 126 highway from Florence to Eugene. I was under the impression that I was driving through dense forests until I glanced past the single line of trees bordering the road and noticed an apocalyptic-looking landscape. There were large plots of land with nothing but stumps scattered across the scorched ground. I was witnessing what Richard Powers referred to as the "voter's curtain" in his book The Overstory (2018). A single line of trees stood strategically to hide the disturbing landscape that resulted from clear-cutting. This method of timber extraction clears every single tree within a forest plot, eradicating the multispecies assemblages that took centuries to build, and leaving nothing behind but stumps.

I eventually pulled up on Highway 99, which would lead me back to Eugene. While waiting at the stoplight, a logging truck drove by. On the truck was a full load of recently logged timber. I noticed the lichen and moss clinging to the bark of the trees. I wondered about other creatures that the driver didn't realize they were taking with them. They were probably headed toward the Seneca sawmill north of Eugene, to take the "crops" of trees they harvested to nearby sawmills, which will process them into pulp.

At the stoplight, there was also a billboard put up by Seneca Sawmills company. The billboard had large white writing that read "We Planted Our Millionth Tree!" and a picture of a family huddled around a tree sapling with large smiles across their faces. If only the billboard said, "After deforesting the Pacific Northwest, we planted our millionth tree in our mono-cropped plantation and profited in the market economy!"

The knowledge that this tradition produced resulted in the expansion of commercial-scale logging and production. While in recent decades timber extraction has dwindled on federal lands, this approach to forestry continues to dominate timber extraction on private lands (Haynes, 2012). The agricultural approach, which consists of replacing forest landscapes with homogenous tree plantations, has left a legacy and is still present throughout the state of Oregon. When the USDA Forest Service and private timber industries transformed the forest landscapes into mono-cropped plantations, they did so by manipulating the forest. These manipulations stem from modernist notions of time as linear and space as discrete. Within an old-growth landscape, time moves in all directions. Different characters of the landscape work on many different time scales; volcanic rock shapes and reshape the land for thousands of years; coniferous trees grow for hundreds of years; the northern spotted owls' lifespan is up to 20 years, and the dew on fir needles lasts only minutes. When the loggers moved in, a single measure of time based on rotational harvests repressed all other cycles and directions of time. At first, harvest cycles were around 100 years, but eventually, commercial loggers pushed it to 50-80 years (Spies and Duncan, 2012).

The manipulation of time to serve commercial logging had consequences. For instance, Oregon Lungwort (Lobaria oregana) is the primary nitrogen fixer in an old-growth landscape. Its habitat is specific to the canopy of old-growth forests. It can fix up to 22 pounds of nitrogen per acre of old-growth, and the forest needs 5 pounds per acre to maintain itself (Denison, 1979). Lungwort can only be found in stands of about a hundred years of age and does not abound until the forest reaches old growth, which is at least another hundred years. When an old-growth forest is clear-cut and coniferous trees come crashing to the ground, they bring the Oregon Lungwort down with them. The typical 60-80 year harvest cycle is not long enough for this lichen to become present and abound (Luoma, 1999). There may be enough nitrogen in the ground for a few cycles, but it's a matter of time before it becomes depleted and we've gotten rid of the old-growth's nitrogen-fixer. The negligence of biological time cycles outside of the harvest rotation demonstrates the manipulation of time for utilitarian pursuits.

Transforming forest landscapes into plantations also resulted in the manipulation of space. The key characteristic of an old-growth forest is the multidimensionality of space. This allows for habitat niche differentiation, where different species can occupy a diverse array of habitats offered within a single environment. Old-growth landscapes offer habitats high up in the forest canopy; in the understory, where you'll find a lot of brush and saplings in need of shade; beneath and within decaying logs, where nutrients concentrate; inside snags, where you'll find the northern spotted owl nesting; and beneath the forest floor, where lies an intricate network of arthropods and fungi. When loggers convert old-growth trees into tree plantations, this multidimensionality of space collapses. What takes its place is a flattened landscape with uniform logs of the same species and the same age; a landscape with diminished diversity. In a plantation, people plant Douglas fir saplings at the same time, which creates homogenization in age and height. This leads to overcrowding, and health problems such as "root rots, Swiss needle cast, beetle outbreaks, and other diseases as well as increased susceptibility to damage by wind, ice, and snow" (Carey, 2009, p.60). There is no more diversity as intensively managed plantations intend to be harsh environments for many native species. The reason for this is that land managers want to concentrate all resources of the site into one selected tree species. This leads to the use of herbicides and pesticides, which also have long-term and negative implications all throughout the landscape.

Not only does the industrial regime haunt the physical landscape, but it also haunts current epistemological methods of understanding the forest. The main agenda for science during this era was to study tree regeneration. This involved plot-based studies to test optimal growth conditions for tree saplings. Research personnel organized small plots into different treatments to test different factors on seedling mortality, such as temperature, shade versus sun exposure and burned versus unburned terrain (Ruth and Silen, 1950; Tarrant and Wright, 1955; Bernsten, 1958). These studies involved a Baconian style of manipulating nature to reveal information through experimental trials. These experiments discretize space and rely on linear cause-and-effect forms of thinking. According to Lach, one of the most basic assumptions of scientific inquiry is that "...the world tends to operate in a linear fashion that can be understood as cause and effect" (Lach, 2015, p.223). These scientific assumptions have led scientists to inform simple management strategies that end up causing more problems than they solve.

Within the tradition of scientific forestry, people believe that taking heterogeneous landscapes and simplifying them into plantations will lead to more optimal methods of resource extraction. This meant eradicating all undesirable species and optimizing growth conditions for species that are most profitable in the marketplace. This is what scientific forestry sought to establish at the H.J. Andrews. This led to the clearcutting of old-growth landscapes and a series of plot-based studies to test optimal growth conditions for Douglas fir seedlings. To convert the forest of the Pacific Northwest into plantations, another agenda emerges—road development.

Road Development: Where did All the Fish Go?

Silen climbs down the hillside of the H.J. Andrews with a fishing pole in one hand and a cooler in the other. He reaches the edge of the creek and sets his belongings down. It's been a long day's work and the pulsating sound of the stream welcomes Silen to exhale and release any stress that accumulated in his body throughout the day.

While standing at the edge of the water, he grabs a stick that he found by his boot and throws it in the water hole. He waits patiently and finds there's no movement or response. Silen grabs a bigger stick and pokes around the water, but the water remains still. While sitting back and shaking his head, Silen remembers the day when he poked around these water holes and fish came out from all directions like a hatchery. The water was busy then, filled with many scaled beings and a lively stream community. Now that the loggers are here, things are different, the fish are gone. He knew that the roads they developed were leading to an increase in run-off. There are no fish left because the increase in sedimentation chokes their embryonic eggs. Silen walks back to a tree and sits and contemplates the change that he's witnessed throughout this landscape.[5]

Sixty years later, I sat in the driver's seat with Frederick Swanson, former PI of the Andrews and an important member of the Andrews science community. Fred was taking me along with two other individuals to visit the H.J. Andrews Experimental Forest. We continued driving up the asphalt and nicely paved road, while he told me stories about scientific forestry. He called it "domesticated science", as in an era when science was domesticated by the grasp of management. He talked about how the timbermen and research personnel had an agricultural mindset to forestry. Meanwhile, we kept driving along the road that took us off Highway 126 and toward the H.J. Andrews Experimental Forest. I understood then why Luoma referred to the Andrews as the "Hidden Forest " (Luoma, 1999). If it wasn't for these roads, it could've taken us several hours to walk to the headquarters let alone any other part of this 16,000-acre forest landscape.

[5] This is another imagined scene, which is inspired by Roy Silen's oral history in 1996. In this oral history Silen shares his stories about fishing in creeks pre- and post-logging. He describes the decline of fish due to increased sedimentation and run-off after the development of roads

Back in the late 1940s and early 1950s research personnel, like Roy Silen, had to travel on foot or horseback because there were no roads throughout the entire landscape. His oral history offers stories about traveling on foot with a backpacking backpack to various parts of the site. There were times when he had to trek through the forest for weeks or months. However, during the 1950s this changed when road development became a top priority. Silen and other research personnel were in charge of studying various systems of road development to improve accessibility into the forest landscape.

After arriving at the headquarters, Fred and I took another fire road that took us up the drainage basin. On the way there, we stopped at a crystal clear creek and Fred expressed to us that during the scientific forestry era, the water was brown and contaminated due to the runoff caused by road development. Fred also told us about the invasive species that bordered the side of the roads. As the loggers infiltrated the site, they carried in foreign species on their boots and tires. At that time, people didn't consider road development as a form of human-induced disturbance, but rather a mark of progress and forward advancement.

We got back into the SUV and continued on the road, which took us up the steep hill. As the tires rolled forward, I looked out the window and imagined the timbermen dressed in durable blue jeans, suspenders, and white long sleeve cotton shirts. The sun was beating down on them, since they removed the trees to develop this road system, increasing their access to the forest landscape. I returned my attention to the present and thought how Fred and I wouldn't be in this very moment if it wasn't for the roads that these timbermen developed. We both were here for different motives than the timbermen, but we were here due to the foundations that they laid out.

Throughout the world, road development is representative of colonial expansion, globalization, and the commodification of more-than-human landscapes. From an aerial view, they look like rivers and creeks that meander through a landscape. However, rivers and creeks circulate sediments, water, and nutrients. Roads, on the other hand, circulate human bodies, vehicles, and they serve the flow of timber extraction from the forest landscape and into nearby sawmills. The sawmills then process the timber and circulate them into the market economy. The timber circulates from these roads to American consumers and also made its way to Japan and other East and Southeast Asian economies that had a large demand for timber during the postwar era (Daniels, 2005).

The H.J. Andrews serves as a microcosm of the Anthropocene, a landscape transformed into a factory to satisfy a growing urban population and rising demands for lumber. The knowledge and science dedicated to developing efficient road systems served the narrative of progress and development. Silen played a role in having some thought into how to develop infrastructure with the least impact, but he was a minority voice in this. His directors and other loggers saw his road system as getting in the way of efficient timber extraction, demonstrating an incompatibility with long-term research goals and short-term harvest patterns. Eventually, Silen's road pattern became the prominent system across the Pacific Northwest, but he initially faced hostility. Reflecting Silen shares,

> "...they watched every move I made. I didn't know it, but I was a political figure, without even knowing it. I was producing information on silvicultural things that would slow down the silviculture and he didn't want that...But then, I added to that, that really what should be done is to go after the methods that would do the minimum damage to the resource" (Silen, Oral History, 1996).

Perhaps it was the trauma of the great depression and the ideology of progress that led the timbermen and district rangers at the H.J. Andrews to have one agenda in mind, which was to get the "cut out". The roads were there to serve that agenda. As a result, Silen watched the landscape that he once spent weeks backpacking turn into an anthropogenic laboratory to serve science that would inform commercial-scale logging. When asked why he left Andrews forest in 1954, he responds, "You get to where you love a certain piece of country and you don't want to see it hurt. And I loved that piece of country and I just didn't want to go back and see it. Can you imagine that?" (Silen, Oral History, 1996).

Scientific forestry resulted in the extraction of timber and the development of roads, both of which led to an increase in runoff. This caused the streams to be inhabitable to many species and it made the water too contaminated for drinking. As a result, another important agenda for research became the maintenance of watersheds. The H.J. Andrews Experimental site consists of the Blue River Water drainage, which made it an ideal location to test not only methods of timber extraction, but also how these various methods impact the "health" of watersheds.

The H.J. Andrews as a Laboratory for Watershed Management

Jerry Dunford sits in a trailer at the H.J. Andrews headquarters, located at the bottom of the Lookout Creek watershed. The trailer smells a bit musty, especially in contrast to the outside smell of moss, cedar, and pines. He sits at the booth with a map of the H.J. Andrews laid out on top. It's getting a bit dark and the dim light barely illuminates the trailer. The map shows three adjacent circles drawn near the bottom of the watershed, which subdivides the drainage basin into three smaller watersheds. Dunford writes down the treatment plan for each of these *smaller watersheds. He takes experimentation to the landscape level. In a matter of time, researchers and timbermen will manipulate the watersheds to test the impact of logging on the quality of water.*[6]

The USDA Forest Service's desire to continue with commercial-scale logging, but maintain "healthy" watersheds led to the establishment of the experimental watersheds. These initiatives led to the work of Jerry Dunford, who drafted plans to study the effect of logging. He subdivided the lookout creek drainage into three smaller watersheds that drained into Lookout Creek and dedicated each to different conditions of logging (Robbins, 2018). The first watershed was completely clear-cut, where timbermen cut 237 acres of the forest. Watershed 2 was the control watershed where no logging took place. Finally, they cut watershed 3 into 3 patches and 6% of it consisted of roads (Robbins, 2018).

