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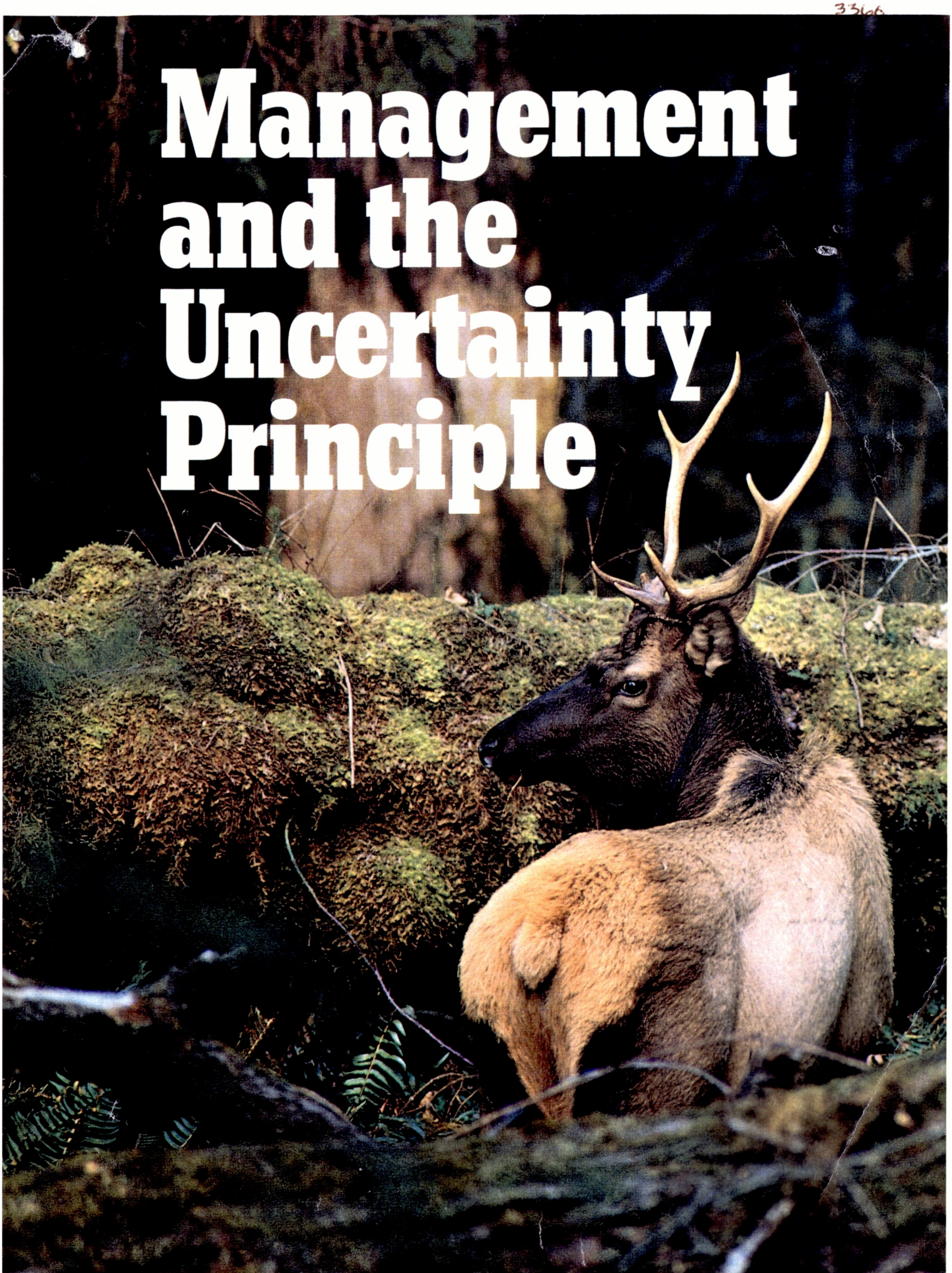
# Management and the Uncertainty Principle



# *Is "Ecosystem Management" a working idea or just another bureaucratic buzzword?*

By Robert Devine

About a year ago I spent an evening hanging out with half a dozen forestry professionals at the H.J. Andrews Experimental Forest, on the western slope of the Cascades in Oregon. We sat around the kitchen table in one of the lodging units, recovering from a long day of tours and lectures, our brains still sore from talk of "paradigm shifts," "connectivity," and "hierarchical context." We'd come to the Andrews to learn more about ecosystem management (EM), the new approach to natural resource management that has caused an uproar in American forestry.

As we sampled some home-brewed beer made by one of the foresters, we discussed EM. All six of my companions welcomed its strong environmental ethic. They thought that EM's many innovative silvicultural techniques would help society get some wood out of the forest without causing undue harm. They applauded the fundamental role EM gives to science. But, above all else, they felt terribly confused. Many of the concepts struck them as vague and overly general. None of the foresters could discern a unifying premise that he or she could use to guide their everyday decisions. One guy took a swig of beer, shook his head, and said: "Ecosystem management can be anything that anyone wants it to be."

Yes, EM is nebulous at this embryonic stage. Yes, the phrase "ecosystem management" has the ring of a bureaucratic buzzword that will do little but breed meetings and conferences. Yes, the U.S. Forest Service is promoting EM with a lavish publication, often a sign that a program is more PR than substance. For these and plenty of other reasons, many people have dismissed ecosystem management as the latest euphemism for business-as-usual. But EM doesn't have to be just another fad, and evidence is mounting that it's not going to be. It's no accident that Jack Ward Thomas titled his first speech as Chief of the Forest Service "Turmoil and Transition." Ecosystem management could bring about the most fundamental changes in American forest policy since the inception of the Forest Service in 1905, changes that bode well for the environment.

