The Northwest Forest Plan: Origins, Components, Implementation Experience, and Suggestions for Change

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Abstract: *In the 1990s the federal forests in the Pacific Northwest underwent the largest shift in management focus since their creation, from providing a sustained yield of timber to conserving biodiversity, with an emphasis on endangered species. Triggered by a legal challenge to the federal protection strategy for the Northern Spotted Owl (*Strix occidentalis caurina*), this shift was facilitated by a sequence of science assessments that culminated in the development of the Northwest Forest Plan. The plan, adopted in 1994, called for an extensive system of late-successional and riparian reserves along with some timber harvest on the intervening lands under a set of controls and safeguards. It has proven more successful in stopping actions harmful to conservation of old-growth forests and aquatic systems than in achieving restoration goals and economic and social goals. We make three suggestions that will allow the plan to achieve its goals: (1) recognize that the Northwest Forest Plan has evolved into an integrative conservation strategy, (2) conserve old-growth trees and forests wherever they occur, and (3) manage federal forests as dynamic ecosystems.*

Key Words: federal forest planning, Northern Spotted Owl, old growth, timber harvest

El Plan Forestal del Noroeste: Oigenes, Componentes, Experiencia de Implementación y Sugerencias de Cambio

Resumen: *En la década de 1920, los bosques federales en el Pacífico Noroeste (E.U.A.) experimentaron el mayor cambio de enfoque de gestión desde su creación, de proporcionar una producción sostenida de madera a conservar la biodiversidad, con énfasis en especies en peligro. Detonado por un desafío legal a la estrategia federal de protección de* Strix occidentalis caurina*, este cambio fue facilitado por una secuencia de evaluaciones científicas que culminaron con el desarrollo del Plan Forestal del Noroeste. El plan, adoptado en 1994, necesitaba un extenso sistema de reservas ribereñas y en sucesión tardía aunado a la cosecha de madera bajo un conjunto de controles y salvaguardas. Se ha demostrado que tiene mayor éxito en la prevención de acciones dañinas a la conservación de bosques viejos y sistemas acuáticos que en el logro de metas de restauración y sociales y económicas. Hacemos tres sugerencias que le permitirán alcanzar su sus metas: (1) reconocer que el Plan Forestal del Noroeste ha evolucionado hacia una estrategia integral de conservación, (2) conservar a los árboles y bosques viejos, dondequiera que ocurran y (3) gestionar a los bosques federales como ecosistemas dinámicos.*

Palabras Clave: bosques viejos, cosecha de madera, planificación forestal federal, *Strix occidentalis caurina*

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Introduction

For over a century, the federal forests of the Pacific Northwest have played an important role in the life of local people. We considered the 10 million ha of federal forests within the range of the Northern Spotted Owl (*Strix occidentalis caurina*) (Fig. 1). The U.S. Department of Agriculture Forest Service (USFS) administers approximately 8 million ha of these forests, the Bureau of Land Management (BLM) administers 1.1 million ha, and the National Park Service administers 0.9 million ha. Before the plan was implemented, USFS and BLM lands provided a significant share of the trees harvested in the region. For example, their contribution in western Oregon, an area with a long-term data set on harvest, averaged almost 50% of total harvest over the 30 years preceding development of the Northwest Forest Plan (NWFP) (Fig. 2). Much of the federal harvest during this period came from old-growth forests. During the 1990s, however, the primary management goal for federal lands in the region shifted from providing a sustained yield of timber to conserving biodiversity with an emphasis on endangered species. These changes, while perhaps inevitable, happened fairly suddenly, disrupting people and communities that depended on wood products for their livelihood and instituted a new approach to federal forest management. We trace the science assessments that set the foundation of the NWFP, its major components, and the plan's record of implementation and make suggestions for changes to help better achieve the goals set for it.

More than anything else, the NWFP was driven by the need to meet the requirements of the Endangered Species Act of 1973 and the "viability clause" of the USFS regulations issued pursuant to the National Forest Management