This is one of the earliest experimental projects at the H.J. Andrews. H.J. Andrews researchers designed similar to a lab-based approach to experimentation, which involves the manipulation of land, controlling for particular variables, and testing for particular hypotheses. Researchers parceled out large spaces of land into statistical units to try and emulate different conditions and test for certain outcomes. These forms of experimentation traditionally came from fields such as physics and chemistry. However, in those fields, it's a lot easier to create controlled environments and ensure repeatability, which are two important aspects of experimental research.

The experimental approach in the watershed project ties with utilitarian motivations. The director of the Pacific Research Station during the 1950's, Robert Cowlin, said that the central

[6] My inspiration for this imagined narrative comes from Robbins (2018) and his account of the history of the watershed experiment at the H.J. Andrews

mission for the H.J. Andrews is to study the relationship between management and maintaining healthy watersheds. "Healthy" in this context means water that's not contaminated by sedimentation and maintained as an important resource for the growing urban populations (Robbins, 2018). Jack Rothatcher, research personnel, states, "the general objective of Forest Service watershed management research is to discover how to maintain an adequate flow of good quality water yet utilize the land for economic output of timber, grazing, and recreation" (Rothatcher, 1966, p. 1). Rothatcher's quote embodies Pinchot's multi-use philosophy to optimize the forest for as many uses as possible, while timber extraction is the underlying agenda.

The close coupling between scientific experimentation and utilitarianism stems from the Baconian approach to science. Bacon was a large proponent of experimentation. He believed that observational methods would not lead us to the "secrets of nature" and he compares experimentation with torturing victims as a way of forcing them to reveal their secrets (Merchant, 2008). To learn the secrets of nature, we must experiment, which involves controlling and manipulating nature. His philosophy and approach to experimental research went hand in hand with his pursuit of mankind's dominion over nature. Certain aspects of Bacon’s philosophy, materialized onto the landscape of the H.J. Andrews Experimental Forest through the postwar years. The USDA did not establish the site to observe and learn about forests in a receptive manner, but rather for the sake of optimizing resource extraction and pursuing greater control over the landscapes.

The Legacy of Scientific Forestry

Although the days of scientific forestry have passed, this tradition has left a lasting legacy. The infrastructure that was put into place by this tradition allowed the H.J. Andrews to continue as an experimental research site for decades to come. The physical infrastructure includes plantations, road systems, watershed experiments, and a collection of long-term data. The ideational legacy that continues is the close coupling between science and management. Top-down funding institutions continue to shape the practice of science and support knowledge that will allow for greater control over these forest landscapes. This is why Donald Worster identifies scientific forestry as a part of the imperial tradition of ecology. This tradition assumes that nature is a stock house for resources and that the Euro-American tradition is superior to others due to the scientific advancements that allow for control over natural landscapes. Forest landscapes are resources and humans are seen to have this manifest destiny to exploit the resources. As mentioned, this tradition is particularly geared towards white settler communities and the continuation of colonial expansion. This leads to the marginalization of those who might perceive and understand these landscapes in alternative ways. During this time, H.J. Andrews was under the administration of the USDA Forest Service, and the site was entirely dedicated to the tradition of scientific forestry. However, a turning point for scientific inquiry took place in 1970, when the community of scientists succeeded in becoming a part of the International Biological Program (IBP). This marks the emergence of a new tradition of scientific inquiry at the H.J. Andrews—ecosystem ecology.

Chapter 3 (Eco) system Ecology

Throughout my time working with the community of scientists at the H.J. Andrews, I'd hear people refer to the 1970s as a cultural and scientific turning point. Through my explorations in the archives, ethnographic interviews, and readings of historical text, I've come to recognize this turning point as the transition from scientific forestry to ecosystem ecology. In this transition, the days of clear-cutting old-growth landscapes, extracting timber and conducting science to optimize resource extraction wanes and a new layer of the palimpsest begins to assemble. This next layer, ecosystem ecology, is the tradition that I will explore throughout this chapter.

At the beginning of my research, when I thought of the term ecosystem, I always associated it with the cultural connotation of the term, which tends to convey the interconnectedness within nature. However, after reading Golley's A History of the Ecosystem Concept (1993) and Worster's Nature's Economy (1994), I learned that the ecosystem concept as a scientific paradigm, is not a product of grass-roots environmental movement, but rather it is a concept that rose under the influence of post-war modernization. The individuals who embodied this concept desired to make the field of ecology more like the prestigious fields of physics and systems engineering. During the post-war decades, these fields gained their prestige through their contributions toward militarization and weapon development. The cultural landscape that supported ecology's shift toward ecosystem science was the side to society that pushed for an increase in mechanization, industrialization, and capitalistic exploitation of natural resources. These cultural motivations materialized into the International Biological Program (IBP), which is a program supported by the U.S. government to coordinate large-scale ecological and environmental studies. The H.J. Andrews' success in obtaining funding from this program in

1970 is what led to the shift toward a new way of perceiving the forest landscapes and new ideas of how to produce knowledge that would explain these forests.

Although ecosystem ecology marks a transition away from scientific forestry, David Worster identifies both of these traditions under the larger paradigm of the Imperial Tradition in ecology (1994). That's because the underlying motivations of scientific forestry and ecosystem ecology are to control and obtain dominion over nature, even though their perceptions of nature and methods of control are different. Scientific forestry saw forests as merely a stock house for resources. The timbermen and scientists at the time saw old-growth as unruly and wretched landscapes that they needed to convert into thrifty and orderly plantations. In the regime of ecosystem ecology, forests are no longer seen as disorderly and wretched wastelands, but rather as mechanistic systems with interrelated parts that contribute to the function of the whole. Since the rise of modern science, nature has been depicted as a mechanistic system from a clock (Merchant, 1980), to more contemporary analogies, such as an engine (Odum, 1971) or a television set (Grier et. al, 1978). This philosophy's depiction of nature as a mechanical system sets us up for exploitation. That's because it coincides with the belief that we as humans are exceptionally suited to manipulate and control these systems due to our divine ability to think with reason and logic. This imperial tradition perceives humans as more intelligent than all other beings and therefore we are the only ones capable of understanding nature's perfectly ordered and programmed systems (Worster, 1994; Merchant, 1980). These are the cosmological roots that support the emergence of ecosystem ecology, which sought control of the environment through the perception of nature as a "cybernetic machine" (Kwa, 1987).

I plan to tell a story about the ecosystem paradigm, how it has manifested at the H.J. Andrews and left another layer of material and ideational assemblages. These assemblages add to the palimpsest and continue to influence scientific inquiry at the H.J. Andrews to this day. In my explorations of this particular paradigm, I have encountered various stories both through archives and through ethnographic encounters. I've taken the historical stories that I encountered in the archives and continue to re-imagine them through fictional writing to breathe life into the story of ecosystem ecology. My purpose behind the reimagined stories is to demonstrate how certain ideas, perspectives, and convictions come from an individual's situated knowledge. In other words, knowledge is inherently situated in particular cultural contexts and motivations. The perspective of those who passed on and continue to pass the tradition of ecosystem ecology do so through a partial perspective. This partial perspective is situated in postwar modernization and the perspective of physics as a field to aspire to. The story of ecosystem ecology at the H.J. Andrews begins with the rise and support of the IBP.

The International Biological Program and the Emergence of (Eco) system Ecology

Through the large glass windows, the red, brown, yellow, and orange trees stand among the urban buildings. The sky is clear, but the heat from the sun is waning, as the fall takes over the summer. It is October of 1970 when President Nixon walks into his office, and on his extravagant wooden desk, lies a document with a heading titled "PUBLIC LAW 91-438".[7] *Below the heading is a joint resolution that states "Expressing the support of the Congress, and urging the support of Federal departments and agencies as well as other persons and organizations,*

[7] (Public Law 91-438, October 7, 1970) https://www.govinfo.gov/content/pkg/STATUTE-84/pdf/STATUTE-84-Pg889.pdf

both public and private, for the international biological program". People crowd around Nixon while he sits there looking at the document, which expresses Congress's support for the International Biological Program and the need to address the "most crucial situations to face this or any other civilization—the immediate or near the potential of mankind to damage, possibly beyond repair, the earth's ecological system on which all life depends." Someone hands Nixon a pen, which he uses to inscribe his signature onto the document. As the ink dries on the page, the cool fall wind continues to whistle outside. This very moment pulsates outward and through time will cascade to many impacts that define and redefine the U.S. government and its constituents' response to the environmental crisis. [8]

While Nixon was signing the document in 1970, on the other side of the country the community at the H.J. Andrews was seeking to find a way to preserve the Andrews as a scientific research site. The days of scientific forestry were waning and certain leaders of the H.J. Andrews, such as Jerry Franklin and Richard Waring didn't want to see the days of research at the Andrews come to an end. They were aware of the IBP and the potential that it could have in continuing research support for the H.J. Andrews. The team succeeded in getting the IBP's support and H.J. Andrews became one of the program's coniferous biome sites (Franklin, Oral History, 1996; Robbins, 2018). The IBP funding brought a new regime of science—ecosystem ecology, which I also referred to as systems ecology. Kwa argues that the IBP wouldn't have succeeded in receiving support from congress if it wasn't for systems ecology and the rhetoric that this paradigm embodied (Kwa, 1987).

[8] This historical imagination is inspired by a real historical event, which is Nixon's signing of Public Law 91-438, which marks the United States government as one of the largest financial contributors toward the International Biological Program in 1970

The platform that allowed the IBP to succeed provokes in me contradicting feelings. On one hand, Rachel Carson's *Silent Spring* (2002) and rising awareness of pollution were provoking dialogue and issues that became pressing enough to get congress to mobilize and support such a large-scale program, a program that sought to understand ecological systems and reform our management strategies. However, the IBP was able to receive the support that it did because ecology and biology transformed itself to some of the more mainstream and prestigious sciences, such as physics and engineering—it did so by shaping into systems ecology (Kwa, 1987; Golley, 1993).

I was curious to know more about systems ecology and so I dug into the origins of this paradigm. I found that the concept emerged under the influence of an Australian biologist, Ludwig von Bertalanffy, and his General Systems Theory (1972). The premise of his framework is that everything can be described as a mechanistic system with interrelated parts that work with one another to support the overall function of the system. Furthermore, this theory asserts that all complex systems have organizing or universal principles, which can be modeled mathematically. While the theory itself has penetrated many disciplines, the concepts are derived from physics and systems engineering (Ryan, 2011). When systems theory emerged at the H.J. Andrews, scientists no longer perceived forests as barren and rotten wastelands, but rather as a complex system with interconnected parts that are linked to one another via causal nexus—essentially, it was a machine theory applied to forests.

What I also found is that this paradigm has roots that stem even further back into history. The rhetoric embodied within systems ecology is rooted in a mechanical and rationalist philosophy of nature that scholars have traced back to the rise of modern science (Merchant, 1980; Abram, 1991; Worster, 1994). Modern science rose under the influence of Christian theology with a perception of nature as a product or artifact of a divine creator, God. This perception stems back to Plato's *Timaeus*, which is the foundation of Western cosmological and creation myths. In this creation story, Plato describes the natural world by two analogies. One is that nature is a product of a divine craftsman and the other is nature as the son of a divine father. Early Christian theology adopted the analogy of nature as a product or object produced by a divine creator, but omitted the analogy of nature as an offspring of a divine father, except in the context of humans (Foster, 1934). This distinction between nature as an object created by God and humans as the offspring is a fundamental turning point for Western Cosmology and our perception of the more-than-human. It is the defining difference between a Christian worldview and pre-Christian animism. When nature is seen as the offspring of a divine God, then nature is akin to God meaning nature is an embodied soul with inward tendencies. However, the perception of nature as a mere product means that nature is no longer seen as an embodied soul with agency, but rather as an embodied concept produced by a legislator, God (Foster, 1935). Therefore, nature bends to the laws produced by God and these laws and can be deduced via mathematical quantification. It is this particular perception of nature that lays the groundwork for systems ecology.

The rhetoric behind IBP depicts forests and other ecosystems as machines, machines that were "broken", "unhealthy", out of "balance", and in need of repair. Systems ecology took on a narrative where science can be used to understand how these machines operate, which can help inform our management strategies and restore these systems. However, systems ecology perpetuates a utilitarian and materialistic view of the forest. That's because the underlying perception of forests as mechanistic systems is rooted in the desire to have more control over their behavior and sustain our economic demands. This was apparent to me when reading about the history and emergence of the IBP. In its development, the committee members decided that the theme for the program is "The Biological Basis of Human Welfare " and that the program's mission would be working "toward the betterment of mankind" (IBP committee as quoted by Golley, 1993, pp. 110-111). The rhetoric underlying the IBP stems from a managerial ethos where ecological systems are depicted as inert, passive units of study that we can manipulate for our continued economic exploitation. During the first general assembly of the IBP in Paris of 1964, it was stated and agreed that the program should contribute "to the optimum exploitation, on a global basis, of the biological resources on which mankind is vitally dependent for its food and for many other products" (as quoted by Golley, 1993, p. 111). This desire to control rather than truly understand the natural world, led to a unilinear framework of systems ecology. That is, it applies theoretical ideas from physics, systems engineering, and economics onto forests rather than contemplating what lessons the forest might have for restructuring our own economic and political systems. As Worster has pointed out, this unilinear learning process is based on a cultural assumption that the environmental crisis is purely a technical problem, rather than a cultural, ideological, spiritual, political, or economic problem (Worster, 1994).