At this point I guess I'll have to quit stalling and get down to defining ecosystem management. You'll soon know

*Surrounded by a wealth of CWD—"Coarse Woody Debris"—in the form of fallen logs festooned with moss and well along in the work of decomposition, a Roosevelt elk pauses in the heart of Olympic National Forest in Washington.*

SCOTT PRICE

*Just to the south of the "owl forests" of Washington and Oregon are the equally diverse and important old-growth redwood forests of northern California—though the huge fallen tree here in Redwood National Park is a Douglas fir, not a redwood.*

CHUCK PLACE

why I've been putting it off. Let's start at the top: Chief Thomas says, "Ecosystem management is more of a concept than an absolute set of processes." That's an important point, but it doesn't get us far. Let's go on to the full-fledged definition given by David Unger, the associate chief of the Forest Service, in July 1994: "Ecosystem management [is] an approach to the management of natural resources that strives to maintain or restore the sustainability of ecosystems and to provide present and future generations a continuous flow of multiple benefits in a manner harmonious with ecosystem sustainability." Quite a mouthful for one sentence. Mike Anderson, a veteran forest resource analyst with The Wilderness Society, notes that some of Unger's phrases, notably "multiple benefits," echo the forest management language that prevailed during the overharvesting of the last several decades. Yet Unger's definition does suggest a heartening concern for ecosystems and for the future beyond the next rotation.

Let's look at the composite definition published in March 1994, by biologist Ed Grumbine, author of *Ghost Bears* and director of the Sierra Institute at the University of California, Santa Cruz. It blends the thinking on ecosystem management by thirty-three authors. "Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term." Another sentence that could swallow several of Hemingway's declarative thrusts. Ecosystem management spawns a lot of these jawbreakers. Stylistic nitpicking aside, Grumbine's definition—and, by extension, those of most of the thirty-three other authors—plants the seeds of change by singling out the protection of ecosystem integrity as the basic goal of EM.

All the definitions of ecosystem management that I've seen share one trait: they're coated with so much jargon and abstraction that the concept feels awfully slippery. Given the elusiveness of EM, I think we'd better start by bringing it down to earth. Let's take a walk in the woods.

I know just the place: sky-piercing Douglas fir above; salal, sword ferns, rhododendrons, and upended root masses all around; and a springy green-brown mat of conifer needles, lichens, fungi, and mosses underfoot. A newt moves its Gumbie body in slow motion across the damp duff beneath a fallen log. A cutthroat trout slides in silvery silence through a deep, cold pool in a whispering stream. And, yes, one of those notorious northern spotted owls ghosts about in the shadows.

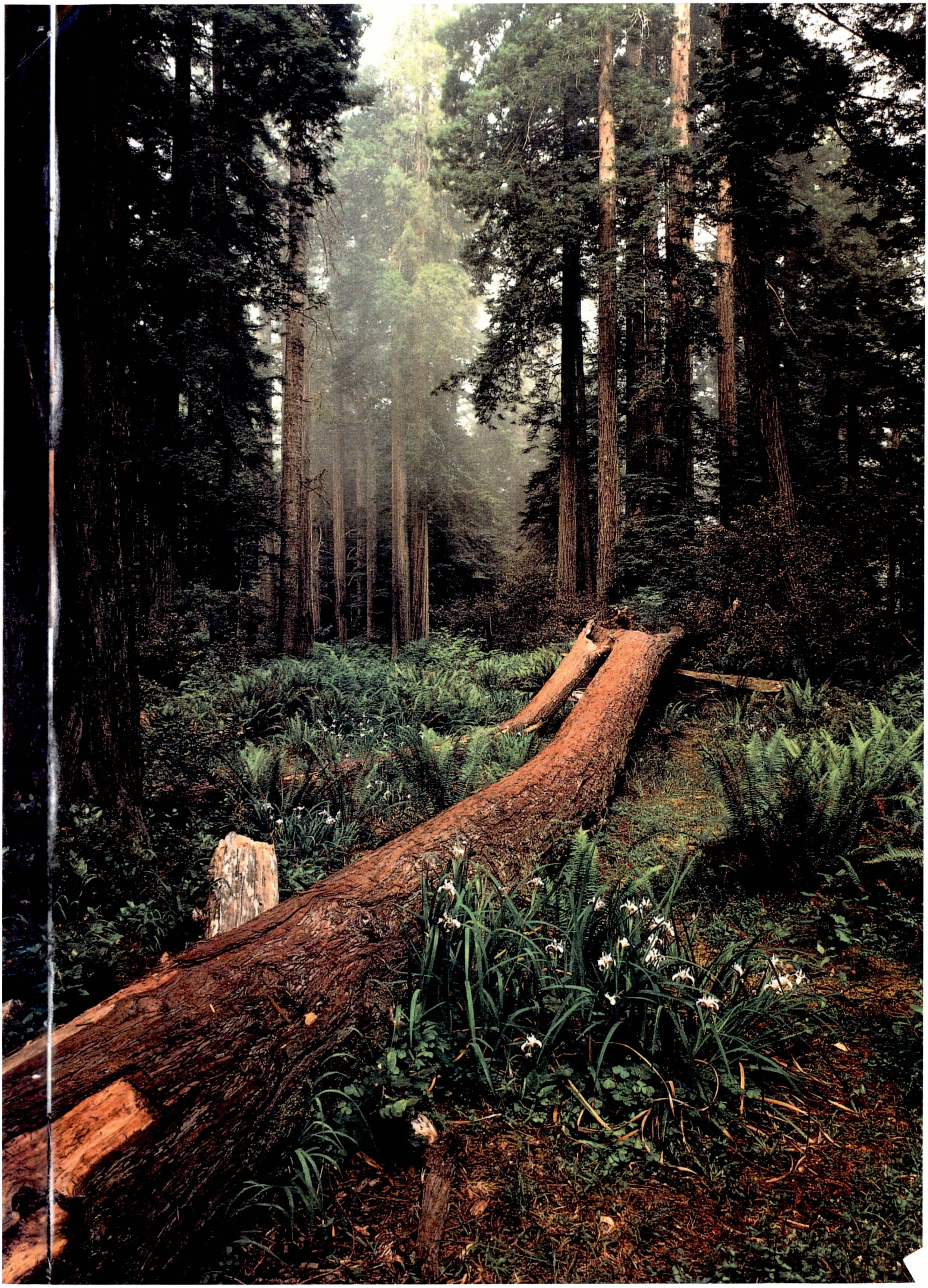
This old-growth grove makes a fitting point of departure, for much of forest ecosystem management derives from the profound intricacies of old growth. Nature is EM's mentor. In fact, the very grove I describe above lies on the tract of forest in which scientists conducted the seminal studies that brought the ecological value of temperate old growth to the nation's attention. The tract to which I'm referring is, once again, the Andrews. Though the Andrews hardly has a monopoly on innovative forest research, it is, as author Elliott Norse notes in *Ancient Forests of the Pacific Northwest*, home to "the world's most concerted, coordinated research on coniferous forest ecosystems."