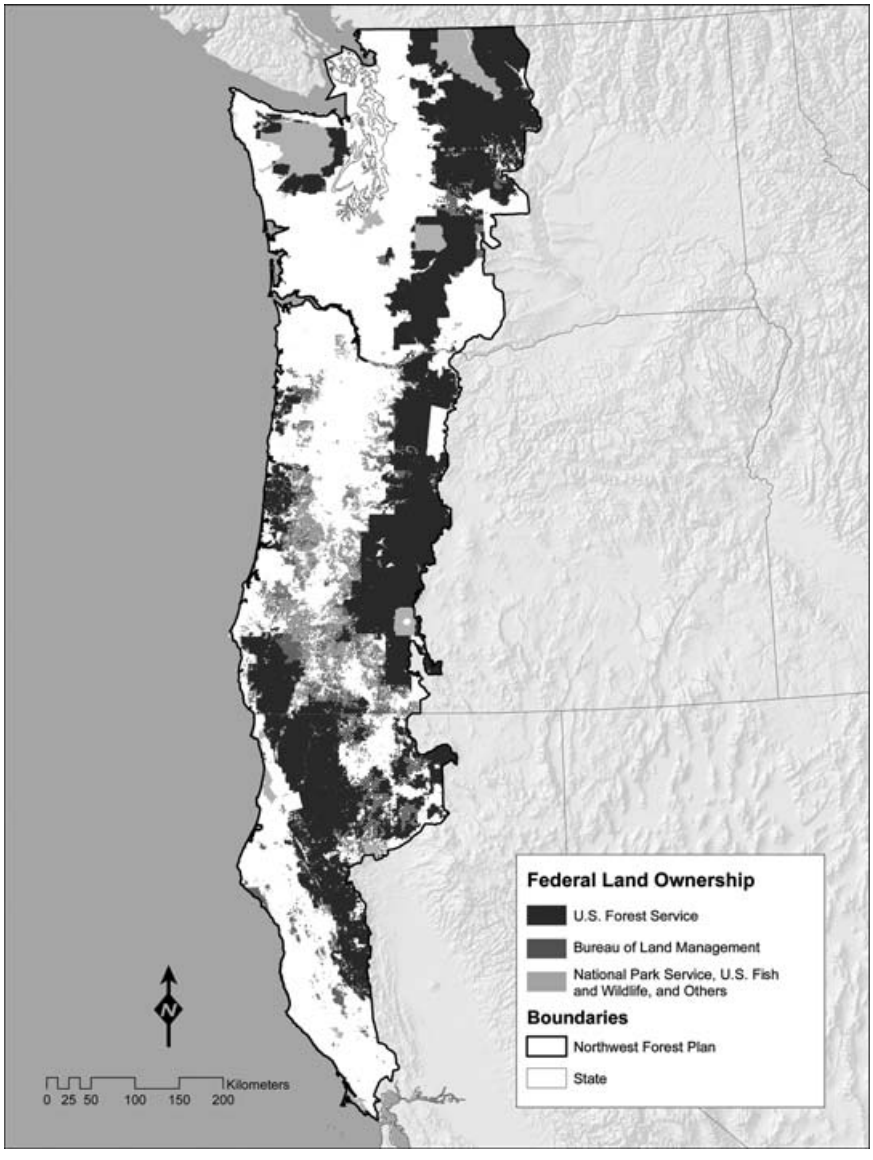

Figure 1. Federal lands within the range of the Northern Spotted Owl (source, NWP Regional Ecosystem Office 2005).

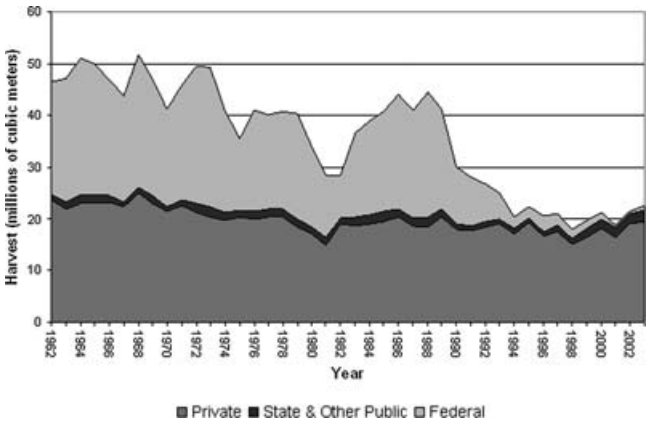

Figure 2. Timber harvest by owner group in western Oregon from 1962 to 2003 (source, Oregon Department of Forestry 2005).

Act of 1976. We were privileged to work on many of the assessments and plans discussed here. We hope the conclusions we have drawn from our experiences may be of wider value to other regions exploring large-scale forest planning.

