Research Natural Areas and Protecting Old-Growth Forests on Federal Lands in Western Oregon and Washington

•

Sarah Greene

Forestry Sciences Laboratory
Pacific Northwest Research Station
USDA Forest Service
Corvallis, Oregon 97331

•

ABSTRACT: Research natural areas in the Pacific Northwest have played a role in protecting old-growth forest ecosystems since the establishment of the Metolius Research Natural Area in 1931. Recent concerns about remaining old growth have led to an attempt to define old growth and to determine the extent of old-growth acreage. Research natural areas are discussed in the context of the old-growth definition, how well they actually protect existing old growth, and whether they can continue to play a useful role. Suggestions for managing old-growth research natural areas include integrating them into the surrounding landscape, doing a better job of protecting edges, and having on-site natural area professionals deal with management.

INTRODUCTION

Research natural areas (RNA's) have played a role in protecting old-growth forest ecosystems on federal lands in the Pacific Northwest since the establishment of the Metolius Research Natural Area in 1931. During the 1970's the realization that old-growth forests in the Pacific Northwest were being depleted at an increasingly rapid rate and that few scientific data were available on their structure and function made the issue of old growth a national as well as a regional issue. Whether RNA's are continuing to play an important role in the protection of old growth and whether they are being managed to maintain viability of the old-growth ecosystems are important issues for resource managers and conservationists.

To look at these issues requires, first, an acceptable definition of old growth. Agreeing on a definition in a region with diverse land ownership and diverse forest types is difficult. Old growth in ponderosa pine (*Pinus ponderosa*) or lodgepole pine (*P. contorta*) forests differs considerably from old growth in Douglas-fir-western hemlock (*Pseudotsuga menziesii-Tsuga heterophylla*) forests. Determining how much old growth exists also depends on the definition. Calculating the extent of remaining old growth, even if a definition is formulated, is complicated by the use of differing mapping techniques, reliability of data, and projected land use as maturing forests acquire status as old growth.

Although I originally intended to review the status of old growth in RNA's throughout the Pacific Northwest, finding a uniform definition of old growth and determining the old-growth inventory was so difficult that I decided to focus on the RNA's that occur in five geographic provinces in western Oregon and Washington: Olympic Peninsula, Washington Cascades, Oregon Cascades, Siskiyou Mountains, and Oregon Coast Range (Dyrness et al. 1975). Most of the remaining old-growth forests and most of the U. S. Forest Service and Bureau of Land Management effort to define old growth, at least in the Pacific Northwest, occur in these geographic provinces.

Old growth as it relates to forest ecosystems in the Cascades is defined for this paper, followed by a discussion of differing federal agency old-growth definitions and projected inventory of old growth. Research natural areas will be viewed in the context of the definition, how well they actually protect existing old growth, and whether they can continue to play a useful role.

Identification of research natural areas in Oregon and Washington is based on a comprehensive list of ecosystems and organisms of critical scientific interest (Dyrness et al. 1975, Oregon Natural Heritage Advisory Council 1981, Washington Natural Heritage Program 1987). A systematic approach has been used to identify these ecosystems and organisms with major emphasis on representative types as opposed to unique types. Using scientific information from various relevant scientific disciplines as well as major academic institutions and land-managing agencies, efforts have been made to include within the RNA system all stages of succession, different age classes, and as many aquatic and terrestrial communities as have been currently identified. Where possible, the terrestrial communities are described beyond the series level to plant community or habitat type.

DEFINITION OF OLD GROWTH

Quite simply, old-growth forests are those that have developed over a long period in the absence of stand-replacing catastrophic disturbances. This description, though simple, tells little about age, size of stand, structure, function, or species composition. The first significant attempt to define old-growth characteristics for the Douglas-fir region appeared in a publication in 1981 (Franklin et al. 1981). Since then, interim definitions for old-growth Douglas-fir and mixed-conifer forests have been developed (Old-Growth Definition Task Group 1986), and data are being gathered to form more objective characteristics. The stand characteristics in the interim definition include: (1) two or more tree species with a wide range in size and age, often including a long-lived seral dominant and shade-tolerant associate; (2) a deep multilayered canopy (except in the Siskiyous, where Douglas-fir should be emergent above an evergreen hardwood canopy); and (3) significant coarse woody debris, including snags and downed logs.