The Andrews is doubly appropriate as a starting point because it falls within the Pacific Northwest's "owl forests," ground zero in the debate over America's woods. It is these forests that occasioned President Clinton's 1993 Forest Conference and the precedent-setting FEMAT report—an acronym that stands for "Forest Ecosystem Management Assessment Team." EM is supposed to be the salvation of these ancient forests. They have become the crucible in which many of the most confusing and contentious elements of EM are being hammered out.

The Forest Service founded the Andrews in 1948, at the dawn of the post-World War II logging boom. The 16,000 acres of this experimental forest sprawl across a mix of old-growth, mature, and managed forests in the Willamette National Forest. Like virtually all forest research during the 1950s and 1960s, early efforts at the Andrews were narrowly focused on finding ways to harvest and grow commercial tree species ever more profitably. This was the era of industrial forestry: build a road, clearcut the timber, burn the debris, replant with a monoculture of Douglas fir, spray herbicides on competing plants, and move on to the next stand. Or, in the words of Dave Perry, a leading ecosystem scientist at the Andrews, "Cut big trees, plant little trees." This model still dominates forestry today, particularly on private lands, but it's fading fast as EM emerges and we run out of big trees to cut.

In the 1960s some unblinkered researchers at the Andrews started getting interested in the workings of natural forests. One early member, Fred Swanson, who now heads up the Andrews research effort, says "we were viewed as a bunch of hippies doing goofy things." The pivotal moment came in 1970, when the National Science Foundation provided funding and Oregon State University scientists joined the effort. Industrial foresters at that time termed ancient forests "decadent" and "biological deserts," of interest only as a source of timber to be rapidly shorn and replaced with a fast-growing plantation. The old-growth researchers coalesced into the H.J. Andrews Ecosystem Research Group and dived deep into the ancient forests. They soon discovered a rich ecosystem terribly misrepresented by the terms "decadent" and "biological deserts."

If you've ever hiked cross-country in an old-growth owl forest, you probably spent a lot of time circling around or struggling over fallen trees—some so huge that you could



*Adult northern spotted owl with downy chick in Olympic National Park, Washington. To survive and prosper, ecologists insist, these birds need more than isolated islands of old growth; they need landscapes of generous dimensions.*

LOTTER GURLING/TOM STACK & ASSOCIATES

hardly get over them without technical climbing gear. On some sites, 150 tons of downed trees sprawl on a single acre of natural forest. Industrial foresters consider fallen trees a fire hazard and a hindrance to their operation, so after logging they remove what ecologists call "coarse woody debris" or "CWD." (FEMAT defines CWD as downed trees with a diameter greater than 20 inches.) But the natural profusion of CWD compelled the Andrews Group to study it. What they found was that in the owl-forest ecosystem, dead trees rival live trees in importance. They also found that dead trees serve the forest for roughly as long as live trees do; it can take 500 years for a large fallen tree to fully decompose.

Andrews scientists have studied CWD closely for more than two decades now. That research serves as a good example of the ways in which ecosystem management practices flow from an increased understanding of natural forests.

A few of CWD's roles are obvious. If you skirt a downed Douglas fir, and a marten or a skunk flushes from the hollowed-out log, you'll immediately realize that the fallen tree serves as shelter for large animals. (A study in northeast Oregon found that 178 vertebrate species used CWD as habitat.) And if you're clambering over a big downed tree, it's hard not to notice a 20-foot hemlock growing out of the top of the log. As CWD starts decomposing, it provides plants with nutrients. The log also provides water, even during the dry summers, characteristic of the owl forests. Once, during an autumn visit to the Andrews, I shoved my hand deep into the soft belly of a prostrate Douglas fir. I pulled out a fistful of mushy wood and squeezed. Cool water squirted out and ran down my arm, even though no rain had fallen for several months.

As with any of CWD's ecological functions, its value as large-animal habitat and as a water reservoir depends first of all on its being there. On a managed forest, this means that timber operators must leave some CWD on logged sites, a practice that has been adopted in some places. But researchers discovered that merely retaining CWD on a clearcut isn't enough to fully preserve its functions. For example, when exposed to full sunlight, the CWD dries to some extent, lessening its ability to support some of the organisms that depend on its moisture. One possible answer is for timber operators to leave clusters of standing live trees that will shade some CWD.

Anyone who has eaten lunch while sitting on a log knows that ants frequent CWD, but prior to the 1970s, research on the less charismatic inhabitants of the forest hadn't gone much past that anecdotal stage—unless those inhabitants happened to be commercial timber pests. When Andrews researchers dug into CWD, they uncovered a teeming universe of life. Bark beetles chew through the bark of a recently fallen tree. Its armor penetrated, the tree is invaded by termites, carpenter ants, and other wood eaters, among them the golden buprestid beetle, an iridescent gem of green, burnt orange, and the eponymous gold. These wood chompers tunnel throughout the log, opening it to settlement by microorganisms, such as bacteria. Next come mites, springtails, and other tiny critters that feed on the microorganisms. Soon larger predators prowl through the dark corridors: centipedes, pseudoscorpions, spiders, and even some vertebrates, such as salamanders and newts. Being lungless and in need of moisture to breathe through their skins, some of these amphibians depend on CWD's propensity for retaining water to see them through the summer drought. This complex food web keeps looping outward until it reaches all the way to black bears—or to scientists armed with collection jars.

Providing food and habitat for such an astounding variety of organisms requires not only ample amounts of CWD but CWD of varied species and stages of decay. Some bugs like their wood rare; others prefer it well-done. Researchers suggest that managers leave standing dead trees (snags) and live trees, which will topple at different times, perpetuating the volume and variety of CWD.

Among the most common, most important, and most overlooked components of CWD are the fungi. One person who never overlooks a fungus is Jim Trappe, the *eminence gris* of forest fungi, a long-time Andrews researcher, and a good-humored man variously described as "the master," "a bald gnome," and "the Pope of Mycorrhizae." (A specialty of Trappe's, mycorrhizae are a symbiotic fungus-plant association.) It was Trappe and biologist Chris Maser who in the late 1970s discovered that truffles play an integral part in one of the most politically important food chains in the owl forests.