Evolution of Federal Forestry in the Pacific Northwest

For hundreds of years, first in Europe and then in the United States, forestry was guided by the sustained yield model, which focused on a continuous supply of timber. Litigation, chiefly over the protection of the Northern Spotted Owl, and changing public values forced a shift in the Northwest to a new approach focused on conservation of species and ecosystems and grounded in principles of landscape ecology and conservation biology. Three studies in the early 1990s were triggered by this litigation and helped usher in this paradigm shift in the Northwest: (1) a conservation strategy for the Northern Spotted Owl (Thomas et al. 1990), (2) alternatives for management of late-successional forests of the Pacific Northwest (Johnson et al. 1991), and (3) viability assessments and management considerations for species associated with late-successional and old-growth forests of the Pacific Northwest (Thomas et al. 1993). We summarize the contributions of these three studies to the NWFP (for further discussion, see Duncan and Thompson [2006]). Additionally, a study by Nehlsen et al. (1991) on Pacific salmon stocks at risk helped alert people to the depth of the salmon decline and the need for new policies. Yaffee (1994) provides an in-depth history of the political struggle surrounding forest conservation during this period.

Thomas et al. (1990): Conservation of the Northern Spotted Owl

Litigants successfully challenged the adequacy of the federal plans to protect the Northern Spotted Owl, resulting in a court injunction on harvest of owl habitat (mature and old-growth forest). In response, the federal agencies responsible for management of the owl formed the Interagency Scientific Committee (ISC), composed of the top owl biologists in the United States, and charged it with developing a "scientifica1y credible conservation strategy for the Northern Spotted Owl." The ISC developed the first regional conservation strategy for federal lands in the Pacific Northwest (Thomas et al. 1990), anchoring its approach in a network of habitat conservation areas designed to support multiple pairs of owls and using conservation design principles that set the template for assessments and plans that came after it (Table 1).

Almost simultaneous with the release of the committee's report (Thomas et al. 1990), the owl was listed as threatened. That gave further impetus for the agencies to accept the ISC report as a management template. The BLM, however, announced that they would develop their own strategy, which they viewed as more consistent with their specific legal mandate. Legal challenges followed and, in the spring of 1991, a federal district court issued a second injunction against cutting owl habitat until questions could be answered about the implications of the BLM strategy for the owl and the effect of the ISC strategy on other species associated with old-growth forests.

Johnson et al. (1991): Conservation of Late-Successional Forests and Aquatic Systems

As the ISC report pointed out, old-growth conservation was about more than owls and always had been: Northern Spotted Owls were only one of the thousands of species associated with old-growth forests (Thomas et al. 1990). Also, wild fish stocks were increasingly viewed as at risk. The Northwest Congressional Delegation and many others in Congress wanted a permanent solution to the problem. Toward that end, two committees of the House of Representatives asked us to develop and evaluate several different approaches to protecting ecologically significant late-successional ecosystems, species, and processes, including but not confined to Northern Spotted Owls, and making sure that Congress did not get surprised by "some damn fish." We became known as the "Gang of Four."

To meet the congressional charge, we worked with agency specialists to delineate and grade "significant" old-growth areas throughout the federal forests in the range of the Northern Spotted Owl. The areas mapped were aggregations of "late-successional-old-growth forests (LS/OG)" over 80 years old. Forests over 80 years of age were

Table 1. Significant contributions of science assessments to concepts underlying the FEMAT report/Northwest Forest Plan.

Thomas et al. 1990
used a team of scientists to develop a scientifically credible conservation plan
constructed a regional plan covering the entire range of the species
used a reserve/matrix approach with each reserve large enough for a self-sustaining population of owls
began the reserve design with forests in old-growth condition containing owls
placed the reserves close enough together to enable successful dispersal of juvenile owls
used a matrix-based approach to facilitate dispersal rather than a corridor-based strategy
built in the ability, through redundancy in the network, to maintain sufficient habitat in the face of succession and disturbance
focused protection on federal lands/minimized the cost to private landowners
Johnson et al. 1991
mapped and classified late-successional/old-growth (LS/OG) forests on federal land
focused conservation efforts directly on old-growth forests
suggested a variety of conservation measures for the matrix, including green-tree retention
constructed a scientifically credible conservation strategy for aquatic systems
estimated the economic effect of alternative strategies to sustain species and ecosystems
provided a matrix of choices, in a modular structure, that differed in the management strategy applied, level of risk, and economic effects
provided evidence that it would not be possible to maintain historical timber harvests while protecting old-growth ecosystems
Thomas et al. 1993
recognized the full suite of species associated with LSOG forests, including invertebrates
suggested protective measures and risk-assessment procedures for these species
developed a biological measure of riparian width (site-potential tree height)

included in the analysis because they provide many habitat features and functions relevant to conservation of late-successional forest species. We also worked with scientists and specialists to delineate key watersheds and create a buffer system for both perennial and intermittent streams, and suggested management strategies for "matrix" lands. We portrayed our results in a framework that allowed a marginal analysis of the influence of different conservation measures on risk to species and ecosystems vis-à-vis the level of timber harvest (Table 1; for more details see Franklin [1995]). Our report (Johnson et al. 1991) confirmed that there would be "no free lunch" in solving the old-growth controversy in the Pacific Northwest: it would not be possible to both protect old-growth ecosystems and continue historical timber harvests. Upon learning this, Congress left the problem to the next presidential administration.