The interim definition lists sizes of trees, numbers of trees per acre, and tons of coarse woody debris per acre for each of the major forest series covered. The definition is based on minimal criteria rather than average values.

The interim definition does not include a minimum-size criterion because of inadequate knowledge of the patch size necessary to preserve these characteristics. Thirty-two ha (80 acres) is a commonly used patch size (Old-Growth Definition Task Group 1986) but, for reasons discussed further on, is probably much too small. The definitions also do not address species composition. The issue of which species depend on old growth for survival is unresolved. Much research is being done on this topic, but results and recommendations are not immediately available. Lastly, the definitions do not include all the different types of old growth at all the series-formation or plant-community levels. The definition also is applicable only to forests in western Oregon and Washington.

HOW MUCH OLD GROWTH REMAINS IN WESTERN OREGON AND WASHINGTON?

Old-growth forests are found mostly on federal land, in particular that in National Park Service, Bureau of Land Management (BLM), and U. S. Forest Service ownership. Most of the old growth is at higher elevations. Each of the agencies uses a different set of criteria for defining old growth; thus, information on acreage remaining is not always comparable or up-to-date. The National Park Service definition for old growth is stand age over 200 years (R. Hyra, pers. comm.). On this basis, 310,122 ha (766,311 acres) of old growth remain in North Cascades, Mt. Rainier, Olympic, and Crater Lake national parks. Information is not available on average patch size or degree of contiguity of these stands.

The BLM definition for old growth includes areas equal to or greater than 4 ha (10 acres) and trees greater than 200 years old (Spotted Owl Environmental Assessment 1987). Several 1983 district management plans defined old growth in terms similar to those of the Old-Growth Definition Task Group (1986), but the current figure uses the definition from the BLM Spotted Owl Environmental Assessment (1987). The BLM has five districts in western Oregon; BLM ownership in western Washington is so limited that it is not considered in this paper. In April 1987, 193,320 ha (477,694 acres) of unsold old growth remained, with a projected 173,348 ha (428,343 acres) remaining by 1990.

The definition used by the Pacific Northwest Region (R-6, Oregon and Washington) of the U. S. Forest Service includes most of the characteristics found in the Old-Growth Definition Task Group (1986) definition, though minimal criteria are different. Of interest is the statement that "optimum tract size will be related to the needs of dependent wildlife species, such as northern spotted owls or pileated woodpeckers, and the ability to insulate part of the stand from the edge effects in created openings."

There are eight national forests in western Oregon and Washington. The old-growth definitions that these forests use differ widely and do not follow necessarily the R-6 definition (United States Department of Agriculture 1984). Definitions range from forests 150 years old to forests that include many or all of the characteristics found in the Old-Growth Definition Task Group (1986) report. Minimum patch size for some forests is as small as 4 ha (10 acres).

The total old-growth U. S. Forest Service inventory, using these eight different definitions, is currently 1,354,420 ha (3,346,772 acres). At the end of the current ten-year planning cycle, old-growth inventory protected from future harvest in the eight national forests is projected to be 696,398 ha (1,720,799 acres) (or a reduction of 54 percent). This area includes old growth in wilderness areas, research natural areas, spotted owl habitat, and other set-aside areas.

Given the range of definitions, the current (summer 1987) total area of old growth for federal land in the five western Oregon and Washington geographic provinces is:

National Park Service	310,122 ha
Bureau of Land Management	193,320 ha
U. S. Forest Service	1,354,420 ha
Total	1,857,862 ha

The total figure represents 10 percent of the land ownership of the three agencies in Oregon and Washington. The figure also includes old growth in an unknown number of forest fragments, patches that are too small for old growth to remain viable.