*The complex habitat systems of the old-growth forest support an equally diverse and complicated web of wildlife, from centipedes, bark beetles, and newts to martens, fishers, and mountain lions (left).* FRANK S. BALTHIS

Truffles are the underground fruiting bodies of certain species of fungus. One sunny afternoon Trappe took me out to the forest to look at truffles, but I must admit I don't think they're much to look at. The ones I've seen ranged in size from a pea to a walnut and looked like animal droppings. However, truffles do emit a rich range of smells, from garlicky to fruity to unmentionable. Trappe says that these powerful scents are a key to the truffle food chain, because they attract flying squirrels, which crave truffles; truffles make up more than 90 percent of the flying squirrel's diet. In many places flying squirrels make up a similarly large percentage of the diet of the northern spotted owl. Fewer truffles, fewer owls. Many silvicultural practices could be changed to keep a site in fungi, including the truffle-producers: leave some live trees, because many mycorrhizal fungi live in a mutually dependent association with tree roots; revegetate logged sites rapidly with native plants that host those symbiotic fungi; and prevent post-logging prescribed burns from reaching intensities that harm soil organisms, including fungi.

Having made the acquaintance of CWD, you now can imagine what forest scientists have learned about other aspects of the owl forests, such as the pivotal role millipedes play in nutrient flows; the function of remnant green trees as wildlife refuges following a fire or logging; the importance of leaning tree trunks to the prosperity of lichens; and the role of snowbrush in re-colonizing burns. Assembling these bits and pieces of knowledge, forest scientists began to discern patterns and formulate principles. They started talking about following nature's lead, holistic thinking, cumulative effects, and managing at greater scales of time and space.

Following nature became a key theme of the silvicultural practices suggested by the Andrews Group. Jerry Franklin, an eminent forest ecologist and the leader of the Andrews Group from 1970-1987, summed up nature's way in a single adjective: "messy." Industrial foresters are meticulous housekeepers who plant evenly spaced Douglas firs on a tidied-up forest floor. Nature is an erratic housekeeper who knocks things over, strews stuff about, and leaves junk lying around. Fire is the primary housekeeper in most owl forests, and it is the quintessential mess-maker. Fire virtually never burns a forest cleanly to the ground. The flames flare and veer and bound, leaving a complicated mosaic of conditions that includes plenty of live trees, snags, and CWD.

To see an example of how nature's messy habits can guide management practices, I recently drove up a logging road in the Blue River Ranger District, the section of the Willamette National Forest on which the Andrews lies. A few miles up the road I got out and stood on the overlook above unit three of the Slim Scout timber sale, logged in 1991 in a manner intended to imitate wildfire. Sure enough, compared with a clearcut, it looked disheveled. Downed logs littered the 17-acre cut, snags poked up like hairs that resist combing, and green trees, including some big, juicy Douglas-fir, stood defiantly among the stumps. Not only do these live trees act as wildlife refuges for organisms that aren't as mobile as deer, but leftover trees (at least those that don't blow down) will serve as the overstory in the regenerated forest. This overstory, along with the snags and CWD, provides some structural diversity, which in turn provides a variety of habitats and is a key to biodiversity. Still, scientists caution that logging, no matter how skilled the mimicry, can never fully assume the crucial ecological role of fire.

In addition to behaving erratically over the landscape, fire behaves erratically over time. For example, in dry ponderosa pine forests, fire shoots through about once every 15 years but kills few big trees. In the sodden cedar-spruce-hemlock rainforest on Washington's Olympic Peninsula, fire returns about once every 400 years but kills most trees in the burned area. These wet forests and their inhabitants have adapted to a rhythm that usually involves centuries without fire, so forest managers who want to imitate fire shouldn't log those forests every 40 or 60 years—a typical industrial forestry rotation—even if the logging is properly messy. This need for long-term thinking also applies when dealing with issues such as shifting watercourses and soil productivity. Stan Gregory, an aquatic ecologist and a leader of the Andrews Group's famed "Stream Team," says, "Our time frame needs to be at least three hundred years. Better yet, five hundred or a thousand years."

While standing on the overlook above Slim Scout, I looked around at the rest of the Mona Creek drainage. In doing

*For generations, the forests of the Pacific Northwest have been methodically stripped for their straight-grained and valuable trees—like those being harvested in the Hoko River Valley in Olympic National Forest, Washington, below, or those taken from the clearcut in Mt. Hood National Forest in Oregon on the opposite page. It is time, as forest ecologist Jerry Franklin says, for a new kind of approach—"a kinder and gentler forestry that better accommodates ecological values. . . ."*

BELOW: RANDI HIRSCHMANN; OPPOSITE PAGE: D. C. LOWE

so, I unwittingly had taken the first step towards thinking at a larger scale. Slim Scout's planners no doubt had stood on this spot doing the same thing; Slim Scout represents an early attempt at placing a small cutting unit within the context of a broader landscape. As I looked around, I noticed quite a few industrial-strength clearcuts—36 percent of the drainage had been clearcut during the previous 35 years. Because the Mona drainage lies in an area that emphasizes spotted owl habitat, Slim Scout was placed next to recently logged sites rather than in large old-growth blocks, minimizing further fragmentation of owl habitat. When old growth exists as small islands surrounded by clearcuts, spotted owls suffer because they need large territories in which to hunt, young spotted owls have difficulty dispersing across large clearcuts, and small islands expose spotted owls to more edge effects, such as predation from edge-dwelling Great Horned Owls. The Wilderness Society's Mike Anderson points out, however, that to adequately protect spotted owls and other wide-ranging species, planners will have to look at landscape scales much larger than a drainage or even a ranger district.

During the 1980s, the Andrews Group and other forest scientists synthesized their work into what Fred Swanson called "a kind of unified field theory for forestry." Jerry Franklin dubbed the result "New Forestry" and became its leading advocate. Borrowing a phrase from George Bush's 1988 campaign, Franklin wrote: "We view the new approach as a kinder and gentler forestry that better accommodates ecological values, while allowing for the extraction of commodities." Franklin saw New Forestry as a possible answer to the rapidly escalating furor over the Pacific Northwest's old-growth forests—an alternative to what he called the "lock-it-up or mow-it-down" perspectives.

Not surprisingly, many roadblocks impeded the implementation of New Forestry, foremost the resistance from the timber industry and its supporters within forest-management agencies. New Forestry's environmental bent would have put a damper on the booming 1980s, particularly on the record-breaking harvests taking place on public lands. Timber operators especially despised leaving valuable trees behind for green-tree retention or coarse woody debris. One study indicated that on some sites, New Forestry techniques would keep 15-25 percent of the potential timber volume from going down the road to the mill.

