Sustainable Forestry *Oregon Style*

Over the past five years, the Oregon Department of Forestry has developed a new management plan for state forests in northwest Oregon. The approach results in healthy, productive, sustainable forest ecosystems and promotes the view that forest values such as timber and wildlife are compatible. Forest landscapes must be designed for wildlife habitat diversity, strategies must be operationally feasible, and the plan must be flexible enough to allow forest managers to address changes. Careful monitoring and an adaptive management approach are key to the plan's success over time.

By Michael A. Bordelon, David C. McAllister, and Ross Holloway

Oregon state forest management plans today hardly resemble the focused timber management plans of the 1950s to 1980s. The complexity of forest management planning changed significantly in the 1990s, when issues of threatened and endangered species, evolving scientific understanding of ecosystem processes, and growing public concern about forest management provided a different context for forest management on private, state, and federal lands in Oregon. Successful state forest management plans must be clearly aligned with legal and policy direction, involve the public, be founded on currently available science, and have a strong adaptive management component.

State forests in northwest Oregon comprise approximately 600,000 acres of land, 97 percent of which is deeded to the state by the counties, primarily from tax-delinquent properties. The remaining 3 percent consists of forestland deeded to the state by the federal government through the Oregon Admission Act of 1859 (11 Stat. 383). Oregon schools and county governments are the primary beneficiaries of the revenue produced from state forests.

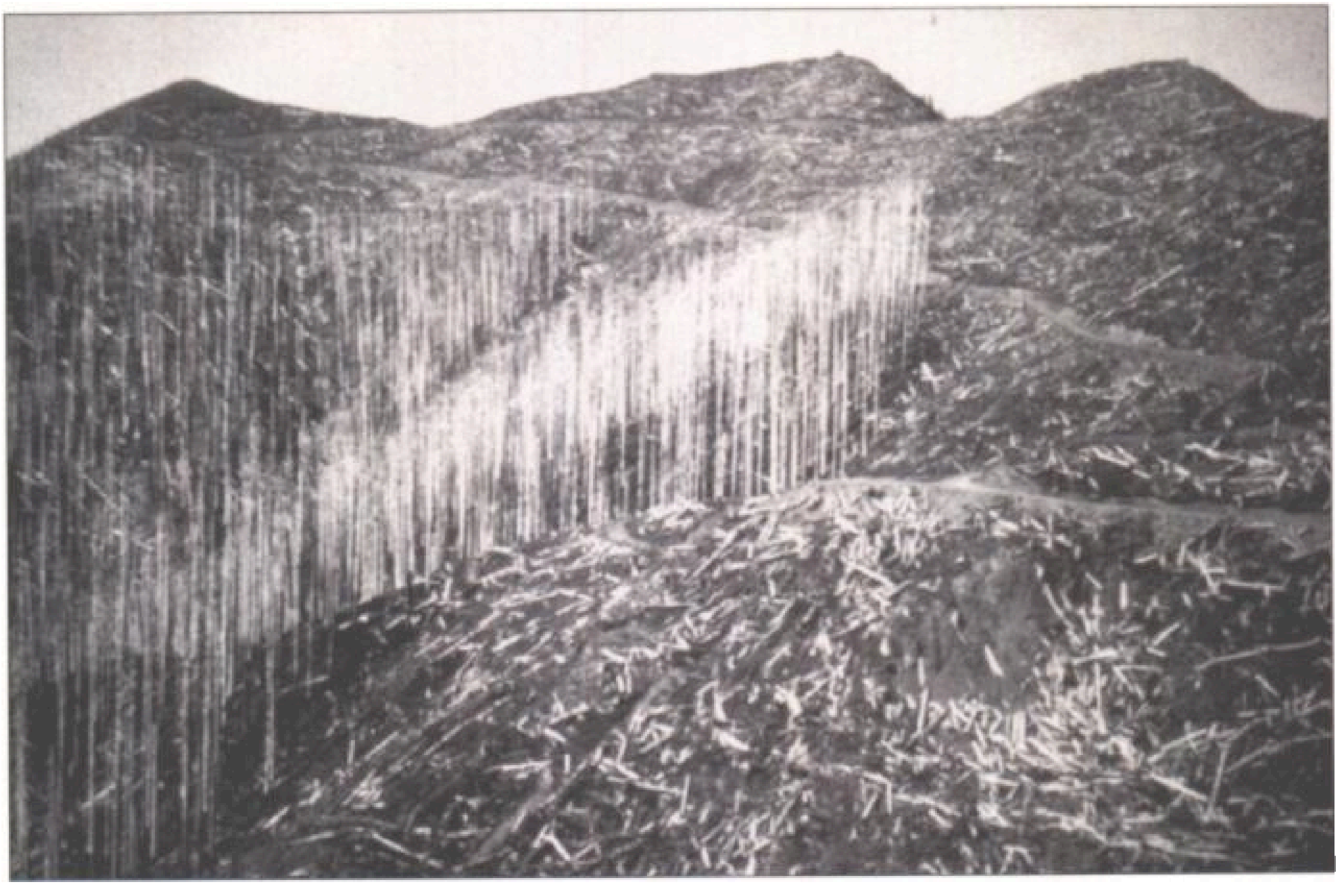
The forests of today were shaped by past timber harvesting and major wildfires, including the Tillamook Burn, in the 1930s, 1940s, and 1950s. Large-scale tree planting and seeding programs after the wildfires transformed these properties into a "sea of green," a major success story for the state and the citizens of Oregon. Today approximately 70 percent of the planning area is composed of 40- to 60-year-old, densely stocked stands of Douglas-fir.