OLD GROWTH IN RESEARCH NATURAL AREAS

Total research natural area hectares in the three federal agencies is 0.5 percent of their Oregon and Washington land ownership. Thirty RNA's on federal agency lands in western Oregon and Washington have old-growth forest ecosystems. These RNA's include 6944 ha (17,159 acres) (including a 110-ha [275-acre] RNA on U. S. Fish and Wildlife Service land) of old growth as defined by the Old-Growth Definition Task Group (1986). The old-growth areas in these RNA's range from 24 ha (59 acres) to 1024 ha (2530 acres). Total RNA area in old growth is 0.3 percent of the 1,857,862 ha (4,590,777 acres) of federally-owned old growth. The percentage is extremely small, so small the area might seem to have little importance in protecting old growth, although the RNA's do include other important ecological features such as endemic plant species, lava flows, a variety of wetland communities, a subalpine lake, and entire stream drainages. RNA's, though, must be viewed as one of several preservation options. The question, then, is whether RNA's are doing an adequate job of protecting the old growth included within their boundaries.

WHAT IS PROTECTED IN RNA OLD-GROWTH ECOSYSTEMS?

Five issues will be discussed in this section: representation at the series level, species composition, size, protectability, and research potential. More complicated issues, for example measuring diversity, could be discussed, but these basic issues need to be covered first.

Series Level

A series is an aggregation of plant associations with the same climax dominant or dominants. It is a broad classification and does not adequately describe all of the possible plant associations that might exist. Because not all federal land in western Oregon and Washington has been classified to plant association, the thirty RNA's can be discussed best by series. Most of the series in the five geographic provinces are represented by at least one RNA with old-growth forests. The Siskiyou province is the one exception. Four of the seven series in the Siskiyous are not represented in an RNA. One series in each geographic province has only one RNA. For all plant associations in these series to be represented in one RNA is highly unlikely.

Plant and Animal Reliance on Old-Growth Ecosystems

Surprisingly little information is available on old-growth-dependent species. Many species of vertebrates make primary use of old-growth forests for breeding, forage, bedding, cover, or a combination of these uses. The spotted owl (*Strix occidentalis*), threatened in Oregon and Washington but not federally listed, is the best known old-growth-dependent species; no consensus has been reached on the number of hectares a nesting pair requires. Only ten of the RNA's are over 400 ha (988 acres), which is probably the minimum area necessary for a pair of spotted owls (Dixon and Juelson 1987). The western big-eared bat (*Plecotus townsendi*) is the only state candidate species in Oregon that is old-growth dependent. Research natural areas in Oregon seem to be adequate to protect this species. The Washington Department of Wildlife lists two amphibians, seven birds, and four mammals believed to depend on old growth for at least part of their habitat needs (T.E. Owens, pers. comm.). No RNA in Washington is known to protect the fisher (*Martes pennanti*); all RNA's are believed to protect the three other mammal species. No reliable data is available for the two amphibians, and one RNA is thought to provide habitat for three of the seven birds. None of the RNA's in either state is big enough — if standing alone — to protect large predators. Other old-growth-dependent species, for example the marten (*Martes americana*), may be present; however, not enough data are available to understand the relations of many animals to old-growth forests.

No state or federally listed plant species in the five geographic provinces is known to be old-growth-dependent at this time.

Size

All but two of the RNA's are larger than 32 ha (80 acres). They all far surpass the 4-ha (10-acre) minimum found in some of the definitions listed above. Where this 4-ha minimum originated is unclear, but it is a figure used commonly by the BLM and the U. S. Forest Service. Four-ha of old growth is not enough to protect old-growth-dependent species, nor is it large enough to maintain the structural and functional characteristics of old growth.

