The H.J. Andrews Experimental Forest

Seventy Years of Pathbreaking Forest Research

WILLIAM G. ROBBINS

OREGON'S H.J. ANDREWS EXPERIMENTAL FOREST is a nationally and internationally acclaimed site for forestry research, especially pathbreaking ecosystems studies. While hundreds of scientists and visitors have travelled to the experimental forest during the past six decades, few people in Oregon, including those affiliated with my home institution, Oregon State University (OSU), are aware of the renowned research carried out on the 15,800-acre forest. "The Andrews," as it is known to Oregon State University faculty who have worked on the forest or were affiliated with the campus offices of the U.S. Forest Service's Pacific Northwest Research Station, embraces the entire drainage of Lookout Creek and is one of four Forest Service–designated experimental forests in Oregon.[1] As part of the Willamette National Forest, the Andrews is a thoroughly western Oregon place of steep mountain slopes, narrow valleys, and cascading streams that empty into Lookout Creek, the main tributary to Blue River. Originally established as the Blue River Experimental Forest in 1948, the Andrews' reputation was long in the making. Its history coincided with the emergence of the environmental age and includes participation in the International Biological Program (IBP), between 1968 and 1974, and National Science Foundation designation as one of its Long-Term Ecological Research (LTER) sites in 1980.[2]

The H.J. Andrews Experimental Forest and the Lookout Creek drainage, which defines its boundaries, encompass great stands of old-growth conifers ranging from 400 to 600 years old, a place reminiscent of western Oregon forests after the Second World War. From its founding in 1948, the experimental forest has been the setting for wide-ranging research. Beginning with postwar studies focused on converting the huge volume of old-growth timber to fast-growing young stands, research on the Andrews evolved over the years to long-term investigations of ecosystems that continue to the

H.J. Andrews Experimental Forest Image Library, photographer Richard Fredrickson

IN THIS 1961 PHOTOGRAPH, Jack Rothacher records readings from a soil-moisture meter station in Watershed 3 in the H.J. Andrews Experimental Forest.

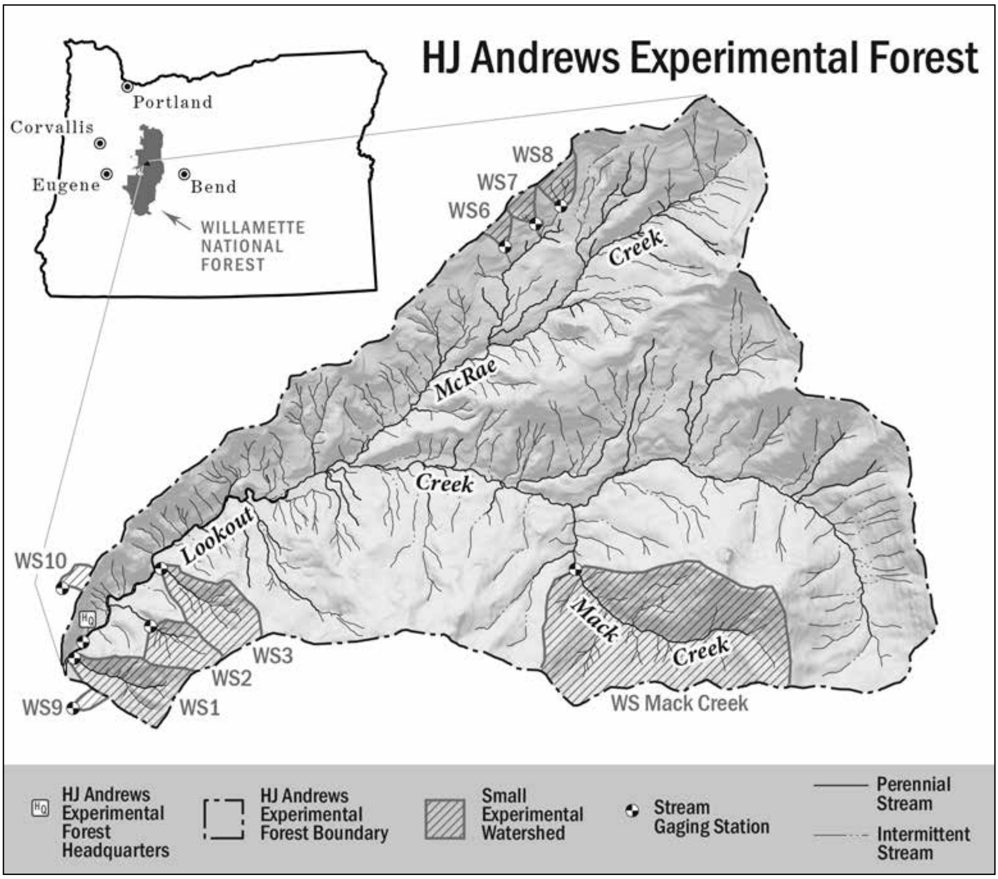
present day. The implications of those inquiries profoundly reshaped Forest Service management policies and contributed to our understandings about healthy forest environments.[3] The Andrews has been at the center of a dramatic shift in federal timber practices — from an industrial paradigm involving intensive forest management to policies emphasizing biodiversity and healthy ecosystems. This article traces that story, from the booming timber harvests following the Second World War to public controversies involving the spotted owl and old-growth forests at the end of the twentieth century.

The title of Jon Luoma's book about the Andrews, *The Hidden Forest*, is a fitting description for the place, which can be reached by driving along the McKenzie River on Highway 126 beyond the town of Blue River and turning left at a sign directing travelers to Blue River Reservoir. Some five miles from the highway, beyond the head of the reservoir, another sign directs visitors to the H.J. Andrews headquarters, a large compound of several buildings — a dormitory, eleven apartments, conference and dining halls, classrooms, laboratories, a library, and a covered seasonal pavilion. The absence of signage on the highway — to protect the multiple research activities taking place — contributes to the anonymity of the place.[4]

THE CREATION of the Blue River Experimental Forest in 1948 took place at a propitious moment in American history: the great building boom following the end of the Second World War. Due to the soaring demand for lumber products, the Northwest timber industry was literally in lift-off, with production in Oregon reaching all-time highs of 9.1 billion board feet in 1955, 8.2 billion in 1965, and 7.3 billion in 1979. Those expanding timber harvests reflected the skyrocketing demand for wood products following the industrial economic collapse of the Great Depression. That unprecedented and thriving construction boom persisted until the early 1980s, when a severe recession in home building caused mill closures in Northwestern timber communities.[5]

The establishment of the Blue River Experimental Forest at the onset of the surge in construction significantly influenced investigations on the Lookout Creek drainage for nearly three decades. When acting Forest Service chief Richard McArdle formally established the Blue River Experimental Forest on July 28, 1948, he underscored its purpose — "the conversion of these overmature forests to managed young-growth stands in the most orderly manner with the least delay."[6] McArdle was repeating conventional notions about forest science in the immediate postwar years: that research should focus exclusively on determining how to grow trees faster to turn out more board feet of lumber. In that sense, the experimental forest would serve an industrial function as a laboratory for Forest Service research that would increase production.[7]

The initiative to set aside significant acreage within the Willamette National Forest for research represented the insights of Horace J. Andrews,



Jesse Nett

THE H.J. ANDREWS EXPERIMENTAL FOREST is located in the Willamette National Forest and is one of four Forest Service–designated experimental forests in Oregon. This map shows the forest's location, boundaries, small experimental watersheds (WS), gaging stations, and streams.

then forester in charge of Forest Service Region 6, which encompassed Oregon and Washington. Andrews wanted to better understand the effects of logging on water quality and fisheries habitat and the influence of the Cascade Mountain Range on flooding in the Willamette Valley. There was more to Andrews' worries, especially the need to protect streams and rivers in the face of the expected increase in timber harvests.[8] A cataclysmic event, the Columbia River flood in the late spring of 1948, loosened federal purse strings to support watershed research.[9] Although most of the


H.J. Andrews Experimental Forest Image Library

HORACE JUSTIN ANDREWS is pictured here in 1951. Andrews was a strong supporter of forest research and was directly involved in selecting the location of the experimental forest near the community of Blue River, Oregon. After Andrews's death in an automobile accident in Washington, D.C., the experimental forest was renamed in his honor in 1953.

destruction occurred far from the McKenzie Valley, Congress appropriated funds through the Pacific Northwest Research Station — a Forest Service unit associated with Region 6 — to carry out research on its watersheds. In announcing the establishment of the experimental forest, J. Alfred Hall, director of the Pacific Northwest Research Station, observed that the site represented "the greatest stand of old-growth timber left in the United States."[10] The first surveys, road layouts, and sales on Lookout Creek were barely underway by 1951 when Andrews was killed in an automobile accident in Washington, D.C., where he was house-hunting after having been promoted to the Forest Service's national office. Two years later, the Blue River Experimental Forest was renamed in his honor.[11]

When Roy Silen arrived on the Blue River Experimental Forest as the forester in charge in 1948, access to the Lookout drainage extended only a mile or two beyond the town of Blue River: "You had to walk before you got to the experimental forest," he told an interviewer. Silen lived in a small trailer in the former Civilian Conservation Corps camp (the site of today's McKenzie River Ranger Station) and made week-long backpacking trips to survey road and timber-sale layouts in what he called "chopped up country." His strategy in designing roads was to minimize sedimentation in streams, a major factor in degrading water quality and causing harm to aquatic life. Silen's reports also revealed the beginnings of interdisciplinary research on the experimental forest. The U.S. Army Corps of Engineers was studying streamflow and snowpack on the Blue River system, and the Oregon Wildlife Research Unit was investigating the effects of logging on fish and wildlife.[12] Interdisciplinary, cooperative research would eventually become the hallmark of inquiries on the Lookout Creek drainage.