The proposed forest management plan for northwest Oregon state forests builds on this successful legacy and envisions a future of stewardship that will provide a sustainable array of economic, social, and environmental benefits.

Greatest Permanent Value

The statutes that apply to Oregon Board of Forestry Lands prescribe that lands shall be managed to achieve "greatest permanent value" for the citizens of Oregon. In January 1998, the Oregon Board of Forestry, the forest policymaking body for the state, adopted a new administrative rule through a deliberate and open public process. This rule defines greatest permanent value as "healthy, productive, and sustainable forest ecosystems that over time and across the landscape provide a full range of social, economic, and environmental benefits to the people of Oregon." The state forester is directed "to maintain these lands as forest lands and actively manage them in a sound environmental manner to provide sustainable timber harvest and revenues to the state, counties, and local taxing districts."

Another example of an open public process about forest use on the state and regional levels is described in "Water Quality without Borders," p. 33.



Photos courtesy of Oregon Department of Forestry

Following the Tillamook Burn forest fires in the 1930s, 1940s, and 1950s (top), reforestation efforts transformed the Tillamook State Forest into the "sea of green" it is today.

Building the Plan

Based on this policy direction, the Oregon Department of Forestry, in partnership with the Oregon Department of Fish and Wildlife, envisioned an integrated management approach that emphasizes the compatibility of forest values over time and across the landscape. This approach contrasts sharply with the "either–or" philosophy that has characterized the debate over federal land management in the Pacific Northwest.

Early and continuous public participation was encouraged through a variety of formats. Activities included newsletters, public meetings throughout the state, written comment periods, forest tours, informal contacts with groups and individuals, a toll-free telephone information line, a website, a planning forum, and a public interest committee. The plan has been developed through consultation with scientists from several disciplines and was the subject of two scientific peer reviews. The most intensive peer review was coordinated by Oregon State University (Hayes 1998) and involved analysis by 26 scientists from a variety of disciplines and perspectives. The department has used both public input and scientific review to refine and evolve plan strategies over time.

The department recognized the need to manage these forests at both the landscape level and the stand level to provide for wildlife and biodiversity in a manner compatible with production of predictable and sustainable timber and revenues. The resulting structure-based management approach is the foundation of the proposed forest plan.

Structure-Based Management

The plan uses structure-based management to guide its landscape-level planning and specific silvicultural activities. The structure-based management approach actively manages stand density through periodic thinning and partial cutting to accelerate stand development (Oliver 1992; McComb et al. 1993; Carey et al. 1996). Some prescriptions will result in fast-growing, well-stocked stands with minimal understories. Others will develop more-complex stand structures, with rapid tree diameter growth, enough sunlight on the forest floor to maintain understory plants, and a complex forest canopy. Thinning and partial cutting will create or maintain snags, down wood, gaps in the canopy, and multiple canopy layers (Hayes et al. 1997). Other prescriptions include regeneration harvests that retain snags, down wood, and residual live trees; patch cuts; shelterwood cuts; and group selection cuts. Where appropriate, seed tree cuts will be considered.