Protectability

The question of size prompts another question: Can the old growth in these RNA's maintain its integrity? One way to find out is to look at the boundaries of the areas and see how they interact with adjacent land or how management of adjacent land affects the boundaries. Clearcuts touch the boundaries of twenty of the thirty RNA's. Nine of these areas have clearcuts on two or more sides. These clearcuts are as old as twenty years and as recent as one year. More clearcuts adjacent to the RNA's are planned for the future. Ten of the areas have clearcuts that expose the natural area boundaries to winter storm winds, thus increasing the potential for blowdown. One RNA has a conifer nursery on the boundary that exposes it also to the ravages of winter winds. One clearcut trespassed into the RNA; this was not a deliberate attempt to cut illegal timber, but it does illustrate how vulnerable even protected areas are.

Attempts have been made to buffer more recently established RNA's to protect them from outside management activities. Little hard data are available on how to establish adequate buffers. Only one of the thirty RNA's has a buffer; it is 75 m (246 feet) wide and lies outside the RNA boundary. The buffer could be entered for timber harvesting once adjacent clearcuts have regenerated. As management activities intensify around these areas, larger buffers would seem to be necessary, but like the core areas themselves, buffer lands are rapidly becoming scarce.

Roads are yet another product of land management that have detrimental effects on the integrity of RNA's. Sixteen RNA's have roads adjacent to their boundaries, while eight have roads along more than one side. Roads become vectors for introduced plant and animal pests; roads provide channels and canopy breaks that increase windthrow vulnerability. Roads that bisect steep slopes, such as those on three of the RNA's, can promote mass failure, erosion, and sedimentation in streams. Finally, roads make the areas more accessible to the public. While public use is not prohibited in RNA's, it can be if the use begins to compromise the values of the RNA. Unfortunately, once recreation patterns are established, they are difficult, if not impossible, to change.

Two of the thirty RNA's are included in recently established wilderness areas, though one of these is on the wilderness edge with a clearcut on the boundary. Two other RNA's are adjacent to wilderness and six, including the largest of the thirty, are within a national park. Presumably national parks and wilderness areas will provide extra protection to RNA's.

Land management practices are not the only events that create changes in RNA's. Two of the RNA's have been affected by the 1980 eruption of Mount St. Helens. Most natural catastrophic events are impossible to predict, and even if they were, protection measures, if desirable, are probably impossible. Nevertheless if a catastrophic event affects a natural area that is representative of a dwindling resource, it will be that much harder to replace.

Research Potential

Ecological and environmental research is one of the major objectives for establishing RNA's. As undisturbed examples of natural ecosystems, they serve as benchmarks for comparison with similar ecosystems influenced by man. As of 1986 there were more than 200 past and current research projects occurring, along with 500 related publications, on RNA's in Oregon and Washington (Greene et al. 1986). Eight of the thirty RNA's have served as research areas for studies on old growth: the role of coarse woody debris; vegetation classification of old-growth wildlife habitat; mammal and bird monitoring in old-growth wildlife habitat; and growth, yield, and mortality of old-growth forests, to name a few. Three of these RNA's are study sites for a regional U. S. Forest Service research project devoted to the study of old-growth forests.

DO RNA'S ADEQUATELY PROTECT OLD-GROWTH ECOSYSTEMS?

Federal agency definitions of old growth vary; each definition somewhat overlaps with others but with no uniformity. The problems of old-growth inventory are complicated but probably resolvable. Use of Geographic Information Systems and increased cooperation between land-managing agencies should produce a more accurate inventory. Nevertheless, old-growth acreage is dwindling (Dixon and Juelson 1987) and will continue to do so regardless of improvements in the inventory. Because old-growth acreage in RNA's is so small, RNA's can play only a partial role in protecting old growth — but that role is vital.

Establishing RNA's to be representative of series is not satisfactory. Because series are so broad, many plant associations are not included. Some of the missing series and plant associations probably can be found in wilderness areas or national parks; however, the missing series in the Siskiyous are unlikely to be found in these areas. Compounding this problem is the lack of adequate plant association guides (detailed classification of forest associations) for much of the federal land, so the present RNA system probably does not protect a full range of ecosystems.