Among the early investigations on the Andrews, none would have greater significance than watershed studies. Robert Cowlin, director of the Pacific Northwest Research Station in 1951, indicated that the central purpose of the experimental forest was to better understand the relationship between silvicultural practices and healthy watersheds. Those initiatives represented the efforts of Jerry Dunford, who returned to the Pacific Northwest Research Station from the Rocky Mountain Region in 1952. Dunford drafted plans to study the effects of logging on three small watersheds near the mouth of Lookout Creek, focusing on stream fluctuations, water quality, snow accumulation, and moisture in the soil. The watershed investigations, designed to last "through one rotation" (harvest cycle), would be critical to future research on the Andrews. Dunford, who proposed to study soil erosion and sediment in streams, ordered the installation of sophisticated instruments, "three trapezoidal flume stream gauges with recorders," silt traps, and rain gauges. His objective was practical, to obtain an understanding of soil dis-

H.J. Andrews Experimental Forest Image Library

DURING THE EARLY YEARS of the Blue River Experimental Forest (later named H.J. Andrews Experimental Forest), access to Lookout Creek was limited and foresters lived in campsites while making week-long backpacking trips to do their work. This photograph of the guard station and camp was taken in June 1952.

turbances on watersheds, with the view that carefully planned roads and landings would reduce the loss of soil.[13]

The three small watersheds ranged between 149 and 250 acres, with an elevation above Lookout Creek ranging from 2,750 to 3,500 feet. Old-growth Douglas fir dominated the drainages, with run-off seldom rising over stream banks, even during heavy precipitation. The purpose of collecting data was to study the watersheds under different conditions over long periods of time. Watershed 2 was left undisturbed, Watershed 3 was scheduled for road building and clearcutting (completed in 1963), and Watershed 1 was the site of a harvesting experiment, using a skyline crane to do select logging to minimize disturbances. Key investigations would compare streamflow under natural conditions to the two watersheds under various disturbances. Dunford and Forest Service employees also participated in a "snow storage" study, involving strategies to slow the melting of snow on high, timbered slopes to increase late-summer flow downstream for irrigation.[14] All of those investigations had implications for Oregon industries and citizens — maintaining healthy streams and maximizing water available for agriculture, recreation, and other uses.

H.J. Andrews Experimental Forest Image Library, photographer Dick Fredriksen

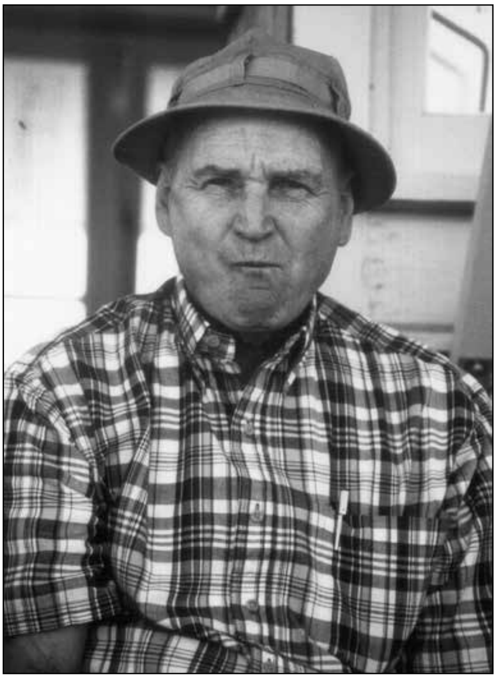
JACOB WYSSEN, owner of Wyssen Skyline Crane Co., stands in 1962 next to a five-ton crane that his company designed and built to handle large trees growing in the Pacific Northwest. Researchers aimed to use this experimental skyline system to harvest an entire watershed without roads.

H.J. Andrews Experimental Forest Image Library

IN THIS 1954 view of Lookout Creek, Roy Silen and field assistant Chew Gretz (both pictured in the left background) use seine nets to fish the creek. Although the author fished Lookout Creek in the spring of 1964, fishing is no longer permitted.

In what became the seminal research project on the experimental forest, the three small watersheds enabled scientists to study complex relationships involving plants, water, soil, and aquatic and land animal life. By 1958, the instruments had enabled staff to collect five years of streamflow and precipitation data. The Region 6 office in Portland later reported that the watershed inquiries were the first of their kind in the Pacific Northwest. As additional watersheds were brought into the ongoing investigations with the passage of time, the experimental forest developed a much richer database.[15]

Amid those go-go years of lumber production, the region's principal industrial journal, *The Timberman*, praised the investigations on the experimental forest. Based on the supposition that it would take "50 years before the region will be entirely converted to a second growth economy," the article applauded the Andrews for demonstrating appropriate methods for achieving multiple-use management on old-growth Douglas fir forests. The journal commended Andrews' personnel for drafting management plans that were consistent with those on both national and private forests, strategies that involved a "permanent and effective road system to take care of future requirements." The beauty of experimental work on Lookout Creek, H.J. Andrews Experimental Forest Image Library



ROY SILEN is pictured here in 1997. He transferred to head the forest genetics program at Oregon State College in 1954.

it concluded, was the search for "an overall forestry logging plan" that would advance industrial activity.[16] In brief, research on the experimental forest dovetailed nicely with the requirements of timber production.

Operating under conditions in which the Willamette National Forest determined where and when to cut timber, the Andrews enjoyed little autonomy in its early years. Logging, the forest's supervisor declared, needed to fit "the requirements for timber removal planned by the Willamette National Forest." As a component of the National Forest system, the experimental forest was part of the McKenzie working circle, a spatial strategy for calculating timber harvests to satisfy nearby sawmills, in this case, the big operations in the Eugene-Springfield area. The initial harvesting agreement for the experimental forest specified that its research program should assist the timber industry in logging old-growth timber with greater efficiency.[17] Research activities on the Andrews during the 1950s and 1960s were joined at the hip with Oregon's thriving postwar lumber industry.

Those unique economic and political conditions prompted Luoma to write that "the Andrews was to be a key industrial laboratory" to develop strategies to efficiently harvest old-growth timber and to reforest cutover acreages with fast-growing young trees. An undated Forest Service document from the early 1950s observed that the Lookout drainage was large enough to provide "answers needed for managing entire watersheds . . . [and] to test logging methods and techniques on commercial-sized operations." The Andrews would also cooperate with the Army Corps of Engineers — which was building flood-control dams on the Willamette River system — with its research addressing the influence of forests on "stream-flow, run-off, snow melt, and other hydrology."[18] The primary thrust of the experimental forest's work, however, was to efficiently harvest old-growth trees and minimize harm to aquatic environments.

H.J. Andrews Experimental Forest Image Library, photographer Jack Rothacher

THIS UPPER BLUE RIVER gaging station was installed in 1951 as part of the Army Corps of Engineers' Willamette Snow Study.

Except for Silen and an assistant checking the watershed gauges, the Andrews was largely spare of a human presence during the 1950s. The Willamette Forest's management plan, however, put Silen — who was attempting to do legitimate research — in a bind, because he needed to accommodate the projected harvests of "large-scale experimental cuttings." In addition to road layouts and sizeable timber sales, the workplan included watershed investigations as "one of the primary purposes" of the experimental forest. For reasons that are not clear, in 1954, the Pacific Northwest Research Station reassigned Silen to Oregon State College (later OSU) where he would head the forest genetics program. Three years passed before the station, at Dunford's urging, appointed Jack Rothacher as Silen's replacement. Rothacher, who had been with the Umpqua National Forest, proved a capable administrator, remaining with the forest until 1974, a critical period when the Andrews emerged as a significant leader in forest ecosystems research. Under Rothacher, the forest continued its pursuit of applied science — how to efficiently and prudently harvest old-growth timber with the least harm to mountain streams. Rothacher reported in 1958 that the forest's objectives were "to learn and demonstrate improved methods of multiple-use management for old-growth Douglas-fir forests on mountain watersheds." The program would focus on harvest methods for old growth and on developing "vigorous young-growth stands," Forest Service policy objectives for the next twenty years.[19]

At the onset of the 1960s, the Pacific Northwest Research Station, the Willamette National Forest, and the School of Forestry at OSU were cooperating in administering investigations on Lookout Creek. By this time the experimental forest had sixty miles of all-weather roads, and loggers had harvested some 8 percent of its timber, activities that increased turbidity in streams, especially during major weather events. Findings from the three small watersheds indicated increased silt loads following severe landslides in 1957. Although future research would address the functions of ecosystems, investigations through the 1950s and beyond focused on "conversion" — a mantra for the industrial paradigm — efficiently harvesting old-growth trees and establishing new stands of timber. Nevertheless, the data gathered at the three small watersheds would also determine how "conversion will affect water quality."[20]

