New Thinking on Old Growth

The forests of the Northwest still hold surprises for ecologists, but the old stands are going fast; will the spotted owl save the day? And if we cut ours, why can't Brazil cut theirs?

Portland, Oregon

THE QUESTION OF WHAT TO DO about the last, vast, remaining stands of ancient forest in the Pacific Northwest has incited tremendous emotion. The issue has become so polarized that at a recent scientific conference on old-growth habitat*, a small army of security guards was on the lookout for intruders rumored to be planning a disruption of the proceedings. Scientists were asked to watch over the poster sessions, for fear that some eco-terrorist might spray-paint environmental slogans upon the data sets.

Douglas fir: *an old-growth stand in Olympic National Park. In the foreground, a branch droops under the weight of bearded moss.*

Indeed, while the conference was in session, members of the activist group Earth First! piled boulders in the paths of loggers to keep them and their equipment from an old-growth stand in nearby Willamette National Forest in Oregon. The loggers cut down the trees anyway.

The lumberjacks are equally adamant about preserving a way of life they say is being sacrificed in order to maintain a viable population of owls that are dependent upon old-growth timber. To the loggers and small mill operators, it is a case of jobs versus owls. In the logging town of Forks on the Olympic Peninsula in Washington, trucks sport bumper stickers that read: "Save a logger—kill a spotted owl!"

Until now, much of the debate over the fate of the old-growth forests has centered on the northern spotted owl. But the owl is largely symbolic of the larger fight to save the old-growth forests. Coveted by the timber industry, the ancient forests of the Northwest are being harvested at unprecedented rates. What remains is largely restricted to federal and state land. The rest is gone.

To protect the owl, the forest service has proposed taking 374,000 acres of national forest out of timber production, a set-aside that would reduce available timber supply by 5% and would result in the loss of about 3000 jobs, according to the forest service. The service hopes that this set-aside, in addition to other acreage such as wilderness areas, will support about 1300 pairs of owls. For how long, no one is certain.

In June, a federal judge in Seattle will decide whether or not the forest service plan gives the spotted owl too little habitat, as the conservationists contend, or too much, as the timber industry argues. Another suit involving forest operated by the Bureau of Land Management will be heard this month in Portland. Still another legal action is pressing the U.S. Fish and Wildlife to list the owl as threatened or endangered.

Ecologists and foresters concerned about the current rate of domestic deforestation point out that the old-growth forests store enormous amounts of carbon. The temperate rain forests of the Northwest harbor more biomass than tropical rain forests of Brazil. Indeed, some ecologists are suggesting the regeneration of old-growth stands may serve as a partial hedge against the accumulation of carbon dioxide in the atmosphere, one of the main gases responsible for the greenhouse effect and the global warming predicted by its accumulation.

Perhaps it is ironic, the ecologists suggest, that the United States is telling Brazil not to cut down the Amazon Basin while the United States takes such a big ax to its own ancient forests.

The U.S. Forest Service, in collaboration with several universities, has attempted to broaden the debate over the old-growth forests by identifying other communities of vertebrates that depend on the forests. The $2-million project employed some 200 field biologists, who spent several years slogging around in the rain, listening for birds, hunting for truffles and other fungi, and searching out a number of secretive small mammals, salamanders, snakes, and bats. One could imagine how happy all this made the timber industry.

In the end, the research results released at the conference produced some surprises and challenged dogma on old-growth forests. It also built upon the descriptive work of ecologists who have been slowly characterizing old-growth forests for the past 20 years.

The forests that generate so much passion grow on the west side of the Cascade Mountains in Washington, Oregon, and northern California. There is great variety among the stands, depending on elevation and precipitation, but the dominant species are generally Douglas fir or Sitka spruce, with a mix of hemlock, alder, and cedar. Some stands, such as those on Washington's Olympic Peninsula, are truly temperate rain forests, with an annual rainfall that reaches 160 inches a year. Other stands are far more dry, and fire has played a dominant role in creating, maintaining, and destroying the old-growth forests.