Thomas et al. (1993): Conservation of Species that Inhabit Late-Successional and Riparian Areas

To answer directly the questions raised by the district court, the federal agencies formed a Scientific Assessment Team (SAT; Thomas et al. 1993). This team concluded that the number of species associated with old-growth forests greatly exceeded the 34 species in question and that they could not discern what the BLM alternative entailed. These two conclusions were a fatal blow to those interested in lifting the injunction. The SAT also began development of a strategy for conserving the multitude of species associated with old-growth forests (Table 1).

Developing Conservation Strategies for a President (1993): FEMAT and the NWFP

Much of the scientific work underlying the NWFP was produced by the Forest Ecosystem Management Assessment Team (FEMAT), whose members built on the three previous studies (FEMAT 1993). President Clinton established the FEMAT after completion of the "Forest Summit," which was held in Oregon in the spring of 1993 to help break the federal-forest gridlock in the Pacific Northwest. The president directed the FEMAT to develop management strategies for the federal forests within the range of the Northern Spotted Owl that would (1) consider human and economic dimensions of the problem; (2) protect the long-term health of forests, wildlife, and waterways; (3) be scientifically sound, ecologically credible, and legally responsible; (4) produce a predictable and sustainable level of timber sales and nontimber resources that would not degrade the environment; and (5) emphasize collaboration among the federal agencies responsible for management of these lands (FEMAT 1993).

When addressing biological diversity, the FEMAT (1993) was instructed to maintain and restore habitat conditions for the owl and the Marbled Murrelet (*Brachyramphus marmoratum*)—a species poised to be listed as threatened. In addition, the FEMAT was instructed to (1) maintain and restore habitat conditions to support viable populations, well-distributed across current ranges, of all species known or reasonably expected to be associated with old-growth habitat conditions; (2) maintain and/or restore spawning and rearing habitat to support recovery and maintenance of viable populations of anadromous

fish species and other fish species considered "sensitive" or "at risk" on federal lands; and (3) maintain or create a connected, interactive, old-growth forest ecosystem on federal lands. These requirements—which by order of President Clinton were to be applied to all federal lands within the purview of the plan—were more constraining than ESA and NFMA requirements. In addition, the FEMAT (1993) was instructed to minimize conservation requirements on nonfederal land, make suggestions for adaptive management, examine silvicultural management to achieve objectives, and use an ecosystem management approach.

The FEMAT delivered 10 options to the president that varied (primarily) in the amount of LS/OG forests and stream systems in reserves and, thus, in expected timber harvests. Analyses conducted by the FEMAT roughly mirrored the earlier efforts of the Scientific Assessment Team (Thomas et al. 1993) in that more than 1000 species of plants and animals were considered in the analysis. One option (Option 9) attempted to overlap terrestrial and aquatic protection measures from the other options and President Clinton chose it as his forest plan.

The FEMAT estimated a harvest of approximately 7.3 million m^3/year could be sustained over time from the unreserved areas under the allocations and rules in Option 9, approximately 25% of the harvest level of the previous decade. The FEMAT scientists also pointed out that almost half the total timber harvest in the first decade would come from forests more than 200 years old (FEMAT 1993; Charnley 2006).

The FEMAT estimated the likelihood that species associated with LS/OG forests would have habitat of sufficient quality, distribution, and abundance to provide for stable, well-distributed populations on federal lands. According to the FEMAT, many species, including the Northern Spotted Owl and Marbled Murrelet, had a high likelihood of achieving such habitat conditions under Option 9. Not all species, however, had such a positive assessment (Fig. 3) because the habitat requirements and distributions of several hundred species, mostly invertebrates, were largely unknown. We took the view, as senior scientists in the FEMAT, that sufficient LS/OG forest existed in late-successional reserves (LSRs) and riparian reserves to protect these species and further protections should await evidence of risk. The Clinton administration, though, wanted to provide a plan to the courts that protected all species at a high level: they did not want to risk legal rejection of the plan as had happened previously. Therefore, a number of changes were made to Option 9 to form the final Northwest Forest Plan (USDA Forest Service & BLM 1994*a*, 1994*b*), including enlarging buffers on intermittent streams, creating 40-ha reserves around existing owl nests in the matrix, and creating the "survey and manage" list.