Among the few people working on the forest in the late 1950s was Jerry Franklin, who took a summer job on the Andrews in 1957. Raised in Camas, Washington, Franklin worked under Rothacher, tending the small watershed-gaging stations and running boundary surveys on the three drainages. After earning his Ph.D. at Washington State University in 1966, Franklin would become a central figure as the experimental forest gained national and international recognition under the International Biological Program (IBP) and Long-Term Ecological Research (LTER) ventures. Al Levno, who described himself as a "young green kid," was another young person hired as a technician to manage the gaging stations. Living in Blue River, he travelled into the Lookout Creek drainage to check the instruments and remembers few people visiting the area through the mid 1960s.[21]

During this quiet time on the experimental forest, Rothacher struggled to protect research projects from Willamette National Forest officials who wanted unlimited access to timber. Rumors abounded that the Forest Service was planning to disband several experimental forests in the Pacific Northwest as a cost-savings measure. There was some substance to the reports. The Pacific Northwest Research Station was increasing its emphasis on laboratory research, and its Forest Sciences Laboratory had recently opened a new building on the OSU campus. With research centered in Corvallis, the station's George Meagher proposed to phase out experimental forests and place them back in the National Forest system. Rothacher, Franklin, and others feared that the move would lead to unrestricted cutting on the

H.J. Andrews Experimental Forest Image Library, photographer Jack Rothacher

THIS PHOTO, taken before the construction of Blue River Dam, shows torrents of water rushing under the Blue River Bridge during the Christmas flood of 1964.

Andrews, obliterate research plots, and make moot the collection of data at the small watershed-gaging stations. Those rumors also worsened relations between Andrews' scientists and foresters at the Blue River Ranger District, who opposed research on the Lookout watershed.[22]

A providential event for the research forest — the Christmas floods of 1964 — galvanized interest in extraordinary weather events, especially flooding streams and landslides. Torrential rain in western Oregon melted snow in the mountains, sending a huge volume of water pouring into the McKenzie and other tributaries of the Willamette River. The downpour wreaked havoc to slide-prone hillsides, scoured roadbeds, and washed away bridges. The flood wiped out the McKenzie River (Belknap) Covered Bridge at a location where bridges had spanned the river since 1890. On the Andrews, small streams plunging down steep mountain slopes spilled water into Lookout Creek at a prodigious rate. Downstream in the low-lying valleys — especially in the Willamette, where flooding had been a regular occurrence before the building of dams — floodwaters historically had found their way through broad flood plains in braided channels. Storage dams built on tributary streams beginning in 1939 had gradually brought an end to the most ravenous flooding by the late 1960s.[23] The floods of December 1964, however, were stark reminders of nature's unpredictable force.

During that Christmas week, Levno and Dick Fredriksen were checking the gaging stations every three hours, reading the instruments and taking water samples. Shortly after midnight on December 21, they were driving into the Lookout watershed when their pick-up's headlights revealed a landslide of logs and debris blocking the road. Reversing direction and anxious to leave the area, they encountered another huge landslide that literally filled the road. Levno's memory of that night tells the story of two men fording streams in the rainy darkness and torrential noise of pounding rocks in Lookout Creek, near drownings, and eventually finding their way to a farmhouse on the McKenzie Highway several hours later. For Andrews' scientists, however, the subsiding waters revealed instructive findings about logging practices on the three small watersheds.[24]

The 1964 Christmas floods spurred significant research into large-scale storms that caused landslides and disrupted tributary streams such as Lookout Creek. Ted Dyrness's study, *Mass Soil Movements in the H.J. Andrews Experimental Forest*, reported that most of the landslides of that season were associated with road-building rather than logging practices. The torrential rains in the Lookout drainage, which took out the Watershed 3 gaging station, were "a real eye-opener." Dyrness's investigation, carried out in April, May, and June 1965, catalogued forty-seven mass soil movements from the winter storms, most of them associated with road-building. He concluded that such activities accelerated the incidence of landslides during major precipitation events in slopes that were notably unstable. In keeping with the applied nature of his research, Dyrness recommended reducing road mileage, improving road design and construction, and using skyline or balloon logging in steep terrain.[25] Within a few years, Dyrness' research would inform investigations throughout the National Forest system and beyond.

The H.J. Andrews Experimental Forest's association with global scientific communities originated with the IBP, an initiative originating with the International Union of Biological Sciences. The new organization included a terrestrial communities section whose purpose was to canvass major global ecosystems to determine if nations were protecting significant natural areas. Although the section focused on land, the IBP protocol also included "terrestrial, fresh-water, and marine ecosystems." After establishing units in several countries, the IBP held its inaugural meeting in July 1964. IBP officials announced that its studies would focus on ecosystems — living and non-living components interacting through space and time. This represented a major scientific shift. Although single components of the physical environment had been studied, ecosystems had not been investigated with respect to all of their constituents.[26]

Congressional funding delayed American participation in the IBP, but the United States eventually outdid all other nations in contributing to ecosystem science. University of Georgia scientist Frank Golley pointed out that "the ecosystem story is largely an American tale," with the nation's scientists focusing on studying "whole systems, such as drainage basins and landscapes through team effort." Frank Smith, director of ecosystems at the University of Michigan, believed the IBP forced ecologists to do science in a different way — what W.F. Blair of the Ecological Society of America described as working collaboratively "in large teams harmoniously and effectively." Blair's plea for multidisciplinary, cooperative approaches fit well with scientists on the Andrews who were already philosophically committed to working across disciplines in their research.[27]

Federal appropriations for American participation in the IBP were channeled through the National Science Foundation (NSF), whose funding for the program increased from $600,000 in 1969 to $8.5 million in 1973. Of the IBP programs in the United States, biome studies (originating in the terrestrial communities' section) were the most ambitious and successful. Biome research focused on five major American ecological regions — tundra, grassland, desert, coniferous forests, and eastern deciduous forests — with investigations measuring ecosystem components such as soil, topographic information, and climatic variables, as well as activities involving the generation of biomass, conveying of oxygen to plants and organisms, and the carbon dioxide and water given off. To effectively perform ecosystems research, therefore, required federal agency and academic scientists to cooperate across institutions and disciplines. Scientists at the Andrews, representing the Pacific Northwest Research Station and OSU, would find their qualifications well-suited for IBP's coniferous biome investigations. The well-defined drainage of Lookout Creek, the practice of converting old-growth Douglas fir forests to fast-growing young stands, road-building and logging strategies, and the data collected on the three small watersheds provided the experimental forest with a compelling repertoire to meet IBP standards.[28]

Rothacher, who authored the letter nominating the Andrews as an IBP site, emphasized the forest's representation "of a large part of western Oregon and Washington coniferous forests." Its "attributes favorable for a study" included the importance of the three watersheds and the "long history of hydrologic and terrestrial research." The data from the small watersheds was critical to attracting the attention of the NSF, the agency distributing funds. The Andrews' application was well-suited for the IBP's coniferous forest biome, but its inclusion in the IBP was no simple matter, because the University of Washington had already submitted an application to NSF that sought to exclude the Oregon proposal. When the NSF threatened to scuttle the coniferous biome altogether, the applicants compromised on a three-site agreement, two in Washington and the Andrews Experimental Forest in Oregon.[29]

Although the Andrews' participation in the IBP focused on applied science, its wide-ranging research would eventually lead to broader ecosystem inquiries. Jerry Franklin, an early and important leader in those initiatives, understood that timber harvesting influenced water quality and, therefore, healthy and viable aquatic communities. He contended that there was a need for more information linking land and water ecosystems and the length of time it took for landscapes to recover from disturbances such as timber harvesting. Franklin insisted that scientists were responsible for providing "problem-solving information" that required working across disciplines to seek solutions. The Coniferous Forest Biome Program, he told a gathering in Bellingham, Washington, was a truly "integrated, interdisciplinary effort."[30]

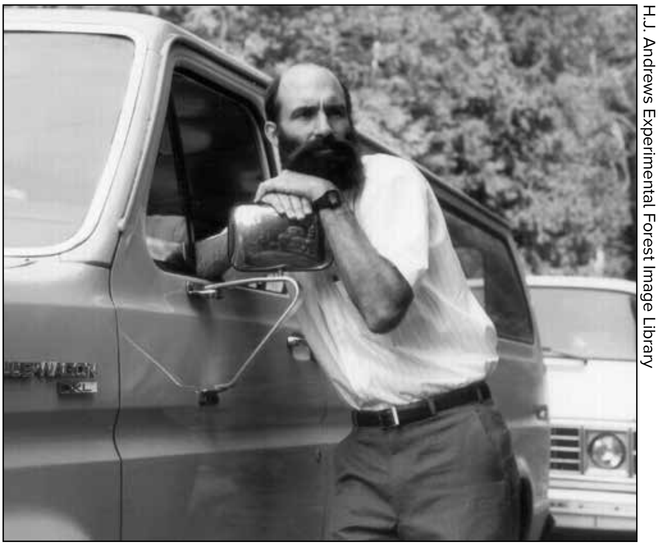
H.J. Andrews Experimental Forest Image Library

JERRY FRANKLIN poses for a photograph in 1983 that was published in the *Sierra Pulse*. Franklin, an early and important scientist on the Andrews, continues to participate in some of its activities. Photograph by Stan Gregory.