Art McKee, director of the H.J. Andrews, told me about a timber company owner who came along on a tour that McKee led a couple of years ago. When they looked over Slim Scout, the owner began to fume about the "waste," gesturing at the green trees that had been felled and left on the ground to create CWD. "There's a Cadillac!" he said, pointing to one big log. "And that one's a Lincoln Continental," he said, pointing to another log. He wrapped up his tirade by saying that one day there would be trials like the Nazi war-crime trials at Nürnberg and that Lynn Burditt, the Blue River district ranger and therefore the overseer of Slim Scout, would be one of those on trial for "crimes against society."

Many conservationists also resisted New Forestry, though they embraced its environmental sensitivity and many of its specific practices. Most of the conservation community considered New Forestry too experimental for immediate wholesale use. Most New Foresters agreed that much uncertainty existed. "We have a lot to learn," said Franklin. "And we need to test some of what we think we know." Expressing a sentiment common among forest scientists, he added, "If we don't learn anything else, we need to learn humility."

A look at the numbers graphically reveals that uncertainty. Why does the logging contract call for leaving eight green trees per acre at Slim Scout? Why not seven or nine or two or twenty? Why a CWD requirement of "an average of 15 logs per acre . . . of which two must be at least 75% firm" and that "Logs must be at least 16 inches in diameter on the small end and 20 feet in length"? Dave Perry, an ecosystem scientist with the Andrews Group and an authority on coarse woody debris, helped set the CWD standards for the Blue River Ranger District, where Slim Scout is located. I recently asked him how he and his colleagues came up with those CWD numbers. He gave a wry smile and shook his head. "You pull numbers out of the air." Because there currently isn't enough empirical evidence to support any particular standard, Perry and about a dozen other scientists spent a day tramping around

the district, offering their best scientific opinions and their "comfort levels" regarding various CWD prescriptions. "How good that is is anybody's guess," says Perry. "My comfort level or any other scientist's comfort level is not the relevant issue. The relevant issue is what is the comfort level of the species that require [CWD] and the processes that go with them. We have lousy information about that, just lousy."

Stifling his scientist's distaste for managing with insufficient data, Perry acknowledged that his and the other scientists' comfort levels weren't entirely baseless, and that Blue River's CWD standards probably will do a fair amount of good for a fair number of organisms. And the efficacy of those standards likely was improved when researchers later looked at CWD levels in natural forests and adjusted the Blue River standards accordingly. But Perry and other scientists warn of the urgent need for detailed information on the ways in which particular species are affected by particular management standards. Mark Harmon, an Andrews researcher and authority on CWD, says, "Until we do long-term studies, we'll be flying by the seat of our pants." Yet fly we must; as Jerry Franklin points out, the paucity of data "is not an argument to do familiar things that aren't achieving our objectives."

Even more than they feared the uncertainty of New Forestry, conservationists feared its misuse. Sure enough, some timber operators left a couple of trees per acre on otherwise sheared old-growth sites and called it New Forestry. More insidious, some timber companies and agency staff used New Forestry to rationalize logging in critical old-growth and roadless areas, despite the assertions by many New Foresters that using kinder and gentler methods didn't preclude the need for plenty of old-growth reserves and a substantial reduction in timber harvest levels.

The spotty adoption of New Forestry methods didn't greatly impress the conservation community. Nor did it sufficiently impress federal district court Judge William Dwyer; the Northwest forest issue soon landed in his Seattle courtroom. As implemented, New Forestry had been too little, too late. In 1991, Dwyer issued the famous injunction that brought logging in the owl forests to a virtual halt. Management of the forests remained mired in Judge Dwyer's courtroom until June 1994. That's when ecosystem management—as much as the FEMAT report and President Clinton's Northwest Forest Plan can be said to be EM—finally got the injunction lifted.

So, doesn't that bring us right back to where we started, wondering what ecosystem management is? No. Don't forget truffles and squirrels and owls. Logging according to a wildfire's blueprint. Thinking at a landscape level. Long-term planning. And you can't have forgotten about coarse woody debris. Such things constitute much of forest ecosystem management and go a long way toward defining it today. However, they alone don't go far enough to change the unifying premise that ultimately guides on-the-ground decisions.

Take Slim Scout. Here, despite the laudable efforts to preserve some ecosystem benefits, commercial logging was the hub around which all management actions revolved. Slim Scout still fits within the unifying premise of industrial forestry: timber comes first; all other values, from watershed to wilderness, come after. Slim Scout's planners

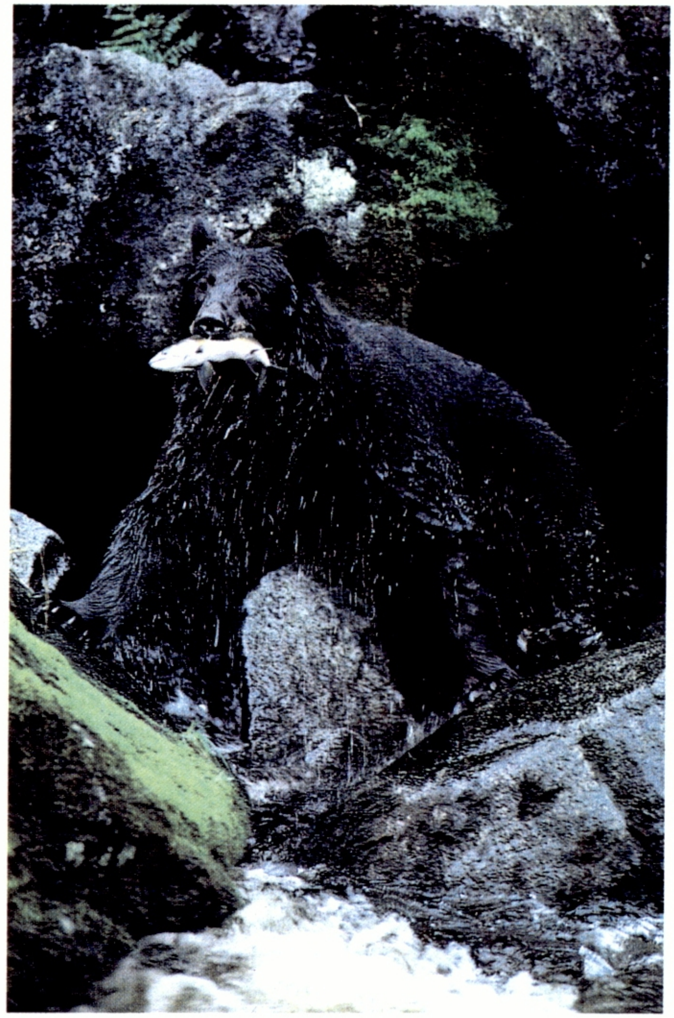
*Diversity, large, small, and shrouded: Directly right, a black bear plucks a salmon from a tumbling Pacific Northwest stream; below, a Douglas squirrel carries off a spruce cone; on the opposite page, the landscape in a stand of old-growth hemlock and Douglas fir in Olympic National Forest is muffled in a luxurious mat of greenery. EM, Forest Service Chief Jack Ward Thomas says, "would identify forest sustainability...as the foremost goal of national forest management."*