This cultural assumption led to the rise of Big Science. Big Science is a series of transformations that took place during the cultural landscape of postwar modernization and industrialization. These transformations pushed for large-scale top-down projects funded by the government, which had a lot of success in fields, such as physics, systems engineering, and chemistry for developing weapons during the increase of militarization in the U.S. (Aronova et. al, 2010). Science had undergone fundamental change with the increase of militarized funding. This change includes a shift away from basic science to more applied science. This also led to a hierarchy of disciplines, where fields such as physics and systems engineering were seen as the most prestigious due to their contributions toward militarization. To gain this level of credibility, other fields strived to be more “physics-like”. That meant a change for ecology and its transition toward a materialistic and experimental top-down field with the ecosystem paradigm.

This economic and materialistic approach was well supported by the U.S Atomic Energy Commission (AEC). They institutionalized the systems ecology paradigm, by offering extensive funding to apply that paradigm to study how nuclear waste moves throughout an ecological “system”. Eugene Odum, who came to popularize the ecosystem concept in his textbook, *The Fundamentals of Ecology (*1971*)*, worked for AEC to help the government understand how nuclear weapons might impact the environment (Golley, 1993; Worster, 1994). Odum and his research paradigm then became the lead authority for the Andrews Science community during the IBP era. The ecologists at the H.J. Andrews were trained to apply the systems approach to studying forest landscapes of the Pacific Northwest (Swanson, Interview, 1996). However, the systems ecology approach was never a hypothesis that underwent extensive testing, but rather it emerged as an idea (Golley, 1993; Worster, 1999). An idea that was passed down generation through generation in an authoritative manner, an idea that was taught as ontological fact, a reality that’s fixed—no questions about it.

The ecosystem concept had changed the game for scientific inquiry at the H.J. Andrews Experimental Forest. It gave ecology a more physics and engineering-like character, through the metaphor of nature as a machine, one which we can understand through rigorous quantitative experimentation and modeling. Before getting into how this concept manifested at the H.J. Andrews, I find it necessary to dig a bit further into the origins of the ecosystem concept to describe the transition from traditional ecology towards this more mechanistic approach.

Origins of the Ecosystem Concept

The sun glistens across the medieval architecture, with pointed arches, stained glass, and elaborate geometric tracery carved from stone. The large and grandiose buildings carry and foster centuries of large and grandiose ideas. These buildings of Oxford University hover over Sir George Arthur Tansley, a botanist professor with a nicely parted haircut, and mustache so extravagant it cannot be forgotten. Tansley walks across the university to his building, where he contemplates the exciting new advancements that came for the physicists.

"Now that is a field that has offered robust advancements to knowledge", he thinks to himself. Tansley makes it to his building, where he sits at his desk while the magnificent paned windows fracture sunlight to illuminate both the pen and paper, as well the thoughts that circulate his mind. The ghosts of thinker's past, hover over Tansley, whispering into his ears and provoking an inspiration for a new idea, an idea that would have a vast impact on Euro-American tradition and thought. Tansley wrote and wrote, and one word, in particular, glistened on the paper, ecosystem.

Sir George Arthur Tansley originated the ecosystem concept in 1935 as a retaliatory response to ecology's current characteristics at the time. In the nineteenth and early twentieth century, ecology as a field primarily consisted of observational and descriptive modes of inquiry. Also, ecology practiced an organicist worldview where influential ecologists, such as Frederic Clements and Philip Collins, perceived ecological communities as superorganisms. This organicist philosophy is more akin to pre-Christian animism for nature as a whole is perceived as a living, animate being, one with inward tendencies. This worldview contrasts with the mechanical philosophy of mainstream sciences, which depicts nature as inert and mechanistic.

Also, the organicist worldview follows immaterialism, which is the belief that not all things in nature are material and therefore the scientific method cannot penetrate all things in nature. This perception of nature was more aligned with observational approaches and experiential learning. If we perceive nature as a living organism with vitality then we come to understand nature through watching, listening, observing, and describing rather than through experimental and quantitative modeling.

Arthur Tansley was discontent with Frederic Clements and Phillip Sollins' perception of nature and he wanted ecology to gain credibility as a "real" science. He was heavily influenced and inspired by the field of physics and chemistry, which he believed carried authoritative prestige and a model for how all other science should aspire to (Golley, 1993). He pushed against immaterialism and felt that it dabbled too much in philosophical thinking rather than scientific empiricism. However, the irony is that he did not introduce the ecosystem concept from empirical observation, but rather as a theoretical idea, one which would transform the shape of ecology decades to come.

Arthur Tansley first introduced the ecosystem concept in "The Use and Abuse of Vegetational Terms and Concepts" (1935). His idea of an ecosystem asserts a materialistic view, where all phenomena exist in material form and therefore are penetrable via scientific and quantitative methodologies. He presents nature as a mechanical system, not a superorganism, and this allowed ecology to eventually gain greater credibility among the mainstream sciences.

Since the introduction of Tansley's ecosystem concept, it has continuously been passed down by authoritative leaders in the field, without undergoing any testing (Golley, 1993). For instance, Tansley's ecosystem concept laid the groundwork for Eugene Odum's textbook *The Fundamentals of Ecology*, which took the ecosystem concept and made it the unit of study for ecology (1971). In his textbook, Odum doesn't discuss the cultural contexts of the term, but rather teaches it as reified fact. According to Golley, Odum also wrote this textbook in an attempt to gain prestige for ecology among the mainstream sciences (1993). As a result, the system's metaphor becomes the dominant approach in ecology and the process marginalizes other perceptions and approaches to studying nature. The ecosystem concept was well fitted for and gained traction in the postwar years of increased modernization and industrialization. It allowed the IBP to succeed in gaining its support from congress and it eventually led to the transformation of science at the H.J. Andrews beginning in the 1970s onwards.

So what did this mean for the Andrews? The IBP approved the site to join an expansive, heavily funded research program that shifted the shape of ecological inquiry from its previous paradigm. When the IBP started to fund Andrews as its Coniferous Biome site, the main agenda for research was to develop ecosystem models. Scientists can use these models to make generalizations and predict the behavior of ecological systems on a global scale (Golley, 1993).

(Eco) system Models

Richard Waring, a lead scientist at the H.J. Andrews, sits in the passenger seat in the cabin next to the pilot. The sky is clear blue, the sun is shining, and it's 1972. Both of them have their headsets on and attempt to speak to one another over the loud humming sound of the engine and the eerie ring that's coming from the propeller, which is spinning round and round. Various gauges cover the dashboard, with needles that point to some dimensional measurement, conveying important information to the pilot and Waring. The two look onto the hilly and steep landscape of the H.J. Andrews, from top-down.

Richard leans over to the pilot and shouts, "The disadvantage of the Andrews is that it's a spot. If you were to generalize anything from there about drought, you hardly have a drought. If you were to generalize about heavy winter snow-packs where you have permafrost, there's no permafrost. So, it isn't inadequate for many things, but it's perfectly inadequate for reaching generalized models. It's a great spot, but it has its limits..."

In the meantime, as they fly over the landscape, miles go by and they see the contours of the hills and a sea of green waves rolling by. Waring continues, "We would make those comparisons and try to scale it up. We're still doing this now with people from other countries...once the remote sensing group has more confidence, then you will see these ideas being scaled, going regional, going to the earth level. We still have a lot of unknowns, but having all these aircraft and ground measurements across a wide area of vegetation gives them confidence that there's something here. There's the same instruments, the same principles, and it's global; Now you can see why a scientist like me is interested." [9]

Richard Waring was a key proponent in shifting ecological inquiry at the H.J. Andrews away from observational and descriptive traditions of the field and towards systems ecology. There was a lot of excitement during this time based on the potential of various technologies to take quantifiable measurements and develop models that are thought to have predictive value on the behavior of ecosystems across the globe. In Waring's point of view, the Andrews is only a spot and if we don't look for generalizations across larger scales, then we miss out on the bigger picture (Waring, Interview, 2020). Furthermore, when Waring suggests that there are the same "instruments" and "principles" and that it's global, he is suggesting that there are universal

[9] The scene for this vignette is re-imagined by taking stories from Richard Waring's oral history and recreating them through fictional writing. However, the quotes in this vignette come directly from Waring's oral history, which is located in the OSU archives, "Voices of the Forest, Voices of the Mills"

processes that describe all coniferous ecosystems. The motivation is to find these universal principles and develop a formula that defines the functions and processes of ecosystems on a global scale.

This effort to use the Andrews as a data point for a larger scale project demonstrates the shift away from ecology's roots in descriptive methodologies and a push towards top-down mechanistic theory. Rather than using observational methods to account for the nuances, and diversity within a particular landscape, top-down approaches seek to find universal principles. This idea of basic or first principles comes from physics. This concept attempts to learn the universal laws or theories.

Mark Sagoff describes top-down forms of ecological inquiry with a metaphor of ecosystems as akin to pendulums (Sagoff, 2003). Mathematicians can model the motion of a pendulum, predict its behavior, and render its patterns intelligible. When mathematicians identify a pendulum's patterns, they can use the same mathematical models to predict other pendulums. The top-down inquiry uses mathematical theory to account for the general structure and function of ecosystems. It employs simplified, abstract representations of ecological systems and uses formal methods to deduce the properties and expected behaviors of whole classes of these systems (Sagoff, 2003). This line of inquiry believes that ecosystems contain order, structure, and regularity. It also strives to understand function in the ecosystem. However, Sagoff argues that the ecosystems can have structure without necessarily having function or purpose and he warns that function might be falsely projected onto ecosystems. He also questions certain concepts, such as ecosystem "health" and "integrity" for these may also be falsely projected onto nature (Sagoff, 2003).

This perception of ecosystems coincides with the systems approach at the H.J. Andrews. In this paradigm, scientists understand forests as complex mechanistic systems. This comes with the assumption that they behave in an orderly and programmed manner. When scientists understand forests to behave in a programmed manner, then they can deduce their behavior via mathematical quantification. This approach tends to place more emphasis on theory than data. Data collection is a means to an end, where the end is developing theoretical models with predictive value. Richard Waring expresses the need to shift towards this theory-oriented approach,

> You have to change your philosophy from first principles to a modeling philosophy, and account for large changes in it before you go there and after you change things. That's better than observing and then telling, simply reporting, what you observed. I liked observing, but you need the theory at the front end, and that takes a lot of work to develop a theory. In physics, they don't ask the people that do the measurements of neutrons and these things to theorize-- they just have to take measurements. In biology, we are supposed to be theorists, measuring people, and administrators. And guess what sometimes suffers? Usually the theory (Waring, Oral History, 1997).

Waring's desire to move the field away from descriptive methodologies and more towards theory is representative of the mechanical cosmological perception of nature. This philosophy perceives forests as inert mechanistic systems that bend to particular universal laws. It is within these perceptions that scientists developed ecosystem models throughout the 1970s. These models, shown in figures 1-3, depict forests as mechanistic systems. The ecosystem becomes the object of research. In this paradigm an ecosystem's inputs and outputs are determined and then the components within the ecosystem are examined to understand the conversion of inputs into outputs (Golley, 1993).

The first time that I encountered these models, I saw them as some kind of cultural inscriptions, a representation of Western cosmological perception of the forests. I sat in my living room in front of the computer, gazing at the screen, while outside of my window ponderosa pines were swaying back and forth. Each tree had its own unique sway. Meanwhile, I was gazing at these ecosystem models that the Andrews science community created during the IBP era and pondered over them for some time. These models depicted the forest as a black box with input and output functions, each step the models got slightly more complex, but the multidimensionality of a forest was still flattened into these two-dimensional diagrams, with discrete and fixed boxes. The diagrams that are meant to represent forest were directly compared to a schema for a Television set or a radio (Gier et al., 1987). As I pondered over these diagrams, I could imagine the sound of electricity zapping from one compartment to the other. Meanwhile, outside my window, the trees continued to sway in circles, as if they were in some ritualistic conjuring of otherworldly spirits.