Between the initial NSF/IBP funding for the Andrews in 1969–1970 and its termination in 1974, a broad array of interdisciplinary scientists plied the streams and steep slopes of the forest. Among them was OSU fisheries professor James Hall, who introduced an aquatic component to the Coniferous Forest Biome. Hall led a team of younger scientists — Stanley Gregory and James Sedell — who formed the "Stream Team," with studies focusing on Mack Creek, a major tributary of Lookout Creek. The findings of the Stream Team and Frederick Swanson's parallel investigations illustrated the importance of woody debris to healthy waterways. Swanson, a post-doc from the

University of Oregon, and the Stream Team built on the earlier research of Henry Froehlich, who had created rough maps and sketches describing the influence of wood in streams — redirecting water, creating obstructions and mini dams, widening channels, and reducing the gradient on mountain streams. Trees that fell into streams seldom moved very far, the researchers found, contributing to storing sediment, providing feeding grounds for aquatic life, and helping to stabilize stream banks.[31]

Those findings ran counter to prevailing management strategies on National Forests calling for the removal of all wood material from streams following logging operations. The investigations on the experimental forest under the IBP suggested that clearing wood from waterways contributed to more frequent downstream torrents during extreme storm events. The woody debris research eventually had management implications on the Willamette National Forest. If woody material in streams was important to the health of aquatic environments, timber-sales contracts would no longer require loggers to remove wood from streams. Operators could save money by not having to undertake what they considered an onerous obligation.[32] The requirements, first to remove and then to leave woody debris in streams, invited barbed humor directed at the Forest Service, with suggestions that the agency was befuddled and confused.


H.J. Andrews Experimental Forest Image Library

DURING THE 1970S, Frederick Swanson worked with stream scientists to investigate the influence of wood in streams. He is pictured here in the late 1980s.

Franklin and Dyrness, early preceptors of Andrews' investigations, published a significantly revised study of their *Natural Vegetation of Oregon and Washington* under the auspices of the IBP. First released in 1969, the expanded volume in 1973 included fresh and updated information. Franklin and Dyrness credited the Coniferous Forest Biome and the Northwest

Research Natural Area Committee with "filling in the gaps and providing new insights" in their recent work. The publication included sections on different environmental and vegetation areas, the various forest zones in the two states, the Columbia Basin and central and southeastern Oregon shrub steppe domains, and a segment on vegetation in unique habitats. Appendixes described soil types and plant species and communities.[33]

Franklin, Dyrness, and William H. Moir also published an important paper in 1974 involving the establishment of plot studies of characteristic forests in Oregon's western Cascades, most of them centered in the Andrews. Additional forest landscapes extending north to the Santiam drainage and to the South Fork of the McKenzie River were included to make the results widely applicable. Issued as Bulletin Number 4 of the Coniferous Forest Biome, the investigation involved 300 circular plots of similar species approximately 50 to 65 feet in diameter to establish "a workable classification" of forest vegetation. The plots were located over a wide range of environmental conditions (elevation, landform, slope, and aspect). The researchers studiously avoided areas of recent natural and human-caused disturbances.[34] Those plot studies set in motion a documented baseline for vegetation classifications that scientists would revisit in the coming decades.

As funding for the Coniferous Forest Biome was winding down in the mid 1970s, the 15,800-acre forest was being recognized for the variety of its ecosystem investigations. Along with the Forest Service's Coweeta Hydrologic Laboratory in North Carolina, home to the Deciduous Forest Biome, the Andrews was gaining credibility for research programs that would extend far into the future. Franklin, on the ground floor in gaining IBP funding, spent a year in Japan in 1971 and then joined the NSF in Washington, D.C., for two years as the Director of Ecosystem Science, a position that further advanced prospects for the Andrews. OSU scientists also benefited from the expanded research opportunities on the Lookout Creek watershed and elsewhere in the Cascades. Robert "Bob" Tarrant, director of the Pacific Northwest Research Station in the mid 1970s, characterized the IBP years as "the glory days of the Andrews."[35]

At the same time, regional and national issues were afoot that would bring the findings on the Andrews to the forefront of the nation's forestry politics. Clearcutting, which had become the norm for both industrial and federal practices following the Second World War, became a subject of increasing public concern during the 1960s. Highly visible, large logged areas caught the attention of the Sierra Club, Friends of the Earth, and the Wilderness Society, especially after the passage of the Wilderness Act in 1964. The advance of clearcuts deeper into roadless tracts of National Forests in the West diminished the possibility of adding acreage to the wilderness system. And then, in August 1975, the U.S. Fourth Circuit Court of Appeals declared that Forest Service clearcutting practices on West Virginia's Monongahela National Forest violated the Organic Act of 1897, the founding document for managing federal forests. The decision moved congressional delegations from timber-producing states, including Oregon's Senator Mark Hatfield, to marshal their forces and pass the National Forest Management Act the following year. The compromise legislation directed the Secretary of Agriculture to establish guidelines to "insure that timber will be harvested from the National Forest System" under regulations that would protect steep slopes, streams, wetlands, and other bodies of water. The legislation also required that cutover areas be replanted within five years.[36]

While the new law minimally regulated clearcutting, Andrews researchers began to question the viability of the wholesale cutting of dwindling stands of old growth on the National Forest system. Investigations on the Lookout Creek drainage and elsewhere increasingly focused on biological diversity and other values inherent in old-growth forests. Eric Forsman, a young graduate student at OSU, who began studying the northern spotted owl (*Strix occidentalis caurina*), was part of that story. With support from the Forest Service, he launched his project in the winter of 1969–1970 and completed his master's degree in 1976 and his Ph.D. in 1980. Forsman's pioneering investigation, severely criticized in industry circles, determined that the nocturnal, medium-sized owl's preferred habitat was old-growth forests. Forsman was the lead author in a 1977 *Wildlife Society Bulletin* article, suggesting that the diminishing stands of old-growth forests might be responsible for the owl's declining numbers.[37]

H.J. Andrews Experimental Forest Image Library, photographer Al Levno

THIS 1994 photograph of an adult northern spotted owl was taken near Deer Creek in the Willamette National Forest. Nesting pairs are found in the Andrews, particularly in Watershed 2.

Except for researchers affiliated with the Andrews Experimental Forest, the Forest Service showed little interest in old-growth forests other than as related to the agency's three-decade mission to convert them to young stands of timber. By the onset of the 1980s, the Forest Service and private industrial landowners had been harvesting old-growth trees at three times their annual growth rate. Federal harvests contributed to this trend, because they were filling the demand for saw logs in the face of diminishing stands of private timber. A study released in 1982 indicated a shift from harvesting low-elevation forests in the 1940s and 1950s to higher-elevation timber by the 1970s. That pattern of clearcutting centered mostly on private forest land in the early decades and, with the passing years, advanced to timber above 2,000 feet in National Forests and on Bureau of Land Management (BLM) land. By the 1970s, there was little old growth remaining on private land, a matter with negative consequences for amphibians, reptiles, and mammals that thrived in regenerating natural and old-growth forests.[38]

Because of their growing interest in old-growth forests, Franklin and others published a seminal Forest Service report in 1981, *Ecological Characteristics of Old-Growth Douglas-fir Forests*, General Technical Report 118 (GTR-118). The Franklin document originated in a Forest Service workshop to identify the ecological nature of old-growth forests, including how they differed from managed forests. At that time, the remaining tracts of old growth represented only 5 percent of the original forested areas in the United States. Public foresters and scientists were increasingly concerned that continued harvests of old growth on public land were endangering unique plant, animal, and insect communities.[39]

GTR-118 cited the unique character of old-growth coniferous forests, underscoring features distinguishing them from "managed and unmanaged (natural) young stands." The exemplary Douglas fir and western hemlock old-growth forest was 350 to 750 years old and possessed ideal habitats for a broad range of invertebrates and vertebrates, notable among the latter the northern spotted owl. Old-growth forests were more than "a collection of some large, old trees," differing from managed forests in major characteristics, including "large live trees, large snags, large logs on land, and large logs in streams." Trees varied in species and size, their canopies producing filtered light "accentuated by shafts of sunlight on clear days." Old-growth trees were important far beyond their timber value, especially in their significance for communities (such as mosses and lichens) and wildlife that thrive in such environments.[40] The combined research findings about the significance of old-growth forests and Forsman's investigations of the northern spotted owl would make regional and national headlines in the late 1980s and early 1990s.