Data on the dependence and relation of plant and animal species to old growth are inadequate. These kinds of data currently are being collected, but many of the studies are long-term and may be too late to be useful. RNA's in western Oregon and Washington can do little to protect large mammals and many birds because of their small size.

The generally small size of RNA's and their isolation are the greatest threats to protecting old growth in RNA's. Much recent work has focused on the size and design of nature preserves. Wilcove and May (1986) pose three different ways to deal with the design of nature preserves. First, the preserve should be big enough to begin with. Unfortunately, information on species, structure, and function often is lacking so that required size becomes obvious only in hindsight. Second, preexisting nature preserves should be linked. Linking is possible where RNA's occur in national parks or wilderness areas, but it is becoming increasingly difficult in multiple-use landscapes as more and more of the old growth and natural young growth landscape is clearcut. Third, adjacent lands should be managed in ways that are compatible with conservation goals. Management of adjacent lands offers the greatest hope for successful RNA management, but as the discussion of protectability shows, past and present management is not oriented in this direction.

Because the size of most RNA's is set, management of edges or buffer areas becomes essential. Work on edge effects, especially with birds, shows that a circular reserve of 100 ha (247 acres) will contain no true forest interior. Forest preserves need to be far larger to ensure long-term survival of these birds (Wilcove et al. 1986). Data from the tropics show that abrupt edges (other than natural ecotonal edges) can cause serious problems within reserves. Microclimatic changes in temperature, humidity, light, and wind affect plant species composition, seeding habits, and general edge integrity. Abrupt edges like clearcuts or roads may increase resources (e.g., more light creating an advantageous microclimate), which could attract certain disadvantageous species (Lovejoy et al. 1986).

The thirty RNA's in the five geographic provinces of western Oregon and Washington apparently are not doing an adequate job of protecting old growth within their boundaries. Noss and Harris (1986) state that the natural area movement has been one of protecting climax remnants that have become isolated, small, and scattered in a hostile landscape. They argue that spatial-distribution characteristics must be considered in relation to the landscape setting. Natural areas, especially those that protect old growth and wide-ranging wildlife, must be integrated into the surrounding landscape, rather than separated from it by roads, clearcuts, developments, and other human modifications. Nearly half of the thirty RNA's were established before the mid-1960's. Many of the RNA's at the time of establishment were surrounded by intact natural stands that were part of a larger unmodified landscape. Few people guessed the extent of future timber harvesting, and fewer still were thinking in terms of landscape linkages. Clearly, the greatest threat to these RNA's was and is human influence from the outside. Herein lies the challenge to RNA management — a challenge that is not being met currently.

IDEAS FOR NEW MANAGEMENT STRATEGIES

A fresh perspective on the management of RNA's is needed in the Pacific Northwest. The most important perspective would be a shift in philosophy supporting management of RNA's as part of the total resource area, not as separate units. RNA's must be connected to adjacent intact stands so as not to isolate them. Adjacent stands do not need to be old growth, but at least should be mature or pole-sized forest. An entire edge of young growth or clearcut is not an acceptable edge. Corridors and buffers wide enough to protect species moving between different functional areas, wide enough to protect old growth from windthrow exacerbated by clearcutting, and wide enough to protect the RNA from the influence of roads and heavy public use can accomplish this linkage. In designing RNA's, managing boundaries along topographic features, rather than section lines, is best.

RNA's must be incorporated into long-range planning efforts where adjacent lands may be manipulated or changed. Essential to this approach is development of comprehensive Geographic Information Systems where RNA's can be displayed spatially as part of the total landscape pattern and resource management plan. Only then can functional connections be made with adjacent lands.