BELOW LEFT: SCOTT PRICE; BELOW RIGHT: TOM & PAT LEESON; OPPOSITE: TERRY DONNELLY

considered **how** to extract timber, but the constraints imposed by timber targets didn't allow them to consider *whether* to extract timber.

By most definitions, ecosystem management fundamentally would alter the unifying premise of forestry. EM would put the well-being of the ecosystem first; all other values, including timber harvest, would come after, because all those other values depend on a healthy forest. The "forest first" position is explicitly stated in a publication from the Cascade Center for Ecosystem Management, a new joint venture of the Forest Service and Oregon State researchers associated with the Andrews: under EM, "...the products taken from the system [are] an important but secondary objective...." Most of the thirty-three authors cited by Grumbine in his overview of the ecosystem management literature consider "ecosystem integrity" as primary.

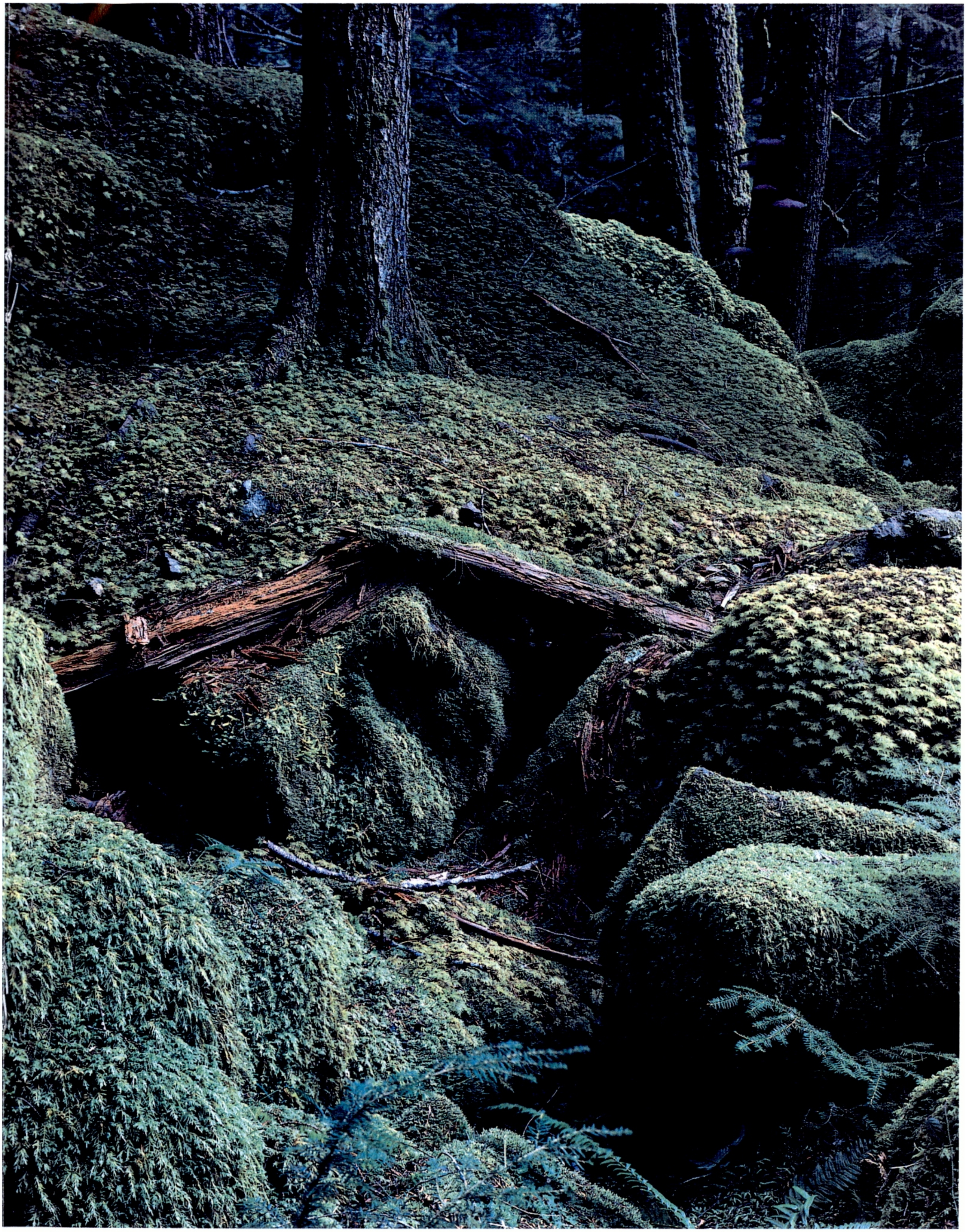
Even the definition from David Unger, associate chief of the Forest Service, implicitly made ecosystem well-being the top priority when he stated that benefits will flow "in a manner harmonious with ecosystem sustainability." Ergo, benefits that aren't harmonious won't flow. And Jack Ward Thomas indicated the primacy of the ecosystem in his first speech as chief when he said that ecosystem management "would identify forest sustainability...as the foremost goal of national forest management, and use the conservation of biodiversity as the mechanism to that end."



If the well-being of forests does become the overarching goal, then the forest debate gradually will rise above the current zero-sum tug-of-war over who gets a bigger piece of the pie—owls or loggers. Arguments will shift to questions such as what constitutes well-being and how various management practices affect it—a giant step forward from a conservationist's viewpoint. Putting forest health first also would shift the burden of proof, a change that Forest Service scientists David Brooks and Gordon Grant consider as important as the move away from timber production. Increasingly, they write, "advocates of intensive forestry must prove these practices are benign, while in the past, critics were forced to prove them harmful (to wildlife, for example)."