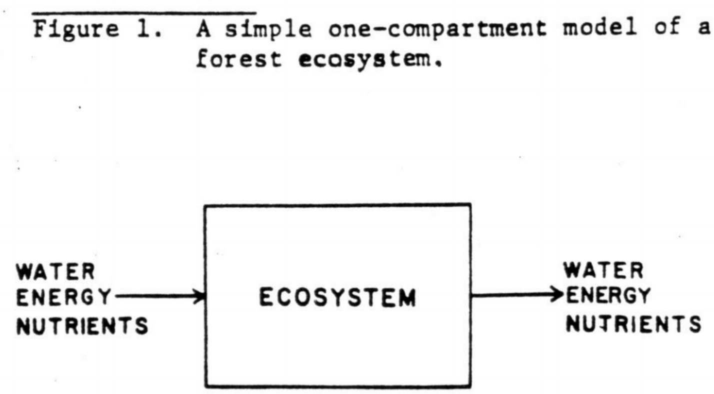

Figure 1. Grier et al., 1987

Sometimes we carry a mindset that one's cultural worldview is ultimately the right way of seeing things. However, as an anthropologist, I'm inclined to try and break us away from these notions that Western worldviews and scientific ideology are the only paths toward knowledge. In doing so, I attempt to deconstruct certain elements of these models to demonstrate how they stem from certain ontological assumptions that are unique to this tradition of scientific inquiry. In analyzing these models, I'm interested in how their different elements represent certain aspects of Euro-American epistemological and ontological notions of forest landscapes.

The first thing that came to my mind, while reflecting on these ecosystem models, is that their foundations lie in a cultural view of the separation between the living and nonliving, a duality that underlies Western Scientific thought. In this model particularly, the "non-living" or physical components include sunlight, nutrients, and water. It is the biological agents that take these elements and actively utilize them for economic gains. For instance, these models intend to depict how vegetation takes sunlight and converts it into energy, which circulates between different organisms. I find it important to articulate how this distinction between living and non-living is a cultural worldview that is unique to our society and some others, but it is not a universal belief.

Figure 2. A three-compartment model of a forest ecosystem.

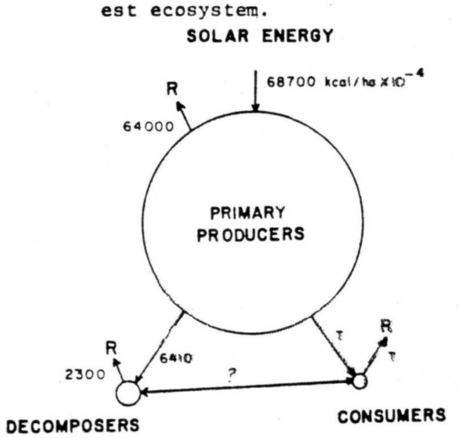

Figure 2. Grier et al., 1987

I've learned that this duality has roots in the transition away from pre-Christian animism toward the secularized worldview of Christian theology and then modern science. Euro-American worldviews once had a perspective where the sun, the moon, the river, and the mountain weren't inert lifeless objects, but rather they had vitality, a sense of life, and agency (Merchant, 1980; Worster, 1994). This was the perspective among pre-Christian communities and also more contemporary scientists that exist on the fringes of mainstream science, such as Henry David Thoreau (Worster, 1994). Continuity with pre-Christian animism has been excluded from the dominant mechanical perception of nature, where nature is no longer perceived as divine, but rather the product produced by the Divine, a legislator God. As a result, physical components of the environment are lifeless and inert. Depicting physical components as inanimate means that they have fixed, programmed behavior that we could render intelligible via mathematical quantification.

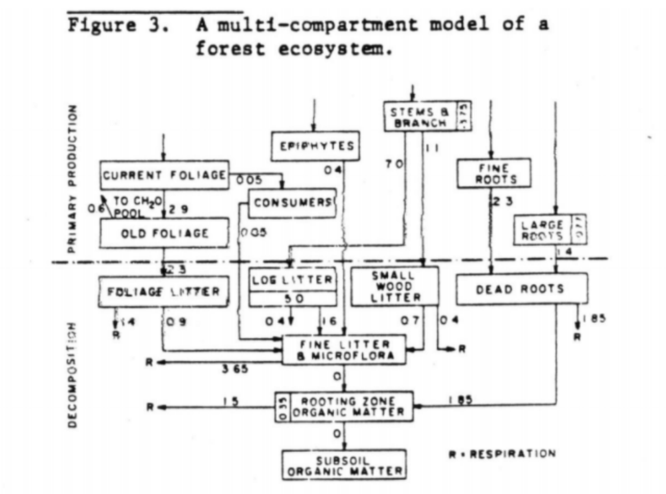

Figure 3. Grier et al., 1987

The second thing that comes to mind when I analyze these models is the categorization of biological beings. These models work from ecological trophic levels, which categorize living organisms (Figure 4). These categories include producers, consumers, and decomposers based on trophic levels, which define where organisms situate in the food chain as well as their overall "function" toward the whole system. The model represents each of these three categories as discrete and enclosed. Producers are plants that photosynthesize to produce energy derived from the sun and processed into sugars. Consumers are organisms that get their energy by consuming other organisms. Finally, decomposers are organisms that break down dead and decaying matter. In ecology, scientists present the different trophic levels in hierarchical structures. According to Golley, the contemporary trophic levels stem from Raymond Lindeman's limnology studies (1993). Lindeman adopted Tansley's ecosystem

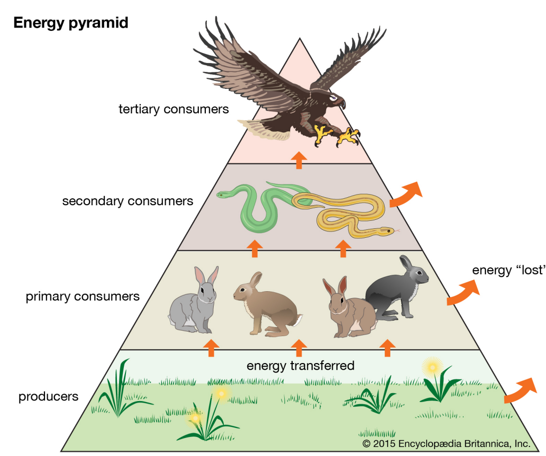

Figure 4. Contemporary Trophic Levels, image from https://www.britannica.com/science/trophic-level

paradigms and developed them further. He did so, by creating a research program that categorized biological beings based on their functions towards the whole ecosystem. Ecologists like Lindeman supported the development of these categorizations because they allowed for the mathematical modeling of nature.


Figure 5. From Didacus Valades, *Rhetorica Christiana* (1579). Found in https://web.stanford.edu/class/engl174b/chain.html

The categorization of living organisms in a hierarchical structure stems as far back as Western Antiquity. In De Animus, Aristotle categorized living beings into three categories based on the types of souls that they had. The first category includes the nutritive soul, which is common among most living things and encompasses anything that absorbs nutrients in order to foster growth. Second is the sensible soul, which entails humans and other animals, but leaves out plants. The sensible soul has the ability to perceive through the senses and experience bodily sensations, such as pain and pleasure. Finally, there is the rational soul, which is attributed to humans and humans only. The rational soul can move from bodily experiences and into active intellect, where we can process the information that we receive through our senses and through the process of thinking (Aristotle, *Animus*). Thus, humans were the only beings that are capable of rationality and logical thought, which sets us apart from all other living things.

This hierarchical organization continues in Medieval Christianity with the Great Chain of Beings. It's also a hierarchical structure, resembling contemporary trophic levels (Figure 5). The beings that are at the bottom of the ladder are the one's assumed to have the least intellectual or spiritual capacity. As you move up the ladder intellect increases as well as divine power. At the bottom lies minerals and physical materials of the earth. Following are plants. As you move up the ladder there are several levels of animals, with prey placed below predatory animals, and above predatory animals are humans, which are at the highest level before the divine (Lovejoy, 1936). The continuity between contemporary trophic levels and the Great Chain of Being demonstrates how this conception of the more-than-human had a pervasive influence on western thought.

Not only do these models base themselves in a hierarchical perception of the more-than-human, but they also pin more-than-human beings into fixed categories that define their functions. As I look at the discrete and fixed boxes of producers, consumers, and decomposers, I can't help but wonder about the creatures that are liminal, that fall between the lines. Are they forced into categories that aren't representative of what they really are? According to Golley, we started to use trophic levels with the rise of the ecosystem concept and its push toward more quantitative and hypothetico-deductive approaches (Golley, 1993). These models brush over biological diversity and nuance for the sake of developing generalizable models. There is a concern that if too much time is spent on considering diversity it would slow us down from developing robust mathematical models for how these systems operate (Golley, 1993; Aronova et al., 2010). What are the consequences of prioritizing quantification and generalizable models over our understanding of biological nuance and diversity? According to Kaishian and Djoulakian, there are many beings that do not conform to discrete categories and as a result, they are omitted in the stories that these models attempt to convey (2020). This leads to their marginalization in conservation and management strategies.

Alternative frameworks call us to question the one-size-fits-all approach to ecosystem paradigm and have individual species speak to us and tell us what frameworks and ways of thinking suit them the most. For instance, Kaishian and Djoulakian talk about queer theory as a more appropriate theoretical framework for mycology. Top-down frameworks have marginalized mycology due to its incompatibility with normative scientific discourse. They talk about the ways in which mycology pushes boundaries, " disrupts our mostly binary conception of plants versus animals, two-sex mating systems, and discrete organismal structure, calling upon non-normative, multimodal methodologies for knowledge acquisition" (Kaishian and Djoulakian, 2020, p. 4). This has challenged current scientific frameworks, and hopefully, this challenge can be an invitation to broaden our epistemological tools to encompass the vast diversity among more-than-human beings.

A third observation is that these models define relations between the different biotic compartments in purely economic terms. The ecosystem models describe the exchange and flow of currency throughout the system, and in the context of these models, the currency is energy derived from the sun. Between each compartment are quantitative values of energy as it moves throughout the system (Grier et al., 1978). An ecosystem's "health" is dependent on physical equilibrium, an idea that systems ecologists adopted from physicists' thermodynamics concept. In this perspective, the forest's "health" equates to a steady state, which is the state of balance between input and output functions. This concept comes from theoretical frameworks from physics and economics.

The fourth and final observation is that these models, and the ecosystem paradigm in general de-historicize the forest. That is, they omit any cultural, social, and political contexts that these forests have existed in. Bruno Latour describes this separation as a part of the Modern constitution (1993). Modernity assumes that culture and nature are two separate entities. This separation between culture-nature, is another symptom of Western dualistic thinking, an illusion that's become so ingrained that we fail to conceptualize the ways in which nature and culture are inextricably entangled with one another. The IBP institutionalized this regime's ecosystem ecology with a strong desire to develop robust and sophisticated models that will inform management strategies. However, these models omit context that is critical to their understanding of forests. Some examples include how indigenous peoples have been modifying the landscape for time immemorial (it's not a primeval forest), how colonization changed the shape of these forests, and the impacts of industrial logging. Even staying within the ecosystem paradigm, it's hard to deny the impact that indigenous peoples, industrial clearcutting, and colonial expansion have had on the ways in which ecosystems "behave" and "function". Since the creation of these particular models, the ecosystem concept has developed by taking into consideration various forms of disturbances. However, our ability to overcome the illusionary separations of nature and culture still haunts our epistemological frameworks today.

The ecosystem concept had changed the game for scientific inquiry at the H.J. Andrews Experimental Forest. It gave ecology a more physics and engineering-like character, through the metaphor of nature as a machine. This tradition was able to receive the support that it did, due to the cultural landscape of postwar modernization and increased emphasis on mechanical and rationalist philosophies of nature. Even though the perception of nature as a mechanistic system emerged as a cosmological perspective, we continue to pass it down through generations as fact and in the process marginalize all other ontological perspectives of forest landscapes. Since 1980, the site shifted away from IBP and is now part of the National Science Foundation's network of Long Term Ecological Research (LTER). Although LTER has many differences from IBP, this program continued the process of institutionalizing the ecosystem paradigm for ecological inquiry in the United States. Like scientific forestry, past traditions don't cease to exist, but rather continue to reshape their form through stages of time.