Forest Stand Types

Five forest stand types were chosen as management targets. They represent "snapshots" along continuums of forest development that historically resulted from patterns of disturbance in the planning area (Oliver and Larson 1996). They range from open areas where new trees are being established to older forest structure that includes old-growth characteristics. Individual stands will change over time, but the range of stand types and their relative abundance across the landscape will be reasonably stable. Because these structural types are in a dynamic balance, the forest will provide a steady flow of timber volume, jobs, habitats, and recreational opportunities. The structure-based management stand types are:

Regeneration. The site is occupied primarily by tree seedlings or saplings, and herbs or shrubs. This type includes young stands up to the stage when the trees approach crown closure. At that point, increasing competition causes a significant loss of vigor or death of understory vegetation.

Closed single canopy. Trees fully occupy the site and form one main canopy layer. There is little or no understory development.

Understory. Understory stands begin developing diverse herb or shrub layers. Tree canopies may range from a single species, single-layered, main canopy (with associated dominant, codominant, intermediate, and suppressed trees) to multiple species canopies.

Layered. Vertical organization and stand structure are more complex than in the understory type. Shrub or herb layers and tree canopies in two or more layers are present.

Older forest structure (OFS). Stands contain a variety of trees, shrubs, and other understory vegetation similar to layered stands. Stands classified as OFS must meet minimum requirements for numbers of large trees, two or more tree canopy layers, and numerous snags and down wood. Multiple tree species and trees with deeply fissured bark, large limbs, broken tops, and evidence of fungal decay are encouraged.

OFS will provide structural components associated with old-growth, but may not emulate all the functions of old-aged forests. Over time, research and monitoring will clarify the relationships between OFS and older forests.

Table 1 describes the desired percentages of the stand types in the planning areas. There is no specific time frame within which targets must be met, as current stand conditions for different regions vary greatly, and these forests are expected to develop along different timelines. The ranges are an estimate of what should be achieved, based on current knowledge. It is likely they will change, as more is learned through research and monitoring.

Table 1. Stand-type targets in Oregon state forest planning areas.

Stand type	Percent of state forest landscape	Percent used for analysis
Regeneration	5–15	10
Closed single canopy	10–20	15
Understory	15–35	25
Layered	20–30	25
Older forest structure	20–30	25

Designing for Wildlife Diversity

Landscape planning for wildlife diversity, as well as for a variety of economic and social benefits, is a relatively new concept in forest management. Earlier attention to habitat was generally restricted to the stand or unit scale, and little consideration was given to habitat decisions at the landscape level. More recently, researchers have focused on the contribution of landscape features to wildlife conservation, particularly the effects of habitat fragmentation (Franklin and Forman 1987; Ruggiero et al. 1991).

Achieving wildlife diversity means providing a full range of habitat conditions at a range of spatial scales. Landscape planning applies management decisions from the regional to the stand level. It considers the number of different habitat units (patches), and their size, shape, location, and relationship to other patches within a landscape. Stand-level planning emphasizes considerations at the stand level and smaller scales and includes decisions related to down wood and snag retention, and thinning and harvest scheduling. It also includes conserving unique habitats such as caves, seeps, wetlands, and talus slopes.

A landscape is not a particular size or shape, but is defined by the number and arrangement of habitat patches of various sizes. Habitat patches are thought of as units differing in quality for one or several species (Wiens 1976). Habitat patches are dynamic, and occur at a variety of spatial and temporal scales. At any given scale, finer subdivisions of habitats can be recognized. An abrupt change between patches for one species may actually be a continuous gradient of suitable patches for another species. The lower size limit of a habitat patch is the size at which the species in question no longer perceives the habitat as suitable; the upper size limit typically is defined by the home range of the species (Kotliar and Wiens 1990). Boundaries separating suitable and unsuitable habitat are meaningful only when considered at a particular scale and for a particular species.

Fragmentation occurs when habitat is divided into smaller, more-isolated patches (McComb, 1999). As fragmentation increases, the habitat patch also becomes more isolated and geometrically complex. Maximum fragmentation occurs when no single habitat patch dominates the landscape.