The FEMAT report and its descendant, the Clinton Northwest Forest Plan, provide the most notorious and perhaps most influential example of EM in action. Many portions of the Clinton Plan show ecosystem management at its best, from reasonable provisions for such commonly overlooked species as mycorrhizal fungi to an admirable attempt to take a long-term perspective. A document produced by The Wilderness Society and endorsed by other environmental organizations termed the draft plan "a major step toward an ecologically sound blueprint for Northwest forests."

"But" was the next word in that document, of course. However, though environmentalists also found much to



*Below, a "new forestry" cut in the Andrews forest provides a telling contrast to the bleak clearcut seen on page 17. At the bottom of the page, a downed log in the Andrews sports a collection of flags and markers in a decomposition study. It can take as long as five hundred years for a big Douglas fir log to fully decompose, and along the way it preserves water, provides a place for new trees to sprout, and serves as miniature habitat for an extraordinary variety of plant and animal life.*

BOTH: ROBERT DEVINE

Fred Swanson showed me a gallery of maps fashioned from remote sensing imagery. "We have a map of ownership and we have a map of current stand conditions," said Swanson, "and there's a change map—who's cut what, when and where. It's dynamite." Swanson was right. The green representing old growth was confined almost entirely to a narrow swath of public lands at higher elevations in the Cascades. Red, tan, and yellow representing recent clearcuts and managed plantations, dominated the vast low-elevation private forests to the west, which washed up into the Cascades like a great tide.

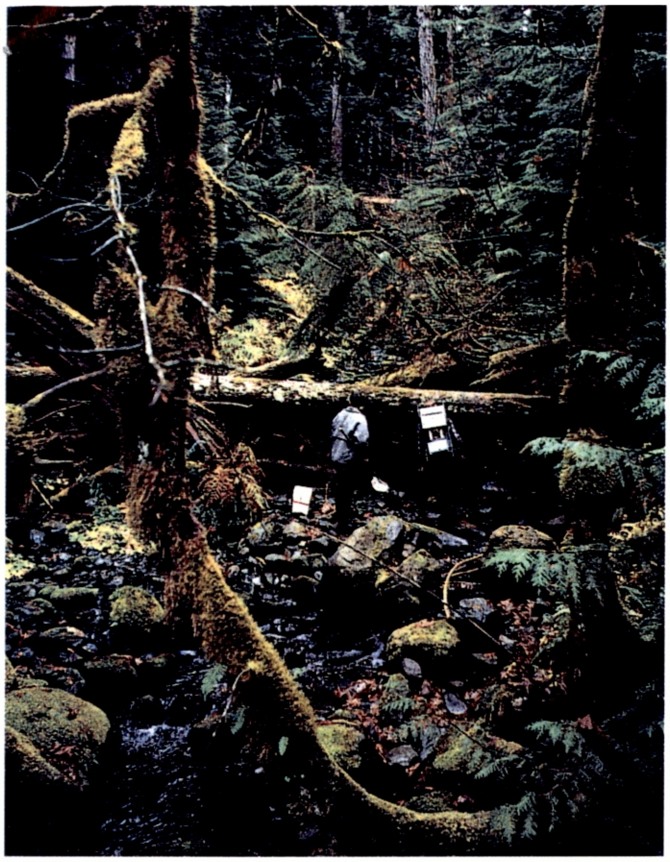
Wide-ranging old-growth species certainly can't ignore the fact that their already shrunken and fragmented public-forest haunts are adrift in a sea of non-federal lands virtually devoid of ancient forests. Well aware that overlooking more than half the landscape is blatantly unscientific, many FEMAT scientists on the species-viability panels took it upon themselves to include non-federal lands in their analyses. A few panels did separate viability ratings, one taking only federal lands into account, one looking at the entire landscape. The contrasts were stark. For example, the odds that the Clinton Plan would protect a viable popula-

criticize in the plan, disenchantment with it shouldn't lead to disenchantment with the potential of ecosystem management. The major problems crop up when the plan deviates from the basic tenets of EM.

Most of the plan's flaws stem from the contaminating influence of implicit timber targets. The Clinton administration wanted to get at least a billion board feet of timber a year out of the owl forests. Though this figure constitutes a huge (80 percent) reduction in harvest levels, the existence of any *a priori* figure violates EM's "forest first" principle. And this violation is not just a theoretical concern. The FEMAT's species-viability analyses indicate that logging a billion board feet annually, virtually all of it from old growth, would significantly increase the risk of extinction for more than 400 species closely associated with ancient forests. Most of the specific complaints of environmentalists—salvage logging in old-growth reserves, logging on steep, unstable slopes—stem from ill-advised provisions that appear to have been shoe-horned into the plan in order to come up with that billion board feet.

Another egregious deviation from EM by the Clinton Plan resulted from a fear of antagonizing private-property owners. FEMAT planners were told to look only at public lands. Non-federal lands, most of them private, were left out of the equation. Considering that non-federal lands constitute 58 percent of the owl's range, ignoring them in the Clinton Plan is like playing the piano without using the white keys.

Had all lands been included in the Clinton Plan's species-viability analyses, the numbers estimating the likelihood of maintaining "well-distributed, stabilized populations" of some old-growth inhabitants would have plummeted. Why? The answer was vividly apparent when



*By offering shade and creating pools where gravel can collect and eggs can safely be laid, fallen logs are as important to stream ecology and anadromous fish as they are to the nurturing of soils and forest regrowth. At left, a fish survey under way.*
ROBERT DEVINE

tion of coho salmon over the course of 100 years nose-dived from 65 to 13 percent when non-federal lands were included.

FEMAT's disregard for the condition of non-federal lands is a central point—Mike Anderson calls it "the fundamental flaw"—in the lawsuit challenging the Clinton Plan filed in May 1994 by eleven environmental groups, including The Wilderness Society. (Just because the plan met the conditions necessary to escape the injunction doesn't make it legal.)

Urging caution, the lawsuit also criticizes the uncertainty that shrouds much of the plan. As with New Forestry, many elements of ecosystem management are based on the incomplete or the unknown. Further research and a great deal more monitoring of results are needed, but foresters have to do something in the meantime. As George Brown, dean of the Oregon State School of Forestry, said, "We can't just say 'sorry, good science takes time, come back in twenty years'." Adds Stan Gregory, "Anything we'd do with the information we have would be light years ahead of what's being done now."