With IBP funding coming to an end in the mid 1970s, the experimental forest joined another international initiative, the United Nations Education, Scientific, and Cultural Organization's (UNESCO) Man and the Biosphere Program (MAB). Originating in 1970, the program would establish a series of global natural areas to be protected and managed as biotic reserves. Franklin, still with NSF, served as head of the U.S. Man and the Biosphere committee. In a 1977 article in *Science*, he cited two principles in selecting reserves: lengthy experiences with ecological research and large natural areas lacking in significant investigations. When the committee selected twenty biosphere reserves in the United States, two of them were in Oregon — the 15,800-acre H.J. Andrews Experimental Forest and the 200,000-acre Three Sisters Wilderness.[41]

The forest's participation in the MAB program was another recognition of the significant research taking place on the Lookout drainage and adjacent natural areas. Its involvement in UNESCO's initiative attracted several scientists interested in coniferous biome research. With the passage of time, however, the United States MAB committee became largely inactive, and the program had little lasting influence on the Andrews. During the same period, NSF began exploring the potential for assembling a network of natural environments dedicated to long-term ecological research. Although such investigations were already underway in national parks, the nation's wildlife refuges, and experimental forests, the passage of the National Environmental Policy Act in 1969 accelerated interest in the circumstances and conditions under which humans and nature could live in harmony. In pursuit of this objective, the American Institute of Biological Sciences (AIBS) compiled a list of significant natural environments appropriate for long-term research and forwarded the information to NSF.[42]

The purpose of NSF's initiative was to provide opportunities for long-term ecological research to assist in improving the health of the nation's natural resources. The foundation's *Mosaic Magazine* referred to the Andrews Experimental Forest as an exemplary site for carrying out such investigations, praising its monitoring stations on mountain streams, animal life, pristine and logged forests, varying small-plant vegetation, and studies of soils and hydrological conditions. Concurrently, NSF invited applications for ecological field locations with a history of "strong ongoing research." As NSF's first Director of Ecosystems Studies, Franklin's ideas about long-term investigations were apparent in the agency's innovative approach for financial support. Years later, he recalled that there had been a need to provide funding continuity for "some very long-term studies."[43]

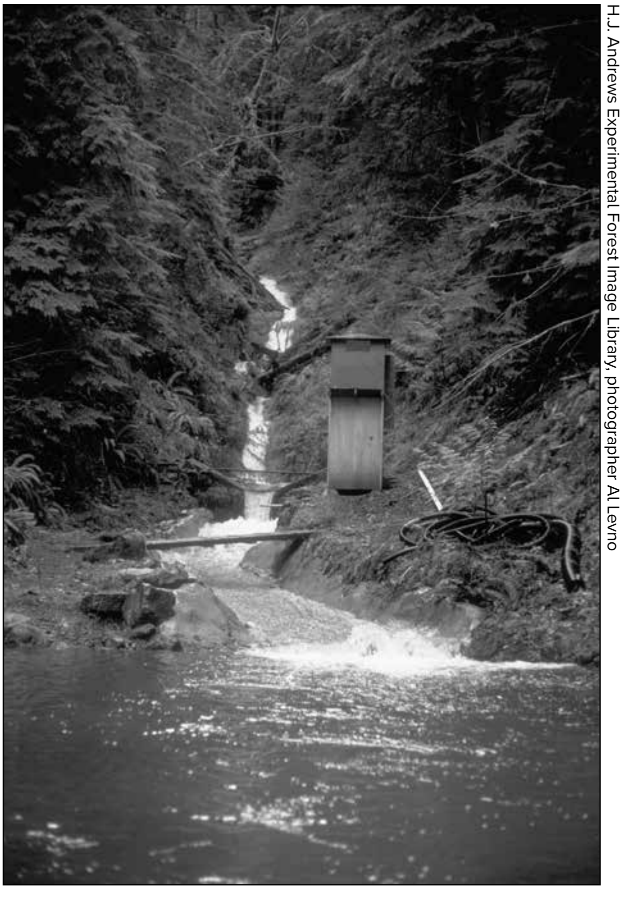
The NSF pilot program provided a three-year grant to the Andrews Experimental Forest in 1977 to investigate ecosystem responses to disturbances under various conditions, including landscapes that had been logged over extended periods. Ultimately, the NSF grant provided a bridge between the IBP and more advanced ecological studies. The program also contributed to increased use of the Andrews, burdening its meager facilities in Blue River and a campground on lower Lookout Creek. Following the advice of an NSF advisory committee, Richard Waring and Franklin submitted a request to NSF for funds to develop trailer pads and water and sewage works, and to move surplus Environmental Protection Agency trailers to Lookout Creek.[44] The soon-to-be headquarters site already housed a small warehouse, and it was anticipated that power lines would soon be extended to the area.[45]

Even with NSF support to advance trailer capacity, activities had increased far beyond the site's physical capabilities. Taking their cue from NSF's advisory committee again, Franklin and Art McKee (hired as the Andrews' site manager under the IBP) drafted a research and management plan for living and working facilities that included modest accommodations on site for scientists, to limit travel and facilitate their efficient use of time. OSU requested $195,750 from NSF in 1980 to prepare the facilities for occupation. The proposal anticipated replacing the trailers at the headquarters with permanent buildings. Although neither the Pacific Northwest Research Station nor OSU had immediate plans to fund permanent structures, it was clear that, if programs and research use continued, the headquarters site would need a large office-laboratory, several apartment buildings, a large garage-warehouse, and an instruction hall with a kitchen and storage space.[46] The Franklin and McKee proposal provided a blueprint for establishing an infrastructure at the Andrews that was partially realized when construction of the first permanent lodgings was completed at the headquarters site in 1987.

With the potential for continuing NSF grants on the horizon, Andrews personnel and cooperating partners — on the payroll of the Pacific Northwest Research Station and scientists affiliated with OSU — signed a memorandum of understanding (MOU) in March 1980 that would extend for ten years. The agreement's narrative identified the parties as the "Pacific Northwest Forest and Range Experiment Station, the Forest Service, USDA, and Oregon State University." The MOU firmed up years of convoluted and confusing legal matters involving a public university and three different units of the Forest Service — the station, the Willamette National Forest, and the Blue River Ranger Station. Hitherto, NSF grants, the IBP, and other small grants had been funded through OSU. And yet, obvious to all, university personnel were operating on National Forest property. While participants found humor in those associations, it was time to give legal clarity to all participants.[47]

Following a series of NSF workshops, the agency circulated an announcement in 1979 inviting proposals for "A New Emphasis in Long-Term Research." Because biological research required longer granting periods than the customary two or three years, beginning in 1980, NSF would begin funding research projects through continuing grants for longer intervals. The plan involved investigations to collect data at “sites representing major biotic regions of North America.” The application requirements were demanding — experienced leadership, institutional support, suitable facilities, significant and representative landscapes, and an extensive history of scientific reports and publications.[48]

The Andrews’ application to NSF’s Division of Environmental Biology — to establish a long-term ecological research program — was detailed and convincing in its presentation. Under the signature of principal investigator Richard Waring, the submission outlined five major research components: (1) issues related to succession in Douglas fir and western hemlock forests, (2) forest-stream interactions, (3) the dynamics of young forest stands, (4) the effects of nitrogen-fixers in forest soils, and (5) studies of log decomposition. Each of those areas reflected investigations already underway, courtesy of the earlier NSF pilot grant. Components 1 and 2 entailed measuring plots “in terrestrial and riparian/aquatic environments,” while components 3 through 5 involved significant environmental manipulations that would address important scientific questions that could only be accomplished through long-term research.[49]



H.J. Andrews Experimental Forest Image Library, photographer Al Levno

A GAGING STATION in Watershed 2 in the Andrews Experimental Forest is pictured here in February 1981. The National Science Foundation praised the forest as an exemplary site for long-term ecological studies on improving the health of the nation’s natural resources.

The Andrews proposal applauded NSF for emphasizing long-term ecological research, because many questions in biology could be resolved only “through a sustained program of measurements.” The objective of the

Andrews Forest was to build a program that would add to "on-going research, monitoring, and data management efforts." In line with NSF's emphasis on long-term research, the experimental forest would coordinate its sampling and data sets with other LTER sites, especially Hubbard Brook Experimental Forest in New Hampshire and Coweeta Hydrological Laboratory in North Carolina. Because much of their current research focused on gaged watersheds, Andrews scientists would be able to compare terrestrial and aquatic interactions on logged sites and old-growth forests.[50]

Working with twenty-nine applications, NSF reviewers selected six submissions, including that of the Andrews, for initial funding. The review committee subsequently chose another five from the remaining applicants. NSF's James Callahan later remarked that "site quality and institutional commitment served as a fine filter in selecting the 11 projects," an assessment that fit the Andrews application. There was another noteworthy factor to its selection as one of the original LTER sites: it was the only one west of the Rocky Mountains. For the co-directors of the Andrews, there was little readjustment in research agendas on Lookout Creek. The NSF-LTER grant simply meant the continuation of investigations already underway.[51]

The H.J. Andrews Experimental Forest's subsequent reports reflect continuing advances in its LTER investigations. By the mid 1980s, the forest was attracting national and international recognition for its advances in understanding forest ecosystems. Mark Harmon, an OSU forest ecologist, led an investigation into whether current logging practices — clearcutting, removing woody debris from sites, and slash burning — were inhibiting the restoration of nitrogen to the soil. His study of decomposing logs focused on the role of decaying wood in returning nitrogen to the soil. Leaving woody debris, tree tops, branches, and snags on logging sites, he suggested, would mimic natural processes. Other studies involved old-growth forests, with Franklin telling the *Oregonian*'s J.L. Mastrantonio in 1987 that much of what scientists had learned about old growth "comes from research at the Andrews." Dead and decaying snags — trees toppling to the ground or in streams — were valuable to healthy ecosystems. Managed forests in the United States and Europe were treated as agricultural crops, Franklin observed, with little attention to their sustainability over long periods of time.[52] In brief, Andrews research was attracting greater public notice.