The Ecosystem Paradigm Post IBP

Throughout my readings of the LTER proposals, I've encountered language that suggests the systems approach to understanding forests still serves as the dominant framework during post-IBP years. For instance, the fifth LTER proposal states,

> "Our final behavior of interest involves the presence (or absence) of ***alternative system*** states in our ecosystem. Compared to other ecosystems (Scheffer et al. 2001, VanDeKappell et al. 2001), Cascade forests are relatively resilient, typically returning to or at least approaching the same state despite the occurrence of major disturbances, such as fire, floods, and logging (Figure 2.5, path A)." (2002, p. 23)

This concept of alternative system states is reminiscent of thermodynamic theory and its concept of equilibrium. In this concept, ecologists perceive systems to have a steady-state. At times of disturbances the steady-state can be out of balance, but through certain processes make its way back to an equilibrium. The proposal states, "LTER 5 continues to use models as a heuristic and synthetic tools to learn about general systems behavior" (2002, p. 9). Therefore, systems ecology continues to drive the philosophy of science at the Andrews. Furthermore, the proposal takes concepts and terminology from the field of physics and systems engineering and applies it to understanding the forest. For instance,

"***Hysteresis*** implies the system response may depend on the direction of change in the driver; that is, the value of the driver may not be sufficient to predict the response. This is similar to path-dependent behavior, although ***hysteresis*** involves a temporal pattern that is frequently repeated (i.e., a hysteresis loop)." (2002, p. 23)

"Lack of **spatial coherence** can lead to temporal stability at the landscape scale, giving a system more resistance to change than apparent from a single location." (2002, p.8)

These terms come from general systems or machine theory. The term hysteresis comes from physics and describes how the value of a physical property lags behind changes in the effect of causing it (Britannica, 2013). In this context, they are using it to describe how the temporal behavior of forest "systems" might involve a lag between driving and response variables. Spatial coherence is another word derived from physics, which defines the correlation to waves at different points in space (Winter et al., 2020). In the context of this proposal, the term describes spatial coherence variables in aquatic and terrestrial spaces. The central emphasis for this proposal is temporal behavior and its consequences for ecosystem change. The incentive behind looking at temporal scales is to test for hypotheses that regulate temporal behavior. This allows them to push more towards experimentation, rather than observational modes of inquiry (2002, p. 8). These proposals show how the systems approach continues to direct scientific perception of these forest landscapes. While the system's approach allows ecologists to think holistically, it also depicts forests as mechanistic systems that can be understood via mathematical quantifications. This makes it a top-down framework, where theoretical ideas from the fields of physics and systems engineering are imposed onto forests.

While NSF-LTER continued the institutionalization of the ecosystem paradigm, it simultaneously made space for traditional approaches to ecological inquiry, such as natural history. Members of the IBP organized the program so that site managers consisted of people with a strong background in mathematical modeling, computer simulations, and the systems theoretical approach. With the transition towards NSF-LTER, the organization changed so that ecologists with more traditional backgrounds became in charge of data collection and site overseeing (Aronova et al., 2010). However, natural history tends to receive less financial support than systems ecology. Nevertheless, several individuals continue to embody natural history and preserve this tradition through time.

Chapter Four Natural History

Amid postwar modernization and the rise of Big Science, I learned that some of the scientists at Andrews were practicing yet another tradition that existed alongside ecosystem ecology. I've come to recognize this tradition as natural history. Natural history is an older tradition that predates ecosystem ecology, scientific forestry, and even capitalism. During the transition from IBP to NSF-LTER, several members of the Andrews science community embodied this archaic tradition, allowing it to be preserved through time. Throughout this chapter, I will talk about natural history as the final layer of the palimpsest at the H.J. Andrews Experimental Forest. As a reminder, the nature of this palimpsest is that the legacy of other paradigms still haunts the ideational and physical infrastructure of the H.J. Andrews. Therefore, added successions co-exist with these infrastructures. While systems ecology continues to be the dominant framework that ecologists exist in, natural history has emerged and made its imprint on the landscape as well. I will delineate core elements of natural history as the third tradition of ecological inquiry at the H.J. Andrews. These elements include a long-term commitment to place, historical knowledge, learning the name of individual species, and finally embodied knowledge.

Donald Worster identifies natural history as part of the Arcadian tradition in ecological inquiry. The term Arcadian comes from the mountainous Arcady region of Greece and their ancient ideas of human fellowship with the more-than-human. This tradition has roots in pre-Christian animism with its dreams to reanimate people's loyalties to the more-than-human and rekindle with the vital energies of the earth (Worster, 1994). To see nature as a vital source contrasts with the imperial tradition and mechanistic perceptions of nature. Rather, vitalism is the "view that plants and animals act according to an indwelling, mysterious power that physics or chemistry cannot analyze" (Worster, 1994, p. 17). In other words, nature consists of sentient and animate beings each of whom carries its own individual story. Within this tradition, knowledge comes from embodied experiences.

By embodied experience or embodied knowledge, I mean the knowledge that we develop by immersing ourselves in the forest landscape and learning through our direct sensory experiences and subjectivities. As I had mentioned in the introduction, modern science stems from the worldview that there is an objective reality that exists beyond our subjective experiences, and the only way to access that knowledge is through scientific and mathematical methodologies. However, this view of objective reality is not a universal belief. There are alternative frameworks that suggest that our subjective experiences are reality. If that's the case, we cannot fixate on universal definitions or formulas to describe the natural world. Rather we must understand through our feelings, sensibilities, and personal interpretations when we physically and emotionally immerse ourselves in forest landscapes. Over time there is a level of intimacy that is developed and you overcome the dichotomies between researcher/object. This is the essence of natural history and the arcadian tradition. It is about grounding oneself to a place and establishing intimacy with the land, the water, and the diversity of beings. This dedication to a place inevitably also means a sense of love and attachment towards a place. When you love something you are willing to sit with it patiently, for as long as it takes to understand and to truly know its name.

According to Robin W. Kimmerer, you come to know a species or a community of species by observing, being receptive, and immersing oneself in their lifeworlds through fieldwork (2003). This form of inquiry is apparent in Eric Forsman's dedication to the northern spotted owl and Jerry Franklin's commitment to old-growth forests. This is one of the most archaic forms of ecological inquiry and resembles ancestral forms of knowledge. This form of knowledge also looks beyond the dichotomies of science/art, objective/subjective, and reason/emotion. Therefore, many figures within the Arcadian tradition are not only scientists but are also humanists, artists, philosophers, etc. (Worster, 1994).

The idea that knowledge is solely produced through logic, reason, and scientific forms of inquiry stems from colonial hegemony, which sought to exclude marginalized communities from the process of knowledge production (Merchant, 1980; Worster, 1994; Haraway, 1988). Therefore, understanding that knowledge comes from embodied experiences allows us to decentralize the knowledge production process. That's because knowledge no longer comes solely from top-down institutions or a dominant scientific habitus. Rather, knowledge can come from individuals that lie on the peripheries of dominant paradigms. These different individuals include natural historians, artists and humanists, and those who come from worldviews that are non-Euro-American based. Throughout this chapter, I will talk about my account with natural history at the H.J. Andrews Experimental Forest, which will include my re-creation of stories that I found in archives, interview recordings, and field notes. The stories are on events that I've encountered through historical texts or in-person via ethnographic encounters. The historical texts require some imaginative thinking to pull them out of the archives and to bring them back to life. For me, this approach to writing is a way of engaging with the community through shaping, molding and re-creating stories. Some might perceive this as unwise since traditional academic writing states we need to "document" our encounters as "factual" as we can. However, I find that it's the disembodied, objective, and flat writing that does injustice to the stories we wish to resurface. These stories are not about objective knowledge, the cold hard truth. I am not particularly trying to conquer doubt, extinguish the unknown, and assert authority over this particular subject. Rather, following the writers of *Crumbled Paper Boat*, I'm more interested in using ethnographic writing as a "means of marking and maintaining openness to events, surprises, and contingencies, to a reality that is as much a source of questions and provocations as of answers" (Pandian and Mclean, 2017, p. 4).

The Log Decomposition Study and Long Term Commitment to Place

During the early spring of 1985, as the rainy season starts to fade out, Mark Harmon stands in the mossy forest working among USDA foresters. There are several coniferous logs that have been felled and brought over to this site. The logs come from pacific silver fir, western hemlock, western red cedar, and Douglas fir. As Mark and other foresters saw the logs into smaller cookies, the loud buzz of a chainsaw echoes throughout the landscape. After the sawing dies down, Mark walks over to each log and places neon flags in their bark. With his notebook, he writes down notes on the size, initial bulk density, moisture, and nutrient content for each piece of log.

In the midst of his work, Mark looks over and pays attention to a log that wasn't placed, by him or the foresters, but rather by the forest itself. The log that lays there rotting has tree saplings growing from it. It is a dead lump of wood, which is serving as a platform for new life to emerge. It's this very sight that has motivated Mark and his log decomposition study. He knew that log decay is an important part of a forest landscape and a log can take hundreds of years to *fully decay. He knew that if we are to understand the forest landscape, we ought to work on its timescale, not ours. That's why Mark is setting up his project to last for 200 years.*[10]

Thirty-five years later, Frederick Swanson drove me and a couple of other visitors up the steep hills of the H.J. Andrews. We were approaching our final destination for the day, the log decomposition site. As we pulled off to the side of the road and got out of the SUV, I noticed the forest here felt darker and more moist. We all walked through a path that took us away from the fire road and into the dark forest. Both burgeoning tree saplings and fallen branches covered the path, both of which represented the cycles of life and decay.

We eventually stopped at a site that had decomposing logs scattered across the forest floor. The site was dark, and fairly quiet except for the sounds of trees creaking and wind blowing through the fern branches, which had moss and lichens draping down from them. There were buckets on the logs and neon flags scattered around. Fred called it "research trash". I saw it as an indication that people are here to communicate with the more-than-human. There were logs from different species laid out. Some were still firm while others felt spongy. Fred walked over to demonstrate how the logs were in the process of decay and poked a finger right through the wood. Not only does the forest represent life, fertility, and growth, but also the importance of death and decline.

The ambition and dedication of the log decomposition site allured me. It was my first time hearing about a scientific research project of that time length, 200 years. This project coincided with the emergence of NSF's Long Term Ecological Research (LTER) program, which believed if we are to understand natural landscapes, we need to conduct research with longer

[10] This story is another historical imagination based on real events. The event is Harmon's set up for the 200 year long log decomposition study. The contextual information for this scene comes from Harmon's oral history, in the OSU archives titled "Voices of the Forest, Voices of the Mills"

time frames. Traditionally, ecologists conducted their research in 2-3 year-long funding cycles. However, many scientists felt that led to misleading results (Franklin, Oral History, 1996). There are many ecological phenomena that occur in much longer time scales, which is why scientists like Mark Harmon felt that if we are to understand forest landscapes we ought to start working on their time scale and not ours.

The shift from the IBP and toward LTER demonstrates a key characteristic of natural history, which is long term dedication toward a particular place. When the IBP program came to an end, particular members of the Andrews science community did what they could to preserve the Andrews as a site dedicated to the study of old-growth forests. In 1973, Jerry Franklin, a prominent science leader at the H.J. Andrews went to D.C. to become a research director at NSF headquarters. He went there with a commitment to the H.J. Andrews and felt that there was something particularly special about the Andrews and the old-growth forests of the surrounding region. Therefore, he carried with him two main goals as a research director. The first was to preserve the Andrews as a research site and the second was to modify infrastructure so that researchers received funding for longer-term intervals (Franklin, Oral History, 1996). It's this very commitment to a place and establishing roots through place-based knowledge that is central to the arcadian tradition and to natural history.

In my interview with Mark Harmon, he talked about his interest in natural history, but also how natural history is dwindling in popularity. Mark went to Amherst College and applied as a natural history major, however, when he arrived the college had done away with the program. Mark said that they didn't think natural history, " ...was a rigorous science. So they stuck me in physics and chemistry. And finally, biology, in my first year or two, was just miserable. It's not what I wanted" (Harmon, Interview, 2020). Despite the marginalization of natural history, Mark's dedication to the Andrews shows that he still embodies the natural history tradition. The tradition has been embroidered into the landscape with his 200 year-long study. Mark knows he will not be around for the research results, rather there is hope that people in the following generations will continue to pick up where previous researchers left off. Mark weaves together the desire to maintain a connection to place and to set intentions for coming generations.

I learned that shifting towards long-term inquiry has had implications for our perception of the forest. During the industrial age, foresters would collect woody debris from the forest floor because they saw decomposing wood as clutter and even hazardous. They believed forests were disorderly and they wanted to impose order onto the forest (Luoma, 1999). As a result, they were not aware that woody debris is an incredibly critical part of both the aquatic and terrestrial landscape. This lack of awareness is a result of their ideology being driven by progress and the perception of forward linear advancement, which led them to overlook the critical role of decay, decomposition, and decline. Understanding the role of decay requires us to step out of our modernist perceptions of time as linear and see that the forest consists of many different directions and cycles of time.

Mark Harmon and the log decomposition study demonstrates a form of learning where we allow the forest to speak to us by using observational methods. Mark observed seedlings growing out of decomposing logs, " Why were all the seedlings on logs? You could go out in these big open areas, and there just wouldn't be seedlings on the forest floor or on the ground." (Harmon, Oral History, 1997). This is what led to a large realization of the importance of deadwood in a forest landscape. Fallen logs in creeks created habitats for fish and helped culminate sediments which also led to a concentration of nutrients. Fallen logs on the forest floor provide shelter for insects and small mammals. Also, a tree that is dead in the forest serves as a nutrient packhouse for decomposers, such as insects and fungi. The observation that deadwood in the forest leads to more life led to a shift from understanding time as linear to time as cyclical. As Robin W. Kimmerer states, "Time is not a river running inexorably towards the sea, but the sea itself it's tides that appear and disappear, the fog that rises to become rain in a different river. All things that were will come again" (2003, p. 207). To observe how time moves in cycles and in many directions requires one to immerse oneself into the forest landscape through embodied learning.