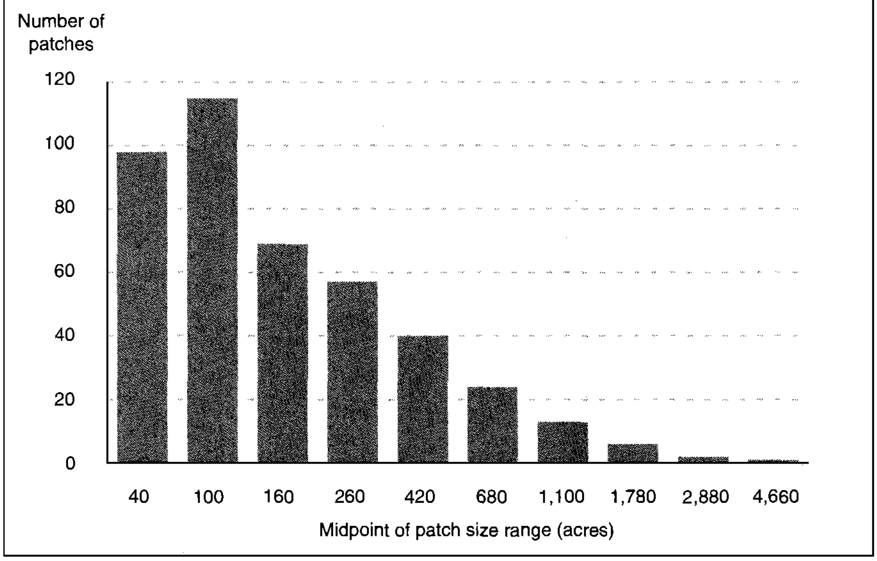


***Figure 1.* Log-normal frequency distribution of IHA patch sizes for a hypothetical 250,000-acre planning unit (based on a 90-percent forested unit with 25 percent older forest structure and 25 percent layered stand types).**

Although research in western forests to date has not provided clear evidence of the negative effects of fragmentation (Rosenberg and Raphael 1984; McGarigal and McComb 1995), studies from other areas do indicate negative responses (Whitcomb et al. 1981; Robbins et al. 1989). Wildlife species regarded as most sensitive to fragmentation in western forests are those that prefer late-seral forest interiors, and wide-ranging species with low reproductive rates (Thomas et al. 1990). Examples of these species include fishers, northern spotted owls, and marbled murrelets.

Functional patch size. Three factors define the functional patch size for meeting wildlife diversity goals at the landscape scale: actual size, distance from a similar patch, and degree of habitat difference of the surrounding landscape (Harris 1984). The presence and abundance of a species in a particular patch can be greatly affected by the composition of adjacent patches. These neighborhood, or edge, effects can be either positive or negative.

In the case of habitat generalists such as deer and elk, the edge between different patches of habitat is beneficial. For interior habitat species, high-contrast edge can have negative effects. Rosenberg and Raphael (1984) found that for mature forest patch sizes of less than 120 acres, the frequency of observations of interior habitat species diminished with the increasing presence and amount of adjacent regeneration and young forest patches. The observed decrease could have resulted from several factors, including predation, competition, and nest parasitism from species occupying adjacent patches. It could also be the result of microclimatic changes within older forest patches due to increased light intensities, wind, and other climatic factors. Chen (1991) determined for Douglas-fir forests that high-contrast edge affected certain biological and microclimatic factors from 65 to 785 feet into the forest, depending on the variable examined.

Landscapes do not exist in isolation; there is always a larger context within which several landscapes exist. Context is most important when organisms can easily move between landscapes. Recognition of the relationship of a particular species to its landscape and surrounding landscapes is essential to providing the proper context for management.

Interior Habitat Area

In western Oregon, the most important patch type to consider is mature forest habitat. Mature forest is important because it is in limited supply and provides important habitat for more than 118 species (Harris 1984). Emphasizing management for mature forest habitat also ensures maintaining other habitats through the course of expected forest development.

Not all the area of a mature forest patch may function as effective habitat. Interior habitat area (IHA) is defined as the portion of the mature forest patch that remains functional after the negative effects of high-contrast edge are removed (Spies et al. 1994). Two factors influence these effects: the degree of edge contrast with adjacent patches; and the patch configuration, which changes the amount of edge.