The warp and woof of the nation's environmental politics were being woven into the National Forests of the Pacific Northwest during the 1980s. When Oregon's lumber market recovered from a severe recession in mid decade, the state's powerful Senator Hatfield and influential congressman Les Aucoin, fearful that environmental lawsuits would hold up timber sales, began amending appropriations bills requiring the Forest Service to increase timber sales on the region's National Forests above their targeted harvest rates (allowable cut). Hatfield, the ranking member of the Senate Appropriations Committee and a supporter of environmental issues, departed sharply with conservationists when it came to timber issues. Writing for the *New Yorker*, Catherine Caulfield termed Hatfield "the strongest congressional supporter of continued high levels of cutting from public forests."[53]

The congressional directives to maximize federal harvests paralleled the work of Andrews scientists, who were providing evidence about the spotted owl's favored habitat in old-growth forests. Their investigations of diminishing stands of old growth highlighted the ecological characteristics necessary to sustain plant and animal life, including the imperiled owl. Citizens who were concerned about the diminishing stands of old growth represented a growing number of Americans who valued natural systems as something more than sources of raw materials. Environmental organizations found legal support in the National Forest Management Act and its clause mandating that National Forest planning take into consideration the viability of wildlife species and their habitats. That powerful legal grounding rested on the spotted owl and its preferred habitat — old-growth forests.[54]

THIS 1988 LOG DECAY STUDY is an example of Mark Harmon's investigations to determine whether contemporary logging practices were inhibiting nitrogen restoration in the soil.

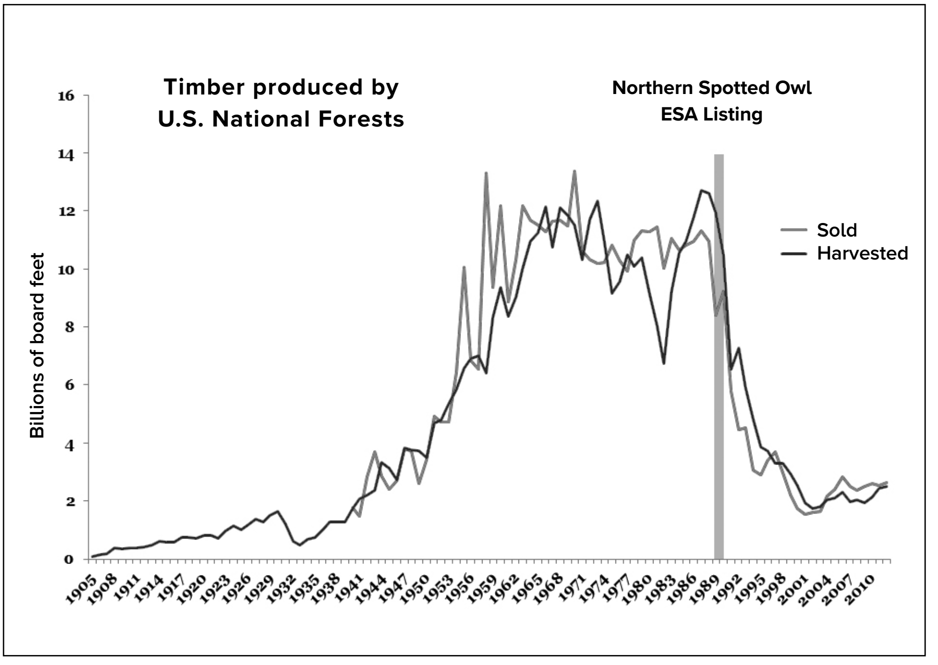
H.J. Andrews Experimental Forest Image Library

In the midst of this firestorm, Franklin devised a management strategy providing a compromise between intensive forestry and outright preservation. Dubbed the "New Forestry," his proposal recognized the importance of old-growth trees to healthy forest ecosystems, balanced against the nation's need for the federal forests to provide wood fiber. Franklin recommended structural diversity in the forests rather than the formulaic simplicity of intensive forest management, a model embracing both commodity and ecological values. “Such a ‘new forestry’,” he argued, “uses ecological principles to create managed forests superior to those created under common forestry practices.” Franklin’s forest would have messy, brushy understories, large standing snags, and logs on the ground.[55]

The convoluted and murky world of federal legislation, environmental impact statements, and dueling lawsuits led to Forest Service Chief Dale Robertson’s creating the Interagency Scientific Committee in October 1989 “to develop a scientifically credible conservation strategy for the northern spotted owl.” The committee reviewed multiple studies about spotted-owl habitat, and determined that the bird preferred near canopy closures, large overstory trees with significant cavities and broken tops, many large snags, and lots of woody debris on the forest floor. The committee proposed establishing large networks of Habitat Conservation Areas (HCAs) to protect the owl. Although the recommendations of the Interagency Committee were never formally adopted, Congress quickly chartered the Scientific Panel on Late Successional Forest Ecosystems, derisively referred to as the “Gang of Four.” The four scientists who headed the panel were Franklin, John Gordon, dean of Yale University’s School of Forestry, K. Norman Johnson, an economist with OSU’s College of Forestry, and Jack Ward Thomas, a wildlife biologist who would serve as chief of the Forest Service from 1993 to 1996. The group reported in October 1991 that to properly protect viable old-growth ecosystems and their species required establishing large late-successional old-growth reserves.[56]

Living up to his campaign promises, newly elected President Bill Clinton convened a “Timber Summit” in April 1993 in Portland to find a way through the timber wars that would satisfy the courts. The upshot of the meeting was Clinton’s appointment of another interagency committee, the Forest Ecosystem Management Assessment Team (FEMAT). Before the year was out, FEMAT, with some 600 people involved, delivered an enormous 1,000-page report offering ten alternatives for managing federal forests. More than any other identifiable group, scientists affiliated with the Andrews were heavily involved in FEMAT (as well as earlier panels), especially in leadership positions. Thomas was team leader of FEMAT; OSU’s Charles Meslow co-led the Terrestrial Ecology Group with Richard Holthausen; and Sedell was second in command of the Aquatic Ecosystem Assessment panel. The names of other Andrews affiliates and Pacific Northwest Research Station personnel are sprinkled throughout the lists of participants. Swanson recalls that Andrews scientists who specialized in various organisms and topics “were stoked — they got to speak for their taxon (lichens, fungi, mollusks) for the first time in a high-level science-input-to-policy forum.”[57]

In an article in *BioScience*, Franklin characterized the spirit of FEMAT participants as “Scientists in Wonderland.” The scientists involved, he wrote,



THIS FIGURE clearly illustrates the drastic decline in timber production from the National Forest system as a consequence of decisions made to protect the habitat of the northern spotted owl. The graph was reproduced from an EcoWest.org table titled "Some Traditional Extractive Industries in Decline: Logging in National Forests a Shadow of Its Former Self," with data sourced from the U.S. Forest Service.

had "the satisfaction of working to ensure that decisions are based on the best science available and that decision makers (and society) understand clearly the difficult tradeoffs."[58] From the ten alternatives in the FEMAT report, Clinton and his advisors chose "Option 9," which called for the designation of late-successional forest reserves, forest-matrix areas for timber production, and management areas to test various silvicultural practices. The Secretaries of Agriculture and Interior, who signed off on the agreement in April 1994, believed that the principles in Option 9 would protect habitat for the northern spotted owl and the marbled murrelet, the latter a small sea-going bird that nested deep inside old-growth forests. Option 9 quickly morphed into the Northwest Forest Plan, which proponents judged a success in ending harvests of old-growth forests on federal lands. It was much less successful, however, in restoring log supplies to local mills dependent on federal timber, as the figure above indicates.[59]

Through the 1980s and 1990s, the H.J. Andrews Experimental Forest continued to push the boundaries of its expansive research programs as one of NSF's leading LTER representatives. Of the original six LTER charter members, five remain (although Coweeta in North Carolina will close operations in 2019). In addition to the Andrews, the remaining of the earliest sites include Konza Prairie (over 7,000 acres) in Kansas, North Temperate Lakes (Wisconsin lake investigations), and Niwot Ridge (alpine studies above 9,000 feet west of Boulder, Colorado). Of the five additional sites that the NSF approved from the twenty-nine applicants in 1980, only two, Cedar Creek (at the intersection between prairie and forest in Minnesota) and Jornada Basin (in New Mexico's northern Chihuahuan Desert), are still LTER-funded locations.[60]