With a long-term commitment to place, comes another important element of Natural history, which is knowledge of a landscape's particular history. This contrasts with the system's ecology approach of defining landscapes by universal processes. Rather, natural history understands that the current state of a landscape is contingent on historical events that are unique to that particular place. In the words of Robin W. Kimmerer, this requires learning the wisdom of the land (Brodie et al., 2017, pp.41-49).

Learning the Hi*story* of the Land

It is 1975 and Frederick Swanson stands amidst the apocalyptic landscape, an open field with nothing but tree stumps dispersed throughout the desert-like floor. The stumps represent the ghosts of ancient trees and the vibrant community that they once housed. To most people, the ghostly landscape seemingly has nothing left to offer. However, Fred knew that the history of the forest lay bare before his eyes. Each stump's concentric ring pattern contains an inscription that reveals something about the forest history.

The sun is beating down fiercely and with no canopy cover, Fred is fully exposed. However, it is only a short window before decomposition takes place and erodes the history that's written across the tree stumps. Therefore, Fred works through the landscape stump by stump with perseverance. He's particularly interested to know the history of fire throughout this once forested landscape. As he approaches one stump in particular he looks down and observes the rings that ripple outward from the center. Each ring accumulates stories throughout that year of growth. One of the rings had a dark scar, signifying that a fire took place that year. Fred brushes off the ants that are crawling up his sleeves then starts to take notes in his notebook. He writes down his interpretation of the history that this particular stump has to share before moving on to the next one.[11]

In 1975, when Fred Swanson joined Peter Morrison in a project to reconstruct fire history at the H.J. Andrews Experimental Forest, they immersed themselves in a landscape learning to read and interpret both tree rings and fire scars marked on different trees. Fred spent a lot of time walking around the landscape and observing the stumps to assess fire history and how different fire regimes can have an influence on soil and sediment dynamics. This requires a historical and spatial perspective rather than an experimental one. That's because while experimental frameworks assume that forests are fixed and static, Fred has more interest in how forests are "banged-up" by different types of disturbances (Swanson, Oral History, 1996). In fact, some would argue that due to the indeterminacy in natural landscapes, geology and ecology deal with unique entities, "events" or chunks of space and time. For this reason, some have defined ecology as an "event science", which means there are no laws at the biological level. Theories

[11] I imagined this historical encounter based on real events that took place. I was inspired by my 2020 interview with Fred Swanson

are essentially non-testable, "and the life phenomenon too indeterminate for assignment of causes and predictions" (Haber, 2011, p. 222). This is why natural historians seek to understand the history and events that have led to the shaping of a particular landscape. This entails observational approaches by reading and interpreting stories, which more-than-human beings have written on the landscape.

Fred's background in geology gave him a perspective situated in long-term and historical processes that explain how various ecological and geological processes have shaped particular landscapes. Understanding how history has shaped a particular landscape involves looking at how certain geological and ecological processes interact with one another causing points of change that alter the landscape through time. Some of these historical processes include both short and long-term relationships between fire, vegetation, soil, hydrology, geomorphological processes, and landforms. These processes interact with one another in a myriad of ways. For instance, fire alters vegetation and soil, which in turn alters hydrological systems, which then reshapes soil movement and sediments throughout watersheds (Swanson, 1981). The interconnectedness between these factors results in unique trajectories of the shaping and reshaping of particular landscapes.

Even though the world that we reside in is constantly undergoing change, Fred argues that history still offers us many clues to how natural landscapes might behave in future events (Swanson, Interview, 2020). In fact, looking at historical disturbance regimes can inform management strategies. For instance, (Cissel et al., 1999) use historical patterns of forest fires to inform management strategies as an alternative to the static reserve approach in the Pacific Northwest Forest Plan. The static reserve takes a plot of forest and protects it from any management. However, landscapes are highly dynamic and variable and as a result, the static reserve approach has caused unintended consequences. These consequences include congested forests that are more prone to intensified wildfires. An alternative approach to this system involves using historical information to better understand how these landscapes are highly dynamic and variable. With the historical knowledge of past fire regimes, Cissel et al. suggest an alternative reserve system where managers would prescribe three different logging methods based on the prediction of how fires might behave (Cissel et al.,1999). These predictions come from the knowledge of the frequency, severity, and spatial extent of past fires. The main argument underlying their approach is that informing management strategies with knowledge about ecosystem history and variability will lead to less risky and more informed management decisions.

Understanding how the shape of a particular landscape is contingent on historical events unique to that particular place contrasts with ecosystem ecology. As I mentioned in Chapter three, systems ecology perceives ecosystems as akin to pendulums (Sagoff, 2003). Their philosophy states there are universal processes that can be rendered intelligible via mathematical quantification. The mechanical philosophy persists to this day with scientists that perceive ecosystems as holistic and mechanistic with particular components serving the overall function of the system. These scientists tend to use methods of mathematical modeling to comprehend the natural world and practice hypothetico-deductive research with an emphasis on theory-building over corporeal observations. However, Sagoff continues with his metaphor and states that the natural history approach perceives ecosystems to be more like plazas (2003). In a plaza, you observe the activities that are going on. To understand it would be better to employ a descriptive, bottom-top analysis. You cannot derive universal laws and apply them to all plazas because each point in space and time has its own unique characteristics. In this framework, empirical data is understood to be more important than theoretical modeling. For this approach, history is a crucial part of the analysis. History helps us to understand the different individuals that are present and how different activities or processes make up the current state of a plaza.

These two different approaches, the top-down versus bottom-up frameworks are also echoed within my own field in anthropology. There have been certain research paradigms, such as the structural-functional framework, which push for more theory and attempt to develop universal frameworks that define all cultures across time and space (Holmwood, 2005). However, Franz Boas offered an alternative approach with his concept, historical particularism. This concept suggests that each culture is a product of historical stories and events that are unique to that particular culture alone (Darnell, 1990). Therefore, imposing universal models can be misleading and neglect the diversity and heterogeneity of cultures across the world. Forests are just as complex, heterogeneous, and diverse as cultures. Therefore, we can understand them at a deeper level by looking for the individual stories that exist within each particular landscape. These unique stories involve the intricacies and entanglements between ecological, geological, cultural, processes that create an unfolding of events that are unique to that particular place. This also entails placing more emphasis on individuals, heterogeneity, and biological diversity. One way of placing more emphasis is by learning the name of the species. Learning the name of a species is a concept that RobinKimmerer uses to describe the intimacy established when we come to learn and observe the stories that more-than-human beings embody (2003).

Learning the Name of a Species

Jerry Franklin walks through the old-growth stand while douglas fir and Western red cedar tower around and circle the forest understory. Sword ferns bustle around in the wind, which is circulating voices, songs, pollen, and moisture into the forest plaza. Chanterelles burgeon through the soil emerging from the busy network of bacteria, actinomycetes, fungi, and algae that lie in the subterranean. Jerry has known these forests long enough to know the different rhythms and cadences of different coniferous tree species. They express their story through the patterns on their bark, where they situate themselves in the forest, the shape of their crown, and much more. Jerry sits on a rock, in a spot where the sun has broken through the canopy offering a shimmering light that illuminates the moss on the decomposing logs and rocks scattered across the floor. He sits there listening as each tree takes its turn telling Jerry their story.

Meanwhile, an hour south of the forest, Eric Foreman walks home from school. His backpack is filled with books about various bird species of the pacific northwest. He hurried out of his classroom for the looming possibility that he might spot a great horned owl on his walk home. Something about owls attracted Eric, whether it is their magnificent wingspan, their brown and golden feather patterns, or the mystery of their existence. Owls tend to exist in the shadows of our perception. This mystery motivates him to understand these species at a deeper level, to bring them in closer from the shadows in which they lurked. It was dusk and the sky was transitioning from pale blue to cobalt. The streetlights began to flicker on, when the silhouette of a large owl appeared from the distance, it flew gracefully over Eric's head, the entire time he refused to let go of his gaze. The majestic owl lands on a post right above Eric, the two of them *greet one another and something in that moment solidifies Eric's dedication to learning the owl's name.*[12]

Learning the name of a species requires learning what lessons different beings embody. It requires one to develop intimacy and Robin Kimmerer says that by learning the name of a species we learn to establish a relationship with that being (2013). We learn the contours of its shape, the way that it moves, where it likes to live, and how it interacts with the forest community. This kind of learning moves beyond reason and logic and requires embodied learning through love.

Eric Forsman demonstrates the concept of learning the name of a species with his relationship to the northern spotted owl. Eric grew up in the Eugene-Springfield area of Oregon. In his oral history, he talks about how his fascination with the northern spotted owl stems back to high school (Forsman, Oral History, 2016). At that time, he paid close attention to great horned owls, which he would often find perched up on posts all throughout his neighborhood. The mystery of the owls allured him. Particularly, how they fall back to the shadows and how people didn't relate to them. In terms of the northern spotted owls, no one among settler colonial communities knew much about them. There were only 29 sightings recorded during the year 1969 (Forsman, Oral History, 2016). Throughout Eric's career at the H.J. Andrews, he brought this species from the shadows by giving them time and attention to truly learn their name.

Eric learns the northern spotted owl's name through observational and descriptive methods. He spent a lot of time getting to know the owl. This includes learning what they like to eat, what their habitat range is, how they shelter, how they behave with one another, and how

[12] These two scenes are historical imaginations. The scene with Jerry Franklin is inspired by my interview with Jerry, which took place in november of 2020; the scene with Eric Forsman is inspired by the stories he shares in his oral history, located in the OSU archives, "Voices of the Forest, Voices of the Mills"

they interact with other species. He demonstrates how learning a species' name is like courting a species and listening to the lessons that they embody. This requires full immersion and embodied knowledge, which is a key characteristic of the natural history tradition. This way of learning contrasts with experimental methods where you start with a predetermined hypothesis and test your hypothesis via manipulation. The experimental approach is another influence from the field of physics, which I discussed in the last chapter. However in his oral history, Eric explicitly states that experimental or theoretical approaches do not interest him. Rather, he is more interested in receptive learning by observing the owl as it expresses itself through its day-to-day living,

> Much of what I've done has certainly been that way, as opposed to going out and setting up an experiment where you have a hypothesis, you do a treatment, measure, have a control, and you then look at the cause-and-effect. But much of what I did with spotted owls were purely observational kinds of studies, where you collect a bunch of data, run statistics, and try to determine what's important and what's not (Forsman, Oral History, 2016).

Eric gathered his information through experiential, visual, oratory observations. He liked watching the birds, listening to their calls, collecting their pellets, and spending the time it takes to observe their natural ways of existing in the forest community. Taking the time to understand the idiosyncrasies of a particular species also allows natural historians to understand the diversity of beings and heterogeneity within a landscape.

During my interview with Jerry, he expressed that scientists often disregard species diversity for the sake of macro-scale generalizations. For Jerry, however, species diversity and natural history are a must-know. He states that if you want any predictive capability then "...you're gonna have to basically understand something about the natural history of the system and the organisms that are part of it" (Franklin, Interview, 2020). However, ecologists that are more supportive of top-down theoretical frameworks tend to do so at the expense of understanding the diversity and heterogeneity of landscapes, which oftentimes can complicate or contradict certain theoretical assumptions. Jerry, being a tree person, went on to tell me about the individuality of coniferous trees in the Pacific Northwest forests. He states,

> You know the Douglas Fir is an absolutely critical species and it's not one that hemlock could substitute for in terms of the longevity, the size of the material, or the persistence in the material. And if you want a real contrast, you can look at the hemlock forest on the coast, which grows very rapidly, and then collapses essentially (Franklin, Interview, 2020).

According to Jerry, each coniferous tree species has its own individual song, its own rhythm of growth, and its own structural characteristics. If each individual tree species is unique then their relation to the rest of the forest community is also unique. This substantiates the claim that each individual forest is different from the next.

Jerry, along with other members of the Andrews science community has shared with me that natural history is losing popularity (Franklin, Interview, 2020; Harmon, Interview, 2020). That's because the systems approach has become the dominant framework that ecologists work in (Golley, 1993). As natural history dwindles in popularity, science tends to move towards big data sets, computer simulation, and *a priori* theoretical frameworks. In fact, people have referred to observational bottom-up approaches as less rigorous, which is why leaders such Arthur Tansley or Eugene Odum felt the pressure to change their disciplines to become more "physics-like". However, when we focus more on theory and less on experiential and situated learning, we neglect the immense amount of diversity, the nuances colored across ecological landscapes (Golley, 1993; Avorona et al., 2010; Kaishian and Djoulakian, 2020).