Perhaps surprising, these forests are not so old on an evolutionary time scale. By examining pollen grains found in the sediment of lakes and bogs, Linda Brubaker, a forest ecologist at the University of Washington, has found that during the North American glaciation, the site of today's old-growth forests were dominated by tundra parklands and open forest. It was not until

*Old-Growth Douglas-fir Forests: Wildlife Communities and Habitat Relationships, 29 to 31 March, Portland, Oregon. Sponsored by the Pacific Northwest Research Station, USDA Forest Service, and the College of Forest Resources, University of Washington.

6000 years ago that the Douglas fir forests became established.

According to Brubaker, "the forests may not represent a coevolved complex of species bound together by tightly linked and balanced interactions." She adds: "We don't know where they existed and even if they existed more than 6000 years ago."

Says Len Ruggiero, director of the old-growth wildlife program at the U.S. Forest Service: "They're ecological toddlers."

When white settlers arrived in the region in the last century, there were probably 19 million acres of old-growth forest. What proportion remains is a hotly debated figure, mostly because the definition of "old growth" has been a moving target. Maybe it is a bit like pornography: you know when you see it. "How much old growth is there?" asks Bruce Marcot, a wildlife ecologist at the Mount Hood and Gifford Pinchot National Forests in Oregon and Washington. "It depends on who you ask."

The forest service estimates that about 6 million acres of old growth survive on public land in the three Northwest states. Others think the true figure may be half that. In an analysis accepted by nonpartisan scientists, Peter Morrison, a forest ecologist with the Wilderness Society in Seattle, found only 1.1 million acres of old growth in 6 of the 13 national forests that support ancient stands. The forest service has maintained that there are about 2.5 million acres in the same six national forests.

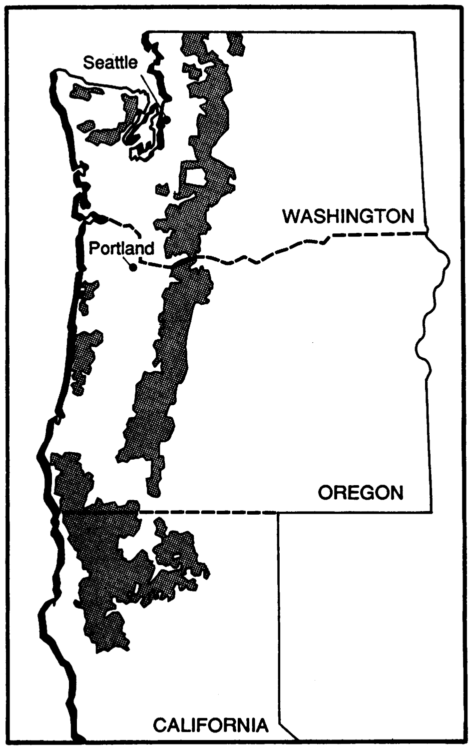
It is relatively easy to identify what Morrison calls "classic old growth," or the "green Cathedrals" printed on the postcards and in the nature magazines. These forests are older than 250 years, with big trees, big downed logs, and big standing snags. Some trees survive 1000 years or longer, and reach heights of 300 feet and diameters of 6 feet. In such late succession forests, there is also a healthy understory, a mixed and layered canopy, and light-filled gaps where shade-tolerant trees such as the western hemlock get their place in the sun, or what amounts to sun in the rainy Northwest. Another feature is the abundance of ferns, moss, lichens, and other epiphytic plants. Of particular interest is the lichen *Lobaria oregana*, which grows in the canopies and fixes nitrogen for the forest.

Jerry Franklin, a forest ecologist with the University of Washington and the U.S. Forest Service, believes an exact figure for the amount of remaining old-growth may elude researchers. "We've gone about as far as we can go with these definitions," says Franklin. "The forests are too variable and we're trying to pigeonhole stands when the process is a continuum."

Both Franklin and Morrison, however, say that the real amount of viable old growth is further blurred by the increasing fragmentation and isolation of the stands. In the Northwest, the forest service sells its lumber in lots, which over time give the landscape a checkerboard quality. Until recently, the forest service pointed to patch-cutting as a very beneficial strategy, because game animals thrive in such a landscape. However, since passage of the National Forest Management Act of 1976, the forest service is required to maintain not only viable populations of elk and deer, but all vertebrate species, including red tree voles, western salamanders, northern flying squirrels, and spotted owls. Hence, the current crop of lawsuits about how much habitat the spotted owl needs to maintain itself.