To meet wildlife diversity goals across the landscape, a range of IHA patch sizes is needed. Harris (1984), in a study that applied conservation biology principles to federal forestlands, suggested using a log-normal frequency distribution to define the size and number of old-growth patches necessary to protect biotic diversity. He chose this distribution because home-range size, wildlife abundance, and spatial movement all tend to follow a log-normal frequency distribution. A log-normal frequency distribution also approximates disturbance processes such as fire and windstorms and physical characteristics of the landscape, such as watershed area and stream length (Strahler 1957; Shugart 1984).

Using the IHA Patch Concept

For the plan under development, IHAs are allocated across the planning area using two principal criteria. The first criterion defines the composition of IHA habitat, using the following parameters:

• IHA patches can be grouped to include structurally similar patch types. This increases the number of functional IHA patches across the landscape, thereby reducing the average distance between units. It also presents the opportunity to maintain IHA patch size by recruiting adjacent man-

Wheeler Basin:

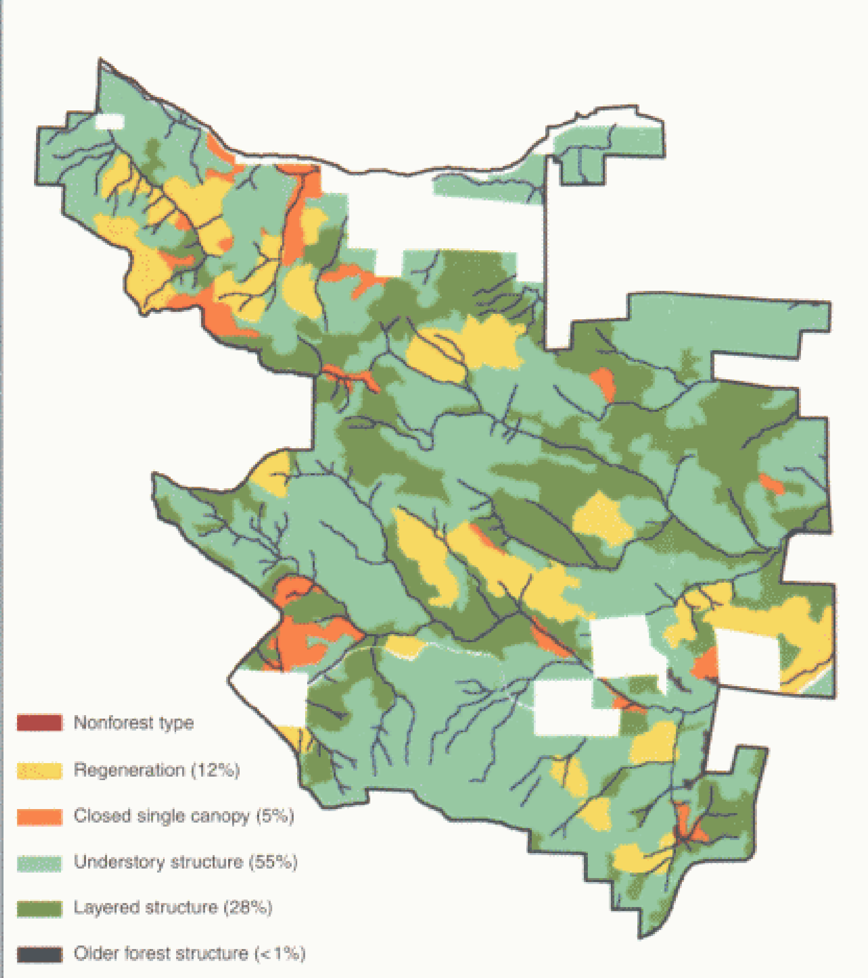


Figure 2. **Current stand conditions for Wheeler Basin (areas in white are non-state lands).**

Implementation planning organizes resource information, determines desired future conditions, identifies and coordinates management activity, and assesses progress toward meeting the goals identified in the forest plan.

Figures 2 and 3 present two key products of implementation planning as it is applied to the 17,126-acre Wheeler Basin, located in the northeast corner of Tillamook State Forest in northwest Oregon. The basin serves as headwaters of the upper Nehalem River and includes many tributaries important for coho salmon habitat. The topography of the basin is mountainous highland, with moderate slopes and ridges rising to about 3,000 feet. Historically, most of the basin was naturally regenerated after extensive railroad logging and smaller forest fires during the 1930s. It is primarily composed of 55- to 65-year-old, heavily stocked stands of Douglas-fir mixed with western hemlock, western red cedar, true fir, and hardwoods. The area receives a moderate amount of recreational use, mostly dispersed camping, hunting, mountain biking, and sightseeing.