Both Eric and Jerry's dedication to learning a species name also demonstrate embodied knowledge. Embodied knowledge is the process of learning through subjective experience and phenomenological immersion into the world. These forms of knowledge are less valued by the market economy and top-down frameworks that are institutionalized by the state. The dismissal of embodied knowledge is so deep that it's even expressed in Western cosmology. Since Western Antiquity, we have depicted rational and logical thought as the most divine characteristic that we as humans are capable of, while deeming emotional sensibility less worthy. However, scholars have argued that we need to reconsider the importance of embodied and situated knowledge (Haraway, 1980). This call has also been echoed by many scientists, but those who remain on the fringes of the dominant scientific discourse. These scientists include Johann Wolfgang von Goethe and Henry David Thoreau, both of whom envisioned and desired a (re) imagination of the scientific enterprise (Worster, 1994).

Embodied knowledge and a rekindling with the Animated Kosmos

It is February 2020 and I have spent weeks reading articles, books, and listening to people talk about the H.J. Andrews Experimental Forest. Therefore, I feel a great deal of anticipation and excitement as we pull up to the parking lot of the H.J. Andrews Experimental Forest. Fred, two other visitors, and I all stepped out of the SUV after our hour's drive from Eugene. While standing on the asphalt, I enjoy the abundant sunshine in this late winter season. The H.J. Andrews headquarters looks like a little town occupied by forest people. There are multiple buildings scattered around a central lawn, which has a large awning, and picnic tables. We're at the very bottom of the drainage basin, and all around are steep forested hills. Fred guides us from the headquarters to the start of the discovery trail, which takes us into an old-growth landscape. It isn't long before I slow my pace in order to acclimate to my surroundings. I had been bogged down in books, articles, glued to my laptop, and desk throughout a busy term learning of the Andrews but not having ever experienced it. I look up and notice the enormous trees that tower up to the sky and swerve around in circles. The floor is quite spongy, and I can hear the running stream pulsating nearby. There is slight movement in the leaf litter and as I focus in I notice a pacific Salamander trying to sneak by. There is something in the air that evokes a sense of euphoria—a lot is going on.

During my visit to the H.J. Andrews Experimental Forest, I realized that there was something to experience that no article, book, graph, or conversation could convey to me. There is something particularly different about experiencing something through one's corporeal experiences. This means being fully immersed in a place or an event so that all of your senses participate in observing and interpreting your surroundings. This requires us to move beyond purely rationalistic modes of thought and develop knowledge through our embodied experiences.

As I mentioned in the introduction, the dominant scientific discourse stems from the modernist belief in the natural attitude. The natural attitude states that there is an objective reality, which stands apart from our subjective experiences. Our only means of accessing this reality are via scientific and quantitative methods. In contrast, phenomenological reduction argues that subjective experience is what defines reality (Heelan, 1987). For instance, the natural attitude would define a minute as a 60 second time unit. The phenomenological reduction would say that there are many definitions of a minute and those definitions depend on the lived experience of that minute; are you bored, are you walking? When you feel excited, a minute tends to feel faster than when you feel bored. If we move away from this idea that knowledge comes from abstract definitions, then we open up to the possibility that there may be many different definitions of a minute or even a forest. We open up to the possibility that it is through our phenomenological experiences that we get to understand the nuances of the world.

Within the arcadian tradition, certain individuals collapse the dichotomies of object/researcher, art/science, and subjective/objective by understanding embodied experience as knowledge. Two examples are Johann Wolfgang von Goethe and Henry David Thoreau. Goethe is an influential figure in German Romanticism. As opposed to the enlightenment's narrative of progress, this tradition comes from a nostalgic sentiment and desire to rekindle humans' relationship with the more-than-human. In fact, (Jardine, 1996) states there's a general agreement among the tradition that the mechanistic philosophy of modern science has resulted in our alienation from nature. Goethe states that as a result of this tradition, the use of experiments has severed nature from man. He also believes that imposing top-down intellectual structures will distort our perception of nature, "the greatest danger in the transition from seeing to interpreting is the tendency of the mind to impose an intellectual structure that is not really present in the thing itself" (Seamon, 1998, p. 3). As an alternative, he introduces the idea of perceptual power, which calls for a dialectical approach to learning (Seamon, 1998, p. 2). In this tradition, knowledge is the process of "seeking experiences that bring into play the aesthetic and introspective faculties of the observer, allowing nature to speak directly to us" (Jardine, 1996, p. 233). It requires that one become more "at home" with a natural phenomenon to understand it with greater empathy, concern, and respect. With proper commitment and practice, we can come to perceive the "deep-down phenomenon", which is the essential core of a thing that makes it what it is and what it becomes (Seamon, 1998). In this tradition, scientists use poetry and painting to practice their work from an intuitive dimension.

David Thoreau also felt discontent towards modern science and has expressed that its fundamental flaw lies in its fixation on rationality and objectivity. This fixation has led to a dualism between human consciousness and the more-than-human. In fact, Thoreau saw objectivity as spoiled by detachment and he was discontent with its rejection of other kinds of inquiry as being worthless or untrustworthy. Similar to Goethe, Thoreau saw knowledge as a process of attachment where the dichotomies between researcher/object are non-existent. By including the corporeal and spiritual sensations in the process of learning both of these figures, "sought to reintegrate man's consciousness into the physical world rather than to divide the two spheres" (Worster, 1994, p. 78). This motivation comes from the belief that the world isn't a dead or inert mechanistic system, rather they see the world as "...a flux of energy that is capable of welding all things into an animated cosmos" (Worster, 1994, p. 81). Connecting with the cosmos requires intimate encounters and receptivity to the voices, songs, and lessons that emanate from nature's vital and pulsing spirit.

In the early 2000's the Andrews community established the Long Term Ecological Reflections program, which marks a particularly important turning point for the H.J. Andrews. This program invites artists, humanists, writers, musicians, and philosophers to the H.J. Andrews to participate in place-based knowledge. The program is set up to last for 200 years in parallel with the long-term scientific dedication to H.J. Andrews. The artists and humanists in this program offer examples of embodied knowledge and how learning requires deep immersion and reflection on how the forest invokes particular emotions and spiritual sensory experiences. One example is Pattian Rogers and their poem, titled "This Day, Tomorrow, and the Next" (Brodie et al., 2017, pp. 174-175). In this poem, Pattian touches on how different sensory experiences open up new perceptions of the forest landscape. The poem opens with,

> When the blind and the deaf walk
> Together into the forest, one of them
> understands the blackness of light
> On a clear day. The other understands
> the deep reach of stillness in a riot of green.

Between these two individuals, one understands through the sight of the deep reach of stillness in a riot of green and the other understands the blackness of light on a clear day. Quantitative analysis cannot describe what they are understanding. Rather, they conceptualize the forest through their sensory experiences. There is also a sense of mystery and we might not be able to rationalize what their understanding is. This moves away from the idea that the forest is purely materialistic and physical. Rather, there might be more to the forest, which is immaterial and intangible.

Robin Kimmerer has also participated in the Long Term Reflections program. In her work, she talks about the differences between western science and ancestral knowledge. A key difference is that ancestral knowledge is also characterized by phenomenology and embodied learning. In her book, *Braiding Sweetgrass*, she offers many examples of learning through embodied knowledge (Kimmerer, 2003). For instance, she talks about how the smell of humus leads to a physical effect on humans, a release of oxytocin, which is the same chemical that is released to promote bonding between a mother and a child. She goes on to talk about her experience in gathering roots, in order to collect raw material for making baskets. Although she looks for raw material to transform into a basket, she is the one who is transformed in the process. This transformation occurs as she immerses herself in the womb of the earth, seeing the patterns of interweaving colors of "Spruce and blueberries, deer flies and winter wren" and coming to the realization that, "the whole forest [is] held in a basket. Big enough to hold me to" (Kimmerer, 2003, p. 236). She goes on to talk about how her students are always different after the experience of root gathering. In that experience, they come out with the knowledge that the earth will take care of them. There is a sense of communion with nature that is achieved through embodied knowledge.

Kimmerer's time at the H.J. Andrews inspired her piece "An Interview with a Watershed" (Kimmerer, 2016). In this piece, Kimmerer uses her dialogue with a watershed to demonstrate how to listen to the wisdom and language of water. These conversations come from an understanding that water and land are animate, which contrasts with Western scientific perceptions of water and other components of a landscape as inert and lifeless,

> Water is a storyteller, and listening to that story helped to write a new one, in which old growth has a role. The opportunity lies in listening to the land for stories that are simultaneously material and spiritual. It is a hopeful sign that people return to the words of the elders and again look to the land for knowledge. Our people say that long ago we

> could all speak the same language as the trees, the birds, the wolves, and the water but that we have long since forgotten. Human capacity has been so reduced that we understand only our own tongue. I like to think that, in the right hands, scientific research is a conversation, an interview of sorts between two parties that don't speak the same language (Kimmerer, 2016, p. 44)

In order to listen to the wisdom of water and other elements of the forest, we need a fundamental shift in our cosmological perception of the world. This shift entails moving away from the perception of the natural world as an inert system and seeing the various forest elements and beings as active and living agents. With this perception, Kimmerer states that data is not enough, there is more the land has to say. To listen to these living agents requires immersing oneself through embodied experience and learning to listen to the wisdom of the land.

Plato, who laid down the foundation of western epistemologies, talks about knowledge as the process of uniting with the ideal or attaining union with the one. The Christian church interpreted Plato's concept of uniting with the ideal as in achieving union with God's thoughts. In Plato's Republic, he states that we can achieve union with the ideal through intellect. Intellect has been associated with reason and logic, which set up the foundations for the Enlightenment and the rise of modern science. However, Plato's earlier and less referenced work, the Symposium, also talks about knowledge as union with the one, however, in this piece Plato states that we are able to achieve union through love, and intellect is never mentioned. While we associate intellect with reason and logic, we associate love with emotions and sensibilities. Some may interpret Plato's change from love to intellect as a reflection of Plato's change in his perception of knowledge. However, Foster proposed a different idea. Since Plato never addresses any reasons for changing the term from love to intellect as our means towards true knowledge, perhaps he saw love and intellect as interchangeable, as one in one. The two are not mutually exclusive and true knowledge requires both love and intellect (Foster, 1935). Knowledge through love characterizes embodied knowledge, which involves sensibilities, emotional processes, and phenomenological experiences. Knowledge produced through love is the poetic writing of Pattian Rogers, the ancestral wisdom that Kimmerer advocates for, and the natural historian who immerses herself in the lifeworlds of other beings to listen and be receptive to the lessons that more-than-humans embody.

Chapter Five Conclusion

During my visit to the H.J. Andrews Experimental Forest, I remember being surrounded by ancient trees, steep rolling hills, and several creeks that rippled throughout the landscape, embodied centuries of knowledge. However, I was there to learn about the stories from the 1950s onwards, which reveal a particular narrative about the relationship between science, society, and the forest landscapes of the Pacific Northwest. These stories begin with the establishment of the H.J. Andrews Experimental Forest in 1948. This marked a significant turning point for this forest, as Euro-American scientists occupied the site and designated the forest for scientific inquiry. Since its establishment, there have been different approaches to scientific inquiry, each of which has shaped and reshaped the relationship between people and the forests of the Pacific Northwest. When I first visited the H.J. Andrews I had not yet started the expedition of unearthing the different layers of science and unraveling its entanglement with culture. However, with time, I came to understand some of the traditions, where their roots stem from, and how they are intricately intertwined with broader views in greater society.

The first layer of the H.J. Andrews palimpsest is scientific forestry, which is the tradition that motivated its establishment as an Experimental Forest. During World War II, there was a skyrocketing demand for timber, which led to massive clearcutting across forest landscapes in the United States. When timber scarcity became an issue, the leader of the USDA Forest Service, Gifford Pinchot, suggested an alternative approach to extracting timber. Rather than the “cut and run” philosophy, he pushed for an agricultural approach to forestry. He established the tradition of scientific forestry, which uses science to study the conversion of old-growth landscapes into "efficient" and "thrifty" tree plantations (Yeager 1977). Pinchot fought for this approach because he believed that nature was inefficient and that it was up to science and management to improve the efficiency of nature. Improving the efficiency of nature meant eradicating so-called undesirable species and optimizing for species that are most profitable in the marketplace. To test and develop methods of scientific forestry, the USDA Forest Service established Experimental Research sites and among them was the H.J. Andrews Experimental Forest.