This fragmentation of habitat causes a number of problems. Not only does it cause a species to become genetically isolated, but a fragmented pattern may also make dispersal more difficult. Many small mammals may have an unpleasant journey as they run for their lives from one section of old growth to another. Some stands of old forest are nothing more than islands in a sea of clearcut terrain.

Another problem with fragmentation has to do with edge effects. Franklin and his



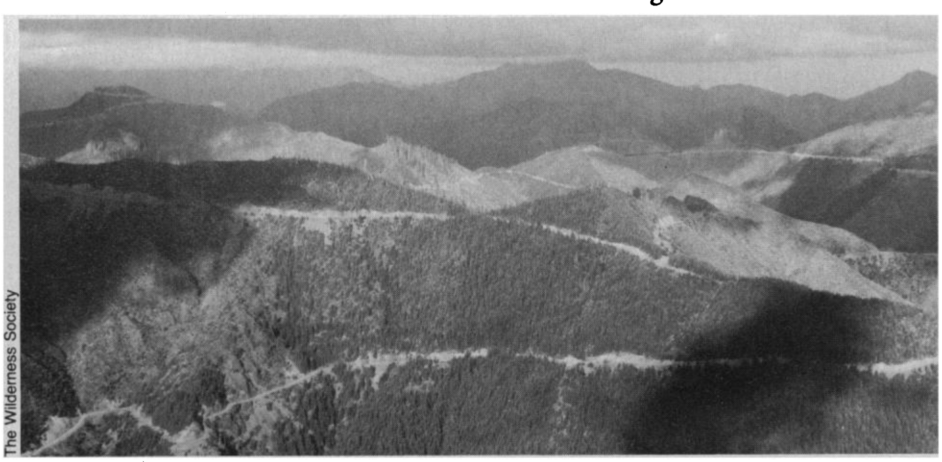
National forests: *shaded area shows where last remnants of old growth occur.*

colleagues estimate that the edge effect penetrates a distance of two tree lengths, or some 500 feet, into the forest. The edge attracts pests and parasites, who invade the residual forest. Seed dispersal patterns are also disturbed. Wind uproots the trees along the edge. Fires from slash burns or natural sources also impact the old growth, which in its natural state is more resistant to fire. Perhaps most important, the edge disturbs the microclimate that is regulated by the forests.

According to John Lehmkuhl, a wildlife biologist at the forest service Pacific Northwest Research Station in Olympia, "There are some tentative indications that fragmentation may be approaching a critical level for the viability of species associated with late-successional forests."

The Portland conference identified a number of species that appear to be strongly associated with old growth, or that reach their greatest numbers in primeval forest. Whether or not this means the species are completely "dependent" on old growth is uncertain. A big surprise was that relatively few vertebrates appear to be associated only with old growth. Most species were also found in young and mature forests as well.

There were some exceptions. Vaux's swift, which nests in colonies of up to 30 individuals and needs large standing dead trees, appeared to be largely dependent on old-growth forests. The secretive red tree vole, which lives in the canopies of the aging



Patched habitat: *the forest service sells its timber in lots, which are then clear-cut in patches.*

Douglas fir and eats its pine needles, was another, as was the flying squirrel, who with the tree vole, is a favored prey item of spotted owls. The Pacific yew, whose bark is currently being tested as an anticancer drug by the National Institutes of Health, is a shade-tolerant tree very closely associated with old growth.

"But in general there are far fewer species dependent on old growth than conventional wisdom suggested," says Ruggiero. "We're not seeing the dramatic differences we expected."

One problem with the research program was that the wildlife biologists looked only at young, mature, and old-growth forests that were "natural." They did not compare the relative robustness of species diversity in managed and natural forests. Most forest ecologists suspect that the managed stands, with their evenly spaced rows of same-age Douglas fir, will prove to be barren habitats.

The recent research suggests that what is important to many species is not the age of the stand, but its structural components. Many species were strongly associated in all ages of forest with coarse woody debris, downed logs, and dead standing snags. "In the natural forest, structural complexity is maintained throughout the succession from young forest to old growth," says Ruggiero. "So in a sense, old-growth structures, like downed wood and snags, permeate the natural system. It's really kind of a 'Eureka!' It may not be so much the age of forest, but its components."