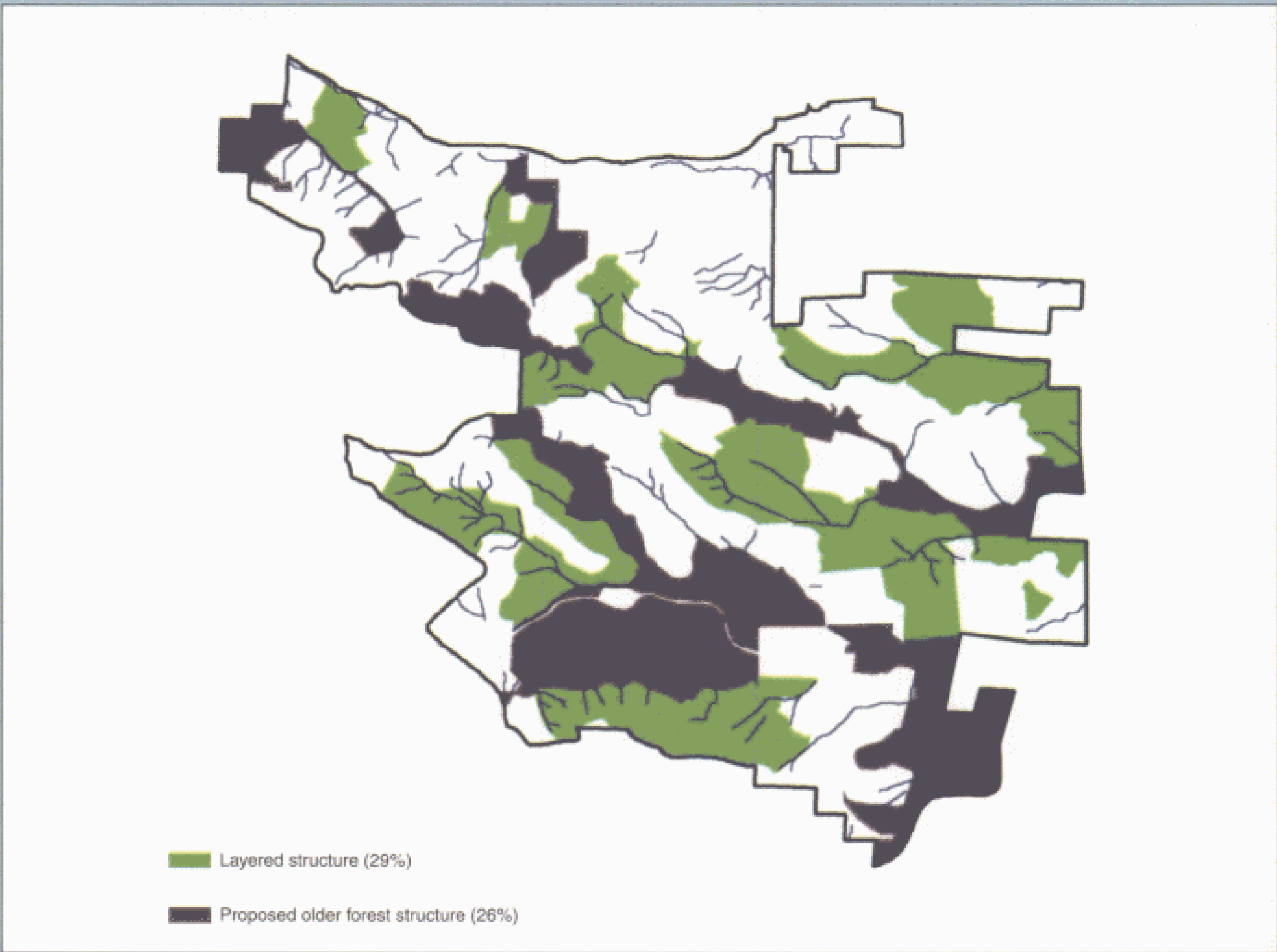


Figure 3. **Desired future stand conditions for Wheeler Basin.**

Managers first used inventory sorting techniques, management history, and personal knowledge to assess and describe the current forest stand types for the basin *(fig. 2)*. Managers next applied the concepts and guidelines in the landscape strategies to develop the desired future landscape condition *(fig. 3)*. This was done using resource teams that considered specific resource values of the area, their knowledge of current conditions, and anticipated stand development trajectories.