Throughout the 1950s and 1960s, the Andrews community materialized the tradition of scientific forestry onto the physical and ideational landscape of the H.J. Andrews. As competition roared throughout the timber market of the Pacific Northwest, the district rangers extensively clear cut old-growth forests, leaving behind a patchy landscape with reduced connectivity. Research personnel conducted tree regeneration studies to replace clearcut landscapes with tree plantations. Compared to old-growth forests, the multidimensionality of space collapsed as these plantations consisted of mono-cropped Douglas firs of the same age and same height. This created a flat and homogenized landscape with significantly reduced biodiversity. Aside from the patchy landscape, another physical imprint of this era was the development of roads. When the H.J. Andrews was initially established there were no road systems and foresters had to travel by foot or horseback. However, they developed roads to increase their accessibility into the forest and facilitate the eradication of old-growth forests and the development of tree plantations. With more roads, the timbermen could extract more timber from the forest and circulate it into the market economy. Yet, the development of roads led to another issue, an increase in runoff and the contamination of the forest's water supply. This turned the USDA Forest Service's attention towards the watersheds as an important resource for municipal water. This led members of the H.J. Andrews community to establish the experimental watersheds to test various techniques of logging on watershed "health". The watershed experiments along with the development of plantations and roads transformed the landscape at the H.J. Andrews from old-growth to an anthropogenic factory that would test techniques to optimize commercial-scale logging. Scientific forestry contributed towards the region-wide replacement of old-growth forests with tree plantations.

Not only is scientific forestry a product of science's close coupling to the market economy, but it is also fueled by a cosmological perception of nature that stems from the Enlightenment. Influential thinkers of the time, including Frances Bacon, believed in a literal interpretation of the bible. Therefore, when the book of Genesis refers to mankind's "dominion" over nature, people took dominion quite literally to mean the exercise of power and control over the natural world. Power and control were both lost during the fall of man, which occurred when Adam and Eve were kicked out of the Garden of Eden and placed in this "wretched" world. With this interpretation, people perceived and spoke of natural landscapes as wretched and unruly, while perceiving managed landscapes as orderly and sanctified. That is because managed landscapes served as representations of what the Garden of Eden once was. Frances Bacon among others represented an ideology where science and management can restore mankind's lost dominion over nature (Merchant 1980; Worster 1994; Harrison 1999). This is where the narrative of progress originates from where mankind is set on a mission to restore its dominion over nature by transforming natural landscapes into an Edenic state. Scientific forestry at the H.J. Andrews embodied this narrative of progress. Political leaders, timbermen, and researchers referred to old-growth forests as wastelands, barren, and full of rot (Geier, 2007; Luoma, 1999). Timbermen and district leaders felt that they were following a moral duty by eradicating these wretched landscapes and transforming the forest into efficient and thrifty tree plantations. With the narrative of progress, the community at the Andrews sought to gain greater power over the landscapes and bring order to nature.

In 1970, funding from the International Biological Program (IBP) brought a new regime of ecological inquiry to the H.J. Andrews systems ecology. The rising awareness of the environmental crisis motivated the establishment of the IBP, which sought to implement large-scale ecological research projects. However, the IBP confronted the environmental crisis with a managerial and exploitative ethos. This is evident in the rhetoric exchanged during the assembly meetings, where the mission was "to the optimum exploitation, on a global basis, of the biological resources on which mankind is vitally dependent for its food and for many other products" (as quoted by Golley, 1993, p. 111).

Some have argued that the reason that the IBP was able to receive the support that it did was due to systems ecology, which is the core framework that the program embodied (Kwa, 1987; Aronova et al. 2010). In this framework, forests and other landscapes are no longer seen as a stockhouse for resources, but rather as mechanistic systems with interrelated components that serve the overall "function" of the "system". Furthermore, the rhetoric of IBP states that these natural systems are "broken", "unhealthy", and "out-of-balance". It is with scientific and technological advancement that we can learn to restore these systems. As Worster states, this program represents a cultural assumption that the environmental crisis is solely a technical problem, rather than a cultural, economic, political, or spiritual one (Worster, 1994).

Systems ecology and its theoretical framework borrow directly from fields such as physics and systems engineering. That's because during post-war modernization these fields contributed toward industrialization, militarization, and weapon development. This gave these fields great prestige and set them up as anchors of authoritative models for what other fields should aspire to. Within the field of ecology, this meant transitioning away from its traditional roots of observational and place-based approaches and shifting towards top-down quantitative modes of research. For instance, when the IBP came to the Andrews, its main goal was to develop macro-scale ecosystem models. Scientists expected these models to predict the behavior of coniferous ecosystems across the globe. Since then, the ecosystem concept has been institutionalized at the Andrews and continues to be the dominant framework ecologists operate in. This is apparent in the NSF-LTER proposals, which contain terminology and theoretical concepts that borrow directly from systems engineering. Scientists continue to depict the forest as a mechanical system where different parts serve a function in the whole system's behavior. This ecosystem concept and its depiction of nature as a mechanical system was never tested, but rather it emerged as an idea. An idea that ecologists pass down from generation to generation as if ontological fact.

Systems ecology is also rooted in a cosmological perception of nature that stems back to the Enlightenment. Modern science rose under the influence of Christain theology, which perceives nature as an object that a legislator God created. This is a significant transition away from pre-Christian animism, which perceives nature as an embodied soul with its inward tendencies and not inert and lifeless. The concept of nature as an object evolved into the depiction of nature as a mechanical system. Early modern scientists compared nature to the workings of a clock with different compartments that serve a function of the whole (Merchant, 1980). The system is rendered intelligible since it bends to the laws made by the legislator God. While early modern scientists perceive nature as an artifact, they perceive mankind as the divine offspring of God. This sets mankind apart from nature and the key characteristic that marks our difference is our intellect and rationality (Foster, 1935). Due to our intellect and rationality, we have a divine capability to understand the mechanical workings of God. With this belief, mankind can deduce the behaviors of nature via mathematical quantification. This is the cosmological underpinning of the systems ecology tradition represented at the H.J. Andrews Experimental Forest.

Both scientific forestry and systems ecology has been classified as a part of the imperial tradition in ecology (Worster, 1994). That's because they are both highly coupled with the marketplace and top-down institutions that hold a great deal of power. As a result, these traditions are tied to colonial and capitalistic expansions, which seek to gain control over various landscapes. However, there is another tradition that is represented by this forest community. This tradition, known as natural history, predates IBP, scientific forestry, and even Capitalism.

While system ecology pushes for top-down and theoretical modes of science, natural history is an observational and bottom-up approach. This means that rather than focusing on *a priori* theories, scientists derive knowledge from experiential learning. In other words, natural history relies on descriptive approaches so knowledge emerges from the forest rather than humans imposing theoretical frameworks onto the forest. Natural history is tied to the traditional roots of ecology before postwar modernization and the rise of Big Science, which shifted ecology toward the systems approach. This meant an emphasis on big data, theory, and comprehensive modeling. In many ways, NSF LTER continued the institutionalization of systems ecology. However, as opposed to IBP, NSF-LTER simultaneously supported more descriptive approaches to ecological inquiry (Aronova et al., 2010). This allowed the Andrews community to continue the tradition of natural history in coexistence with the system's approach.

Major characteristics of natural history include a long-term commitment to place, understanding the history of a particular landscape, and learning the name of a species. When LTER provided funding support in longer time intervals, researchers were able to pursue long-term projects for ecological inquiry. One manifestation of this is Mark Harmon's log decomposition site, which is set up to take place for 200 years. Logs take several hundred years to decompose and Harmon knew that if we are to understand forest landscapes we ought to work on their timescales, not ours. Frederick Swanson's fire reconstruction work shows us how we can come to understand the historical particularities of a landscape. This work entails reading tree rings and markings to interpret the fire history of a particular forest. This history can reveal certain patterns of different fires and how forests might respond to post-fire disturbance. As opposed to systems ecology, which seeks to make macro-scale generalizations, this approach seeks to understand how a landscape is contingent on historical events that are unique to that particular place. Finally, learning the name of a species is a concept introduced by Robin Kimmerer, which describes the process of understanding certain species through intimate and long-term encounters (2003). While the ecosystem approach tends to brush over biological diversity for the sake of generalizations, natural history practices attentiveness toward species diversity and nuance. That's because rather than emphasizing standardized models, this approach learns about species through descriptive and experiential learning. This experiential learning takes place by courting a species to learn the unique stories that it embodies. Jerry Franklin's commitment to coniferous tree species and Eric Forman's dedication to the northern spotted owl both demonstrate this concept of learning a species name.

Natural history doesn't work within a mechanical or rationalist philosophy, but rather with the conception that the natural world consists of sentient beings with their unique tendencies. As opposed to scientific forestry and systems ecology, natural history has roots in pre-Christian animism. To describe these roots, Worster traces the continuity of this tradition through several figures, such as Gilbert White, Johann Wolfgang von Goethe, Henry David Thoreau, Alexander von Humboldt, and others (Worster, 1994). All these figures have particular characteristics in common, which describe the cosmological roots of natural history. As opposed to the mechanical rationalist philosophy, they do not perceive a separation between humanity and nature, but rather see nature as a reflection of humanity. Goethe's concept of correspondence, and Thoreau's concept of "Nature looking onto Nature" both overcome this dichotomy between us and the more-than-human (Jardine, 1996; Worster, 1994). Second, they carry a conviction that the only knowledge we have is knowledge produced by phenomenological or embodied learning. Many of these figures saw an inherent flaw in the concept of objectivity among the mainstream sciences. That's because people tie objectivity with the belief that the only way to access knowledge is through logical and rational thought. This dichotomy between rationality/sensibility has led towards a detachment in the process of learning and our alienation from the more-than-human community. Rather, we seek large data sets, mathematics, and computer simulations to understand the world that we live in. However, the romantics within the natural history tradition argue that the act of observing, listening, and having the more-than-human speak to us is how we come to produce knowledge. A third important characteristic of this tradition is that spirituality and science are one in one. That's because the divine is not a centralized figure that is situated apart from this world, but rather the divine is embodied throughout more-than-human communities. Rather than robotic components in an inert system, the forests consist of pulsating life and a diverse array of animate beings that tie to a larger web of cosmic energy, one with which we are inextricably entangled.

While this work allowed me to understand the different nuances of ecological inquiry that this forest community represents, I also learned how these traditions are inextricably tied with broader cultural views. In moving forward, I'm curious to know how these different paradigms impact the world around us. How are they materializing into policy and how does the policy that materializes from these paradigms impact the local communities who interact with and depend on these forests in nuanced ways?

Science, society and these forests are constantly changing. How they will continue to unfold through time continues to be dependent on one another. With this in mind, I hope that we can continue working across disciplines to imagine a future for the science of old-growth forests. A future where we can overcome the divide between culture/nature, researcher/object, and logic/feeling. I also hope to imagine a future where the science of the old-growth of the Pacific Northwest can be diversified so that different perceptions of nature and knowledge can be taken into account. A good place to start is inside of the forests where a collective of beings carry particular songs, stories, and narratives that we can attune ourselves to if we are willing to listen.

The concept of tradition has been central to this journey through the different layers of scientific inquiry at the H.J. Andrews Experimental Forest. Tradition is a body of beliefs, stories, and practices that people hand down from generation to generation. The noun tradition has Latin roots in the word *trader*, which means hand over or hands down. This is important to keep in mind when it comes to all aspects of culture including science. The reason that it's important is that we must think about who is handing down the tradition. Where does the tradition stem from? What are the intentions that allowed for these traditions to emerge and persevere through time?

We as people and as a society rely heavily on tradition. It's our lifeboat, we wouldn't be able to survive without it. This is why I find it necessary to analyze the different traditions that we've carried with us through sedimented layers of time at the H.J. Andrews Experimental Forest and beyond. We as individuals have the agency to reassess and transform certain traditions that are handed down from generation to generation. Just as ecological disturbances, like wildfires, bring fertile soils to the ground and allow for new life to emerge, social disturbances can also be beneficial to the ideational landscape. My goal here has been to contribute to this process by examining our cultural conceptions of knowledge and of the more-than-human. While the H.J. Andrews community continues to do their work, science will continuously change as will our cultural relationship to the forests of the Pacific Northwest. I hope that this change will result in the decentralization of knowledge and an attempt to learn through love, not just intellect.

Sources

I received IRB approval from the University of Oregon to conduct semi-structured interviews with members of the H.J. Andrews science community. These interviews supported the writing of this master's paper and they were conducted during the fall of 2020. Each interview was completed over zoom due to the COVID-19 Pandemic. The list of interviewees are as follows,

1. Dr. Frederick Swanson; October 21, 2020
2. Dr. Julia Jones; December 3, 2020
3. Dr. Jerry Franklin; November 19, 2020
4. Dr. Mark Harmon; November 11, 2020
5. Dr. Sherri Johnson; November 10, 2020
6. Dr. Barbara Bonds; February 19, 2020

Additionally, this master's paper draws from the extensive oral histories collection titled, "Voices of the Forest, Voices of the Mill". This collection is located in the Oregon State University Libraries Special Collections and Archives Research Center http://scarc.library.oregonstate.edu/omeka/exhibits/show/forestryvoices/interviews/

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