Some scientists think they have what is at least an interim answer to uncertainty. To complement what is known about maintaining species and processes, these researchers advocate the use of the "range of natural variability" to guide forest management. In pursuit of this concept, forest scientists have spent years crawling around the 19,000-acre Augusta Creek watershed in the Blue River Ranger District, eyeing ancient stumps for blackened tree rings, scanning aerial photos for evidence of fire and mudslide patterns, and searching riparian zones for signs of bygone floods. These scientists have pieced together a rough image of the historic patterns of vegetation and disturbance that shaped this watershed—patterns to which species have adapted.

Proponents of natural variability think that some logging can take place without unduly degrading the ecosystem if managers take their cues from the historic patterns—an extension of New Forestry's imitation of nature. For example, large, moderate-to-high-intensity fires typically hit the east-facing section of the Augusta watershed's Loon Creek Basin every 160-240 years. They left behind a jumble of young, mature, and old-growth patches of a certain species mix. If timber operators log the Loon Creek Basin every 200 years in a way that leaves a similar pattern of trees, then replant with a similar mix of species, presumably the organisms adapted to this circumstance will survive. Though the past would guide the present, scientists stress the word *guide*—they are not aiming at the impossible goal of returning the forest to some idealized pre-European state. Besides, ecosystems are irrepressibly dynamic and will never remain static.

At the watershed level, planners must strive to keep the entire 19,000-acre area within its natural range of variability, particularly in terms of forest age-classes. The Augusta Creek watershed, for instance, historically consisted of from 40 to 70 percent old growth, depending on where it was in the fire cycle. Researchers figure that old-growth-dependent species will fare well if managers log the watershed at a rate that keeps the watershed's percentage of old growth in that range.

Along with the considerable promise of natural variability come considerable problems. For one thing, accurately determining the natural range is difficult. For another, managers tend to manage to the minimum, leaving ecosystems vulnerable to the unforeseen. Dave Perry, the Andrews forest ecologist, worries about the fanciful interpretations of natural variability that are being tossed around: "There's a lot of loose bullshit going down out there right now that needs to be stopped." He adds, "A lot of managers don't have a clear understanding of the scales that they need to address, so they're using historic variability in a knee-jerk fashion, and in many cases they're getting it wrong."

He's especially fearful that managers will neglect the landscape scale and succumb to the temptations of the deceptively simple arithmetic: if a 10,000-acre watershed is 90 percent old growth, and historically that percentage dipped as low as 40 percent, then 50 percent of the big trees can be cut without causing harm, right? Well, maybe, if a million acres of pristine ancient forest surround those 10,000 acres. But almost all old-growth blocks are oases encircled by cut-over lands. When viewed as part of the larger landscape, those 10,000 acres most likely would be a rarity that rates total protection.

When one applies natural variability at the scale EM counsels, the conclusion is striking. "These species need regional levels of habitat to maintain viable populations," *A fallen redwood log decomposes wetly at Hidden Beach on the shores of Redwood National Park, California. Below, a hiker takes the measure of a pair of living Douglas firs in Mt. Rainier National Park, Washington.*

BELOW: CARR CLIFTON; RIGHT: DAVE SCHIEFELBEIN

says Perry. "We've got a region that historically had 60 to 70 percent old growth, and now it has 10 to 15 percent. The historic range of variability is pretty clear. If you apply the concept correctly, you don't cut another stick of old growth."

Other than to underscore what conservationists intuit—that, from a strictly environmental point of view, all remaining natural forests should be protected—ecosystem management would seem to be of little use until our forests have recovered sufficiently to bear substantial logging, which will take at least decades. But EM does have many vital roles to play in the present. For one thing, EM principles can guide restoration; for example, CWD is being returned to many forest creeks. For another, society may choose to log some old growth despite the environmental price in order to keep certain people and communities afloat. In that case, EM can provide the least harmful harvest strategy. Perhaps most important, ecosystem management can make clear how high that environmental price could be. Fred Swanson's thought on natural variability applies to EM generally: "It can be used as a reference point for asking what we might lose in an ecological sense if we deviate from it." Perhaps we'll pay attention to the lessons of EM and avoid such dire tradeoffs in the future.

But EM's main short-term use would be in what the Clinton Plan calls the "matrix": the lands outside the reserves that are to be the main source of timber. (Non-federal lands need to be part of the definition, naturally.) Apart from the million-plus acres of old growth inappropriately included as matrix under the president's plan, the matrix consists of plantations, most of them under 50 years old. The conservation potential of the matrix has been grossly neglected, even by most environmentalists, who have been absorbed in the old-growth debate. Often they recognize the importance of the matrix only as a link between old-growth reserves. Yet the matrix (the real matrix, including non-federal lands) comprises some 85-90 percent of the forested landscape and almost all of the low-elevation forests, which are the most biologically diverse and productive. Jerry Franklin writes, "Reserves cannot be the only or even, perhaps, the primary strategy for maintaining biological diversity." The FEMAT report concurs, estimating that more than 400 owl-forest species would be at significant risk even if no more old growth were cut.

The New Forestry precepts imbedded in EM indicate that a managed forest can retain a significant amount of its ecological value if it's logged wisely. Dave Perry repre-

sents many forest scientists when he discusses what he would do in the matrix if he were king. He talks about devising an overall plan that places managed stands within the context of a larger landscape, about thinning densely stocked young stands to accelerate the growth of much-needed big trees and to open up the understory so that sun-loving plants and animals can prosper, about creating a mosaic of differently thinned stands, about using helicopters instead of building roads, about putting existing roads to bed for 50 years between thinnings, about extending rotation ages to 125, 150, or even 200 years—about, in short, "fixing what we've done."

Perry's approach, plus New Forestry silvicultural techniques, could mimic young natural forests well enough to serve many organisms. Studies indicate that young natural forests harbor almost as much biodiversity as old-growth forests, though not necessarily the most imperiled species. Compared with natural forest, how much ecological value could be derived from the matrix? Mindful of his earlier comments on the uncertainty of coarse woody debris standards, Perry smiles and says "about fifty percent."

Uncertainty again. No doubt a degree of uncertainty is a permanent condition of EM, but the condition should ease as EM comes of age during the next few years. So should our uncertainty as to whether EM marks a historic and positive turning point in American forest management. I keep thinking back to what that forester at the Andrews said as he swigged his beer: "Ecosystem management can be anything that anyone wants it to be." Meant as a statement of confusion, his words also contain great hope.

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