This example focused on the quantity and arrangement of the two most-complex stand classes, layered and older forest structure (OFS). These structures are currently limited and their future quantity and arrangement are key considerations in identifying opportunities to develop existing stands toward those conditions. Areas not identified as layered or OFS will contain a mix of the three other stand types (regeneration, closed single canopy, and understory).

Managers then developed an action plan describing management activities to achieve the desired future condition. Specific silvicultural prescriptions are applied to move existing stands along pathways toward the more-complex structures. The activities represent the range of opportunities on which short-term harvest activities will be based. From this information, yearly projects will be planned and instituted and progress can be monitored.

Adaptive management is an important component of forest plan implementation. A rigorous monitoring and adaptive management program is described in the plans.

Table 2. Resource considerations that will be addressed at various scales of landscape planning.

	Landscape planning scale			
Consideration	Region	District	Basin	Stand
Contribution to population goals for threatened and endangered species and sensitive species	X	X		
Structural targets		X		
Patch size distribution		X		
Recreational sites		X		
Sites with operational constraints (unstable or steep slope)		X		
Unique habitats (wetlands, eagle sites, etc.)		X		
Scenic corridors and viewsheds		X		
Desired basin stand structures		X	X	
Current stand condition			X	
Riparian management strategies			X	
Placement of patch and stand structure types			X	
Isolated stands			X	
Adjacent land uses and adjacent basin patch location			X	
Edge considerations			X	
Connectivity between patches		X	X	
Patch relationships between aquatic and upland management units			X	
Location of replacement stands or patches		X	X	
Big game management considerations		X	X	
Timber harvest plans and operation-specific decisions			X	X
Structural components (down wood, layered canopy, snag targets)			X	X
Within-stand diversity (gaps)				X
Species composition				X

aged stands as components are removed through thinning or harvesting.

- IHA patches may be made up of OFS, layered, and, in limited situations, understory stands.
- IHA patches should be centered on OFS stands.
- Patch size must consider adjoining structural types. For a given patch size, IHA is most reduced when it adjoins regeneration stands. This effect can be observed up to 300 feet from the patch edge.

The second criterion defines the number and range of IHA patch sizes for a given planning area. The plan followed Harris (1984) in using a log-normal frequency distribution with the following parameters: 250-acre average patch size; 0.2 variance; 40-acre minimum patch size.

Figure 1 (p. 29) shows application of the log-normal frequency distribution of IHA patch sizes when applied to a hypothetical 250,000-acre planning unit. The distribution emphasizes a larger number of smaller IHA patches.

Patch Placement

Habitat patches are arranged to achieve the wildlife conservation goals. Direction to foresters and adaptive management and monitoring plans will be used to evaluate and modify projected outcomes if necessary, and provide the link between plan goals, landscape strategies, and implementation plans. A decision-making process *(table 2)* addresses wildlife diversity planning from the stand level through various landscape scales. At the regional landscape scale, decisions support regional conservation goals, and are therefore broad. Threatened species or groups of species such as salmon, northern spotted owls, and marbled murrelets are addressed at this level.

At the local level, stand-type targets for management basins are established and the frequency distribution of IHA patch sizes is defined. The overall frequency distribution of patch sizes is allocated across various management basins, based on current age structure, regional conservation objectives, and other resource considerations, such as recreation, scenic quality, or operational constraints. Depending on these factors, certain basins may emphasize different parts of the frequency distribution. Thus, one basin could emphasize smaller IHA patches, while another may emphasize larger IHA patches.

Conclusion

Oregon state forestland managers are challenged with actively managing state forests to provide greatest permanent value to the citizens of the state. The widespread and integrated nature of these resources requires that forest management planning address issues at a variety of landscape scales through a landscape design system.

The structure-based management approach and landscape design system must be one that benefits wildlife diversity and indigenous wildlife habitats, can be applied in an efficient and cost-effective manner, and can be reasonably implemented by forest managers at the field level. The system must be flexible enough to allow field managers to address changing forest conditions through time and space. This article described a system that meets these tests and will result in a forest capable of achieving multiple resource objectives into the future.