The H.J. Andrews Experimental Forest has been doing scientific investigations in the McKenzie River country since 1948. Beginning with studies on how to expeditiously convert its vast old-growth timber to uniform stands of fast-growing trees, investigations on the Lookout Creek watershed evolved through the years to embrace the complex relationships between terrestrial and aquatic environments and, eventually, to understand the ecological characteristics of old-growth trees themselves. The research findings on the Andrews and adjacent Research Natural Areas ultimately generated management changes on the entire National Forest system. The spotted owl studies and the relationship between the bird and its old-growth habitat accelerated investigations involving ecosystems, natural and human-induced disturbances, and how to properly manage forest environments that can be sustained far into the future. Although their work is generally outside the scope of this article, several women scientists have made important contributions to the experimental forest's work. Susan Stafford made early contributions to information and data management beginning in the mid 1980s, Barbara Bond was a lead principal investigator for H. J. Andrews grants between 2008 and 2014, and Julia Jones and Sherri Johnson have been important scientists since the 1990s. All of them have numerous and significant publications.[61]

The Andrews celebrates its seventieth anniversary in 2018, a remarkably long and important history of applied and theoretical research that has advanced our understanding of ecosystems and contributed important findings about the viability of forest environments. As this narrative indicates, the Andrews has made significant contributions to the greatest shift in the management of National Forests since their creation. The compound on lower Lookout Creek continues to serve as the nerve center for national and international scientists interested in advanced ecosystems investigations. But the Andrews is more — as the 2016 publication, *Forest Under Story: Creative Inquiries in an Old Growth Forest*, indicates. A product of the "Long-Term Ecological Reflections" project, the program serves as a humanities adjunct to scientific research on the Andrews, representing OSU's Spring Creek Project for Ideas, Nature, and the Written Word.[62]

The Andrews web site — which readers are invited to explore — declares that its "research is ongoing and continues to reveal surprising and important information." Since its affiliation with the LTER network, the forest has carried out investigations of forest-stream relations and the health of watersheds, and has encouraged "collaboration among ecosystem science, education, natural resource management, and the humanities." The website welcomes visitors, inviting them to hike the many trails in the forest. Scientists can link to "Guidelines for Researchers," graduate students are offered ready assistance, and undergraduates are provided information about intern-research experiences. Despite its seeming anonymity, the Andrews is a busy and hospitable place that continues to expand the boundaries of our understanding of natural systems. As an additional measure of its prestige, in April 2018, Richard Powers, author of eleven novels and winner of the National Book Award, published *The Overstory*, a fictional tale with part of its setting taking place in the "Franklin Experimental Forest."[63]

NOTES

The author would like to acknowledge the H.J. Andrews Experimental Forest and Long Term Ecological Research Program, funded by the U.S. Forest Service and National Science Foundation, for use of its document and image archive.

1. For purposes of brevity, I use its present name, the Pacific Northwest Research Station, in lieu of the agency's earlier title, the Pacific Northwest Forest and Range Experiment Station.

2. Sara Zaske, "Seeing the Forest through the Trees: H.J. Andrews Experiment Forest tackles tough ecological questions," *Focus on Forestry* 19:2 (Spring 2006): 26–27; National Academy of Sciences, Organized Collections, "The International Biological Program (IBP), 1964–1974," http://www.nasonline.org/about-nas/history/archives/collections/ibp-1964-1974-1.html (accessed March 9, 2017); Frank B. Golley, *A History of the Ecosystem Concept in Ecology: More Than the Sum of Its Parts* (New Haven: Yale University Press, 1993), 4, 110, 135–38; David C. Coleman, *Big Ecology: The Emergence of Ecosystem Science* (Berkeley: University of California Press, 2010), 24, 45, 48, 74; National Research Council, *Finding the Forest in the Trees: The Challenge of Combining Environmental Data* (Washington, D.C.: National Academy Press, 1995), 46–47.

3. Jon R. Luoma, *The Hidden Forest: The Biography of an Ecosystem* (New York: Henry Holt, 1999), 8.

4. Luoma, *The Hidden Forest*; and the H. J. Andrews Experimental Forest web site, https://

andrewsforest.oregonstate.edu (accessed October 1, 2018).

5. William G. Robbins, *Landscapes of Conflict: The Oregon Story, 1940–2000* (Seattle: University of Washington Press, 2004), 175–77.

6. Max Geier, *Necessary Work: Discovering Old Forests, New Outlooks, and Community on the H. J. Andrews Experimental Forest, 1948–2000*, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report, PNW-GTR 687, March 2007, pp. 9–18; *Establishment Report, Blue River Experimental Forest*, U.S. Department of Agriculture, Forest Service, R-NW, Branch Stations, Blue River Experimental Forest. Copies of this and many other documents in the H.J. Andrews files are in the William G. Robbins Papers [hereafter Robbins Papers], Oregon State University Special Collections and Archives Research Center, Corvallis, Oregon [hereafter SCARC].

7. Sally Duncan, "Openings in the Forest: The Andrews Story," *Forest History Today* (Fall 1999): 20–21; and Ivan Doig, *Early Forest Research: The Story of the Pacific Northwest Forest and Range Experiment Station* (Washington, D.C.: Forest Service, U.S. Department of Agriculture, 1976), 19, 21

8. Duncan, "Openings in the Forest," 20–21.

9. Doig, *Early Forest Research*, 19, 21.

10. For J. Alfred Hall's remark, see "Forest Set Aside for Research," *Oregonian*, August 29, 1948.

11. The dedication ceremony renaming the Blue River Experiment Station is cited in the "Test Forest Rites Sunday," *Oregonian*, July 20, 1953.

12. Max Geier interview with Roy Silen, September 9, 1996, Robbins Papers, SCARC.

13. "Forest Report Asks Research," *Oregonian*, July 13, 1951; Jerry Dunford, *Work Plan for Forest Influences Studies: H. J. Andrews Experimental Forest*, June 13, 1953, Robbins Papers, SCARC.

14. Dunford, *Work Plan for Forest Influences Studies*, 8, 12–16; "Forests Try to Regulate Snow Melt in Timbered Areas on McKenzie River," *Oregonian*, March 28, 1955.

15. Jack Rothacher, *Working Plan for Small Watershed Study*, USDA Forest Service, RI-NW, Watershed Management, Small Watersheds, Water Quality and Yield, February 4, 1958, p. 6–8, Robbins Papers, SCARC.

16. "Can there be Orderly Harvest of Old Growth?" *The Timberman*, March 8, 1957, 48–52.

17. *Blue River Experimental Forest, Representing the Old-Growth Douglas-fir Type*, Willamette National Forest, Oregon, R-NW, Region 6, U.S. Forest Service, approved by Acting Chief R.E. McCardle, July 28, 1948, p. 7, Robbins Papers, SCARC; *Working Plan for Blue River Harvest Cuttings — Sale # 1*, USDA, Forest Service, RS-NW, Blue River Sale, 1–2; R-NW, Branch Stations, Blue River Experimental Forest, Agreement, June 4, 1948, Robbins Papers, SCARC; Doig, *Early Forest Research*, 19, Robbins Papers, SCARC. The term "working circle" refers to the Forest Service plan where National Forest timber sales would be designated for local mills. Adopted at the end of WWII, the working circle strategy was abolished by 1970.

18. Luoma, *The Hidden Forest*, 11; *Blue River Experimental Forest, Representing the Old-Growth Douglas-fir Type of the Central and Southern Cascades*, Willamette National Forest, Oregon, R-NW, Region 6, U.S. Forest Service, 1 and 7, Robbins Papers, SCARC.

19. Jack S. Rothacher, *A Projected Plan to Study the effects of Road Building and Logging, Erosion, Sedimentation, and Streamflow Behavior on the H.J. Andrews Experimental Forest*, USDA Forest Service, R1-NW, Research Program, Project Plans, May 23, 1958, Robbins Papers, SCARC; *Blue River Experimental Forest, Representing the Old-Growth Douglas-fir Type*, 7; *Working Plan for Blue River Harvest Cuttings — Sale # 1*, 1–2, Robbins Papers, SCARC.

20. Carl M. Bernstein and Jack Rothacher, *A Guide to the H.J. Andrews Experimental Forest*, USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, 1959, pp. 1–5, 7–17, Robbins Papers, SCARC.

21. Max Geier interview with Jerry Franklin, September 13, 1996; Max Geier interview with Al Levno, September 12, 1997, both in Robbins Papers, SCARC.

22. Max Geier interview with Ted Dyrness, September 11, 1996; Geier interview with Jerry Franklin, September 13, 1996, both in Robbins Papers, SCARC.

23. Max Geier interview with Ted Dyrness, September 11, 1996; Max Geier interview with Andrews Group, September 22, 1997, Robbins Papers, SCARC; and Max Geier, *Necessary Work*, 109–110.

24. Max Geier interview with Levno, September 12, 1996; Geier, *Necessary Work*, 104–109.

25. Max Geier interview with Tex Dyrness, September 11, 1996; C.T. Dyrness, *Mass Soil Movements in the H. J. Andrews Experimental Forest*, USDA, Forest Service, Pacific Northwest Forest and Range Research Station, Portland, Research Note, PNW-42, 1967, pp. 1–2, 4–5, and 12.