Proponents of the so-called "New Forestry" are asking that the federal caretakers of the national forests use the recent research findings to attempt to mimic some of the complexity of the natural forests in their managed stands.

During the conference, there were numerous suggestions. When an area is harvested, many biologists recommended that clusters of green trees be allowed to survive, as these trees will slowly age with the young stand and provide dead snags and rotting logs in the future. Says Franklin: "Decadence in moderation is probably a very useful thing."

The biologists also suggested leaving downed logs in the clearcuts, since this rotting wood serves as a nursery for many tree seedlings that cannot compete with the herbs and forbs of the forest floor. Franklin also wants to see some downed wood allowed to collect in the streams, thereby providing habitats for organisms that live in the riparian world.

Asks Franklin of his peers: "Are we going to develop a new way to do forestry or are we going to be technicians tending a long-growth row crop on a dwindling amount of land?" ■ WILLIAM BOOTH

Confirmations Heat Up Cold Fusion Prospects

Researchers are having fun trying to reproduce a report of room-temperature fusion, and even more fun trying to explain it

THREE WEEKS AFTER the highly publicized claim of a revolutionary fusion discovery, reports of confirmation are beginning to appear. One of the most convincing came on Monday this week, when scientists at the Texas A&M University System reported heat production from simple electrochemical cells similar to the ones that were used in the original experiment. However, even if the heat production is shown to be real, the question remains of whether it is actually fusion that is producing the heat, or something else, perhaps some unknown chemical reaction. If it is indeed fusion, it is proceeding by a path that is completely mysterious.

On 24 March, electrochemists Stanley Pons of the University of Utah and Martin Fleischmann of the University of Southampton started the current furor when they told a press conference they had done the seemingly impossible—created a sustained fusion reaction at room temperature with very modest equipment. Their setup consisted of a palladium and a platinum electrode immersed in heavy water (water in which hydrogen is replaced with deuterium, a hydrogen isotope with one proton and one neutron). When a current was passed between the electrodes, deuterium was absorbed into the palladium electrode and there, the scientists said, it underwent fusion, producing heat as well as a small number of neutrons.

The claim that the experiment produced neutrons—an expected byproduct of deuterium fusion—was quickly confirmed by Steven Jones at Brigham Young University. He announced that in independent experiments very similar to that of Pons and Fleischmann, he had seen neutrons of the expected energy. (For details of the somewhat heated rivalry between the two groups, see last week's *Science*, p. 27.) Little more than a week later, two physicists at Kossuth University in Hungary reported they too had observed neutron production.

This Monday, Kenneth Marsh, Bruce Gammon, and Charles Martin offered a confirmation of Pons and Fleischmann's heat production. Marsh and Gammon are director and associate director of the Thermodynamics Research Center at the Texas Engineering Experiment Station, and Martin is a professor of chemistry at Texas A&M. Marsh said that calorimetric measurements showed their fusion cell, modeled after the ones at the University of Utah, had a heat output 1.6 to 1.8 times that of the electrical input going into the cell. That output-to-input ratio is well below the 10-to-1 that Pons has reported, but the palladium electrode used in the Texas A&M experiment was much smaller than the Utah researchers used, and Pons has said the size of the electrode can affect the heat output. The Texas A&M group has not yet tried to detect neutrons.

The Texas researchers were careful not to say that they have shown fusion is taking place in the cell, only that they are getting a positive heat production. Assuming that both the neutron and heat measurements are correct, the question remains: What is going on in these cells?

The presence of neutrons indicates that at least some deuterium fusion is taking place. If so, theorists must describe how fusion can proceed in palladium electrodes at room temperature when fusing two deuterium atoms normally requires tremendous heat and pressure. A second question is why the heat measured from the Utah cells is a billion times what is expected by the number of neutrons detected. If it is fusion and not some unknown chemical reaction generating the heat, then scientists must specify what type of fusion reaction could be producing so few neutrons.

Walling's hypothesized mechanism would be a nearly perfect way to do fusion.

Peter McIntyre, a physicist at Texas A&M University, suggested that the answer to the first question might hinge on the role electrons play in bringing deuterium nuclei together. Inside the palladium electrode, electrons can behave as if they are much heavier