Applying such a system will require careful monitoring through time and a willingness to adapt and change as we learn more. That has been the nature of state forest management over the past five decades, as the lands in northwestern Oregon have been reforested and nurtured into the valuable resource that exists today. We believe this approach provides a path for this strong stewardship tradition to follow into the future.

Water Quality without Borders

State natural resource management programs can be leveraged through partnerships with other agencies and organizations. In New York City's watershed, the New York State Department of Environmental Conservation contributed its experience and resources to a broad-based partnership of agencies, organizations, and individuals. This continues to be the obvious strategy both to ensure a productive forest and to protect water quality.

Nine million people in New York City and surrounding communities use approximately 1.3 billion gallons of clean water each day. The city collects this water from a surface-water supply system of nearly 2,000 square miles, the largest unfiltered supply system in the world.

In 1990, New York City proposed watershed regulations to comply with the Clean Water Act. The initially fragmented agricultural and forestry sectors in the watershed united in their belief that proposed regulations would significantly restrict customary farming and forestry practices. In 1994, agricultural interests formed the not-for-profit Watershed Agricultural Council (WAC) to negotiate with the city. Soon after, forestry interests coalesced as the Watershed Forest Ad Hoc Task Force and joined WAC as part of the Watershed Forestry Program (WFP). This coalition represents more than 90 percent of the land use in the watershed.

In 1996, the task force published its "Green Book" of forest policy statements and recommendations, which subsequently served as a blueprint for the current WFP. Since then, the USDA Forest Service has joined the partnership as an active participant.

The WFP committee, which is composed of four farmers, four forestry members, a New York City representative, and nonvoting members from various organizations and agencies, oversees all programs and projects to further the objectives outlined in the Green Book. The task force continues to meet once a year to review the status of WFP and to suggest new initiatives.

To meet the needs of watershed communities and city water consumers, the initial regulatory approach evolved into cooperative problem solving by all parties. Relevant groups participated in consensus-building meetings over two years to arrive at mutually acceptable policy statements and recommendations. Meeting participants included representatives from New York City, watershed towns, state natural resource and public health agencies, US Environmental Protection Agency (EPA), forest industry and landowners, farmers, loggers, consulting foresters, environmentalists, and academics. Any concerned person, party, or organization could participate in meetings and contribute to the grassroots dialogue. Positions were only adopted when all task force members agreed.

The central thread in all WFP activities is that voluntary, incentive-based best management practices (BMP) are the best way to ensure a productive forest and clean water. Because all participants, including New York City and EPA, accept this statement as scientifically valid, WFP tends to avoid deadlocks over unrelated, traditionally polarizing issues. Consequently, the agricultural and forestry sectors have been given the opportunity to implement and validate the Green Book through voluntary partnership programs administered locally by WAC. Nearly all funding for WFP comes from New York City and USDA Forest Service, as well as in-kind contributions from participants.

All WFP policies, practices, and programs must have a solid scientific foundation. Existing research supports many activities, but where gaps remain WFP conducts research projects. Supported research currently includes studies of the connection between silvicultural treatment and water quality, the effectiveness of BMPs, the phosphorous cycle, and other research and monitoring connected with four watershed model forests. Research projects involve multidisciplinary team members from various local, state, and federal agencies, organizations, and individuals.

Among the program's current efforts are the following:

- To help landowners understand the connection between well-managed forests and water quality, WFP not only hosts educational workshops and woods walks, it also provides cost sharing for management plans to landowners who do not have a current plan.
- To help timber harvesters and foresters learn state-of-the-art techniques to protect soil and water resources, WFP hosts training sessions with both local and national BMP experts. Then the program provides cost sharing for some of the materials necessary to initiate the practices, such as geotextile fabric, portable skidder bridges, and open-top culvert pipe.
- To improve the understanding of forestry and water quality issues by schoolchildren, the program cosponsors the Watershed Forestry Institute for Teachers, a four-day, hands-on seminar for elementary school teachers.
- WFP works with a coalition to provide information to help state lawmakers understand the impact of high property taxes on forest management.

In 1999, the New York City Department of Environmental Protection conducted an interim evaluation of WFP, and confirmed that the program is meeting its commitments and is overwhelmingly supported and successful. In the spring, WFP received the 1999 EPA Region II Environmental Quality Award.

The program is described in detail on the WFP website at http://www.nycwatershed.org/forest.htm.

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