Roads, clearcuts, and human activities like nurseries next to RNA boundaries must be avoided. If timber removal cannot be avoided, uneven-age management, shelterwood, or partial cuttings are preferred. It would be best to phase cutting over a rotation, preferably longer than the normal managed rotation, so that entire boundaries are not exposed at one time. This way edges will not be abrupt, and a mosaic of tree sizes and structures will occur. Regeneration should be accomplished as soon as possible with a natural mix of species. Planting is preferable to natural regeneration if it will regenerate the areas faster; if possible uniform rows should be avoided. Effort is needed to protect high-risk windthrow areas from cutting.

Finally, agencies managing RNA's should have professionals on their staffs, people who are trained in natural area management. Stewardship of RNA's is as important as stewardship of wilderness areas, timber management areas, and wildlife areas. Cooperation of all resource specialties — including wildlife, timber, range, recreation, and watershed — is essential in RNA management.

CONCLUSIONS

Research natural areas play a useful role in protecting old-growth ecosystems; they are the only systematic attempt to preserve a scientific cross-section of all old-growth types. Their very existence, though tenuous, adds heterogeneity to an increasingly homogenous landscape. Finally, much of the research on old-growth characteristics has taken place on RNA's (Greene et al. 1986). Research natural areas are among the few places on federal lands where long-term research plots can be established and protected in perpetuity.

ACKNOWLEDGMENTS

I thank the following individuals for their critical reviews and helpful suggestions on this paper: J. Franklin, R. Frenkel, L. Harris, C. Kiilsgaard, and J. White.

LITERATURE CITED

Dixon, K.R. and T.C. Juelson. 1987. The political economy of the spotted owl. Ecology 68(4): 772-776.

Dyrness, C.T., J.F. Franklin, C. Maser, S.A. Cook, J.D. Hall, and G. Faxon. 1975. Research natural area needs in the Pacific Northwest: a contribution to land-use planning. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station General Technical Report PNW-38. 231 p.

Franklin, J.F., K. Cromack, Jr., W. Denison, A. McKee, C. Maser, J. Sedell, S. Swanson, and G. Juday. 1981. Ecological characteristics of old-growth Douglas-fir forests. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station General Technical Report PNW-118. 48 p.

Greene, S.E., T. Blinn, and J.F. Franklin. 1986. Research natural areas in Oregon and Washington: past and current research and related literature. USDA Forest Service, Pacific Northwest Research Station General Technical Report PNW-18. 115 p.

Lovejoy, T.E., R.O. Bierregaard, Jr., A.B. Rylands, J.R. Malcolm, C.E. Quintela, L.H. Harper, K.S. Brown, Jr., A.H. Powell, G.V.N. Powell, H.O.R. Schubart, and M.B. Hays. 1986. Edges and other effects of isolation on Amazon forest fragments. Pp. 257-285 *in* M. L. Soulé, ed., Conservation biology. Sinauer Associates, Sunderland, Mass.

Noss, R.F. and L.D. Harris. 1986. Nodes, networks, and MUMs: preserving diversity at all scales. Environmental Management 10(3): 299-309.

Old-Growth Definition Task Force. 1986. Interim definitions for old-growth Douglas-fir and mixed conifer forests in the Pacific Northwest and California. USDA Forest Service, Pacific Northwest Research Station Research Note PNW-447. 7 p.

Oregon Natural Heritage Advisory Council. 1981. Oregon natural heritage plan. State Land Board. 141 p.

Spotted Owl Environmental Assessment. 1987. Bureau of Land Management, Oregon State Office. 23 p.

United States Department of Agriculture. 1984. Regional guide for the Pacific Northwest region. USDA Forest Service.

Washington Natural Heritage Program. 1987. State of Washington natural heritage plan. Washington Department of Natural Resources. 108 p.

Wilcove, D.S. and R.M. May. 1986. National park boundaries and ecological realities. Nature 324(November): 206-207.

Wilcove, D.S., C.H. McClellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pp. 237-256 *in* M.L. Soulé, ed., Conservation biology. Sinauer Associates, Sunderland, Mass.