26. Elena Aronova, Karen S. Baker, Naomi Oreskes, "Big Science and Big Data in Biology: From the International Geophysical Year through the International Biological Program to the Long Term Ecological Research (LTER) Network, 1957–Present," *Historical Studies in Natural Science* 40:2 (Spring 2010): 192 and 196–200; Frederick E. Smith, "The International Biological Program and the Science of Ecology," *Proceedings of the National Academy of Sciences of America* 60:1 (May 1968): 5–11; E.M. Nicholson*, Handbook to the Conservation Section of the International Biological Programme* (Oxford, England: Blackwell Scientific Publications, 1968), 7, 15–16.

27. The Smith and Blair comments are in Robert P. Mcintosh, *Background of Ecology: Concept and Theory* (New York: Cambridge University Press, 1985), 214–18.

28. Aronova, Baker, and Oreskes, "Big Science and Big Data in Biology," 208–209; *H. J. Andrews Experimental Forest*, undated mimeograph copy in Robbins Papers, SCARC.

29. *H.J. Andrews Experimental Forest — A Proposed Comprehensive Research Site*, undated mimeographed copy, Robbins Papers, SCARC; Jack Rothacher to Frederick E. Smith, July 21, 1967, Robbins Papers, SCARC; Arthur McKee, "Focus of Field Stations," *Bulletin of the Ecological Society of America* 79:4 (October 1998): 241–42.

30. Jerry Franklin, "Why a Coniferous Forest Biome?" *Proceedings—Research on Coniferous Forest Ecosystems—A Symposium,* Bellingham, Washington, March 23–24, 1972, 3–5, Robbins Papers, SCARC.

31. For a summary of these findings, see S.V. Gregory, F.J. Swanson, W.A. McKee, and K.W. Cummins, "An Ecosystem Perspective on Riparian Zones," *BioScience* 41:8 (1991), 540–51; and Victoria Ruiz-Villanueva and Markus Stoffel, "Frederick J. Swanson's 1976–1979 Papers on the Effects of Instream Wood on Fluvial Processes and Instream Wood Management," *Progress in Physical Geography* 41:1 (1991), 124–33.

32. Max Geier interview with Mike Kerrick, August 28, 1996, in Robbins Papers, SCARC.

33. Jerry F. Franklin and C.T. Dyrness, *Natural Vegetation of Oregon and Washington,* Portland, Oregon, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service General Technical Report, PNW-8, 1973, iii–vii. Research Natural Areas are representative of common ecosystems in their natural condition and serve as model baselines for reference.

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36. Stephen H. Spurr, "Clearcutting on National Forests," *Natural Resources Journal* 21:2 (Spring 1981): 223–43; Paul W. Hirt, *A Conspiracy of Optimism: Management of the National Forests Since World War Two* (Lincoln: University of Nebraska Press, 1994), 243–46.

37. Eric Forsman, "A Preliminary Investigation of the Spotted Owl in Oregon," (M.S.

thesis, Oregon State University, 1976), unpaginated abstract, and 1–2; Eric D. Forsman, E. Charles Meslow, and Monica J. Strub, "Spotted Owl Abundance in Young versus Old-Growth Forests, Oregon," *Wildlife Society Bulletin* 5:2 (Summer 1977): 43–47.

38. Larry D. Harris, Chris Maser, and Arthur McKee, "Patterns of Old Growth Harvest and Implications For Cascades Wildlife," *Transactions of the 47th North American Wildlife and Natural Resources Conference* (Washington, D.C.: Wildlife Management Institute, 1982), 374–84; Hirt, *A Conspiracy of Optimism*, xxxix–xiv. The "Introduction" to Hirt's book (pp. xv–liv) provides a striking critique of the liquidation of old-growth timber on the National Forests during the post-World War II years.

39. Jerry Franklin Retirement Lecture, Forest Sciences Laboratory, Oregon State University, November 22, 1991, copy given to the author, courtesy of Fred Swanson; Jerry F. Franklin, Kermit Cromack, Jr., William Denison, Arthur McKee, Chris Maser, James Sedell, Fred Swanson, and Glen Juday, *Ecological Characteristics of Old-Growth Douglas-fir Forests*, USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station, General Technical Report PNW-118 (February 1981), summary, n.p.; and Hirt, *A Conspiracy of Optimism*, 23–24.

40. Franklin, et al., *Ecological Characteristics of Old-Growth Douglas-Fir Forests,* abstract, 1–2 and 42; Hirt, *A Conspiracy of Optimism*, 24 and 289.

41. M.B. Dickerman (U. S. Forest Service, Washington Office) to Regional Foresters, Directors, Area Directors, List of Biosphere Reserves in the United States, October 1, 1974, Robbins Papers, SCARC; Report of the Task Force on Criteria and Guidelines for the Choice and Establishment of Biosphere Reserves, UNESCO, International Coordinating Council of the Program on Man and the Biosphere, Washington, D.C., September 17–19, Robbins Papers, SCARC; Jerry F. Franklin, "The Biosphere Reserve Program in the United States," *Science* 195: 4275 (January 21, 1977): 262–67.

42. James T. Callahan, "Long-Term Ecological Research," *BioScience* 34:6 (June 1984): 363–64.

43. Author unknown, "Preserving Sites for Long-Term Environmental Research," *Mosaic Magazine* (January–February 1976), 29–31; Biological Research Program, Support of Field Research Facilities, National Science Foundation, Washington, D.C., 1975; Jerry Franklin to William Ferrell, et al, Preparing an NSF Proposal for Support of H.J. Andrews Experimental Forest, December 8, 1975, USDA Forest Service, Forest Science Laboratory, Corvallis, Oregon; H.J. Andrews Experimental Ecological Reserve Proposal, 1976, 1–2, all documents in Robbins Papers, SCARC.

44. Richard H. Waring joined the OSU faculty in 1963, participating in the IBP and early LTER funding.

45. Proposed Supplement to Grant for support of the H. J. Andrews Experimental Forest as a National Field Research Facility, National Science Foundation, Richard Waring, Principal Investigator, August 16, 1978, pp. 1–4, Robbins Papers, SCARC.

46. Jerry Franklin and Arthur McKee, Facilities Development Plan for H.J. Andrews Experimental Forest and Associated Research Natural Areas, Willamette National Forest and Pacific Northwest Forest and Range Experiment Station, October 15, 1979 [III A-7], 1–5 and 8–11.

47. Research Agreement, Operation of the H.J. Andrews Experimental Forest, Supplement No. PNW-80-256, March 17, 1980 to March 17, 1990, authorized Principal Investigator, Richard H. Waring, in Robbins Papers, SCARC.

48. Callahan, "Long-Term Ecological Research," 364; National Science Foundation, "A New Emphasis on Long-Term Research," December 25, 1979, p. 1–4, in Robbins Papers, SCARC.

49. Long-Term Ecological Research on the Andrews Experimental Forest, Proposal to the National Science Foundation, Division of Environmental Biology, February 4, 1980, Richard Waring, Principal Investigator, cover and p. 19, Robbins Papers, SCARC.

50. Ibid., 1–5.

51. Callahan, "Long-Term Ecological Research," 365; Long-Term Research on the Andrews Experimental Forest, Richard Waring, Principal Investigator, Proposal to the National Science Foundation, April 24, 1981, Robbins Papers, SCARC; Long-Term Research on the Andrews Experimental Forest, in Robbins Papers, SCARC.

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54. A. J. Hansen, T.A. Spies, F.J. Swanson, and J.L. Ohmann, "Conserving Biodiversity in Managed Forests," *BioScience* 41:6 (1991): 91–108. Some of this argument reflects my reading of David J. Brooks and Gordon E. Grants's *New Perspectives in Forest Management: Background, Science Issues, and Research Agendas*, USDA Forest Service, Pacific Northwest Research Station, PNW-RP-456, September 1992, 1–14.

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58. Jerry F. Franklin, "Scientists in Wonderland," *BioSience Supplement* (1995): S–78.

59. Marcot and Thomas, *Of Spotted Owls, Old Growth, and New Policies*, 4–5; Franklin, "Scientists in Wonderland," S–77; Jack Ward Thomas, Jerry F. Franklin, and K. Norman Johnson, "The Northwest Forest Plan: Origins, Components, Implementation Experience, and Suggestions for Change," *Conservation Biology* 20:2 (2006), 277–87.

60. Michael Nelson, Lead Principal Investigator for the H. J. Andrews Experimental Forest LTER program at Oregon State University, to the author, November 11, 2017.

61. See H.J. Andrews Experimental Forest Timemap, https://andrewsforest.oregonstate.edu/sites/default/files/lter/about/HJA_Timeline_June2017.pdf'. I am indebted to Lina DeGregoria for this and other information.

62. Nathaniel Brodie, Charles Goodrich, and Frederick J. Swanson, eds., *Forest Under Story: Creative Inquiry in an Old-Growth Forest* (Seattle: University of Washington Press, 2016).

63. For the H.J. Andrews Experimental Forest web site, see https://andrewsforest.oregonstate.edu/ (accessed October 2, 2018). Richard Powers, *The Overstory* (New York: W.W. Norton, 2018).