The most profound change was survey and manage—the development of protocols for conserving species that

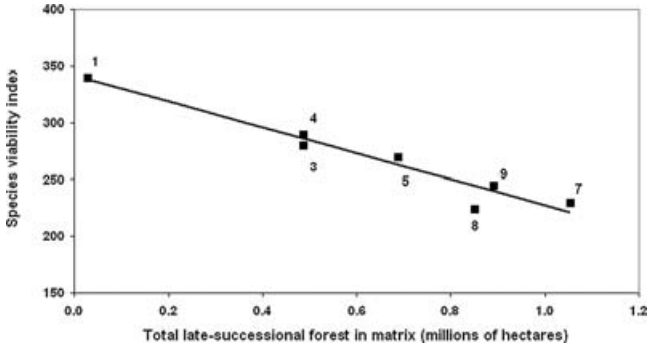

Figure 3. Area of late-successional forest in the matrix and associated number of species or groups of species rated as having a greater than 60% likelihood of habitat of sufficient quality, distribution, and abundance to allow species to stabilize and become well-distributed across federal lands within the range of the Northern Spotted Owl (FEMAT 1993).

did not achieve high likelihood ratings under the NWFP. In our eyes, this addition unfortunately shifted the NWFP from a coarse-filter approach (the occurrence of species is predicted by the occurrence of habitat) to an intense, fine-filter approach (based on actual site-specific data). For many species, survey and manage required searching LS/OG stands proposed for cutting to determine whether the species at issue were present—a survey and manage approach—and then adjusting the harvest plan to conserve them (USDA Forest Service & BLM 1994*b*). To incorporate these protocols into the NWFP, a comparable adjustment would be needed in harvest levels, but little reduction occurred in projected quantities of timber sale to account for them. After considering all changes from Option 9 to the NWFP, the agencies lowered the likely harvest level from 7.3 million m^3/year to 6.4 million m^3/year (Charnley 2006). Both the wood products industry and the environmental community filed lawsuits challenging the NWFP. The courts upheld the NWFP against all claims.

Since 1994, approximately 10 million ha of USFS and BLM lands within the range of the Northern Spotted Owl have been managed under the NWFP. Key elements of the NWFP are a network of LSRs and an Aquatic Conservation Strategy (ACS; Table 2, Fig. 4; FEMAT 1993). Remaining unreserved forest, where regularly scheduled timber harvest would occur under existing USFS and BLM plans, was designated either as adaptive management areas (AMAs) or matrix.

The LSRs (45 in number and covering 30% of the NWFP area) were located to protect areas with concentrations of high-quality LS/OG forest on federal lands and to meet the habitat requirements of the Northern Spotted Owl. The amounts of old growth included within reserves varied widely. The intent was to preserve existing LS/OG forest

Table 2. Land-use allocations in the Northwest Forest Plan (source Moeur et al. 2005).

Land-use allocation	*Hectares (%)*
Congressionally reserved areas[a]	2,963,830 (30)
Late-successional reserves	3,008,421 (30)
Managed late-successional reserves[b]	41,376 (1)
Adaptive management areas	616,113 (6)
Administratively withdrawn areas[c]	598,016 (6)
Riparian reserves	1,063,765 (11)
Matrix	1,609,433 (16)
Total	9,900,955 (100)

[a] *Wilderness areas, national parks, and other areas designated by Congress before the Northwest Forest Plan.*
[b] *Buffers to protect Spotted Owls and other species.*
[c] *Areas identified as withdrawn from timber production in forest or district plans before the Northwest Forest Plan.*

and to manage younger stands within the LSRs to attain tree size and stand structure resembling old growth. Most LSRs were designed—in conjunction with adjacent, already reserved land—to accommodate at least 20 pairs of Northern Spotted Owls, a number believed to enable self-sustaining local populations (FEMAT 1993). Redundancy was built into the system to allow for future disturbance, including wildfire.

Management strategies prescribed for the LSRs were based, in part, on historical fire regimes. In forests with infrequent, stand-replacement fire, stands over 80 years of age were to be preserved, but stands under 80 years could be thinned to speed development of old-growth structure such as large trees. In forests with frequent, low-intensity fire, where fire suppression had led to a buildup in stand densities, actions were allowed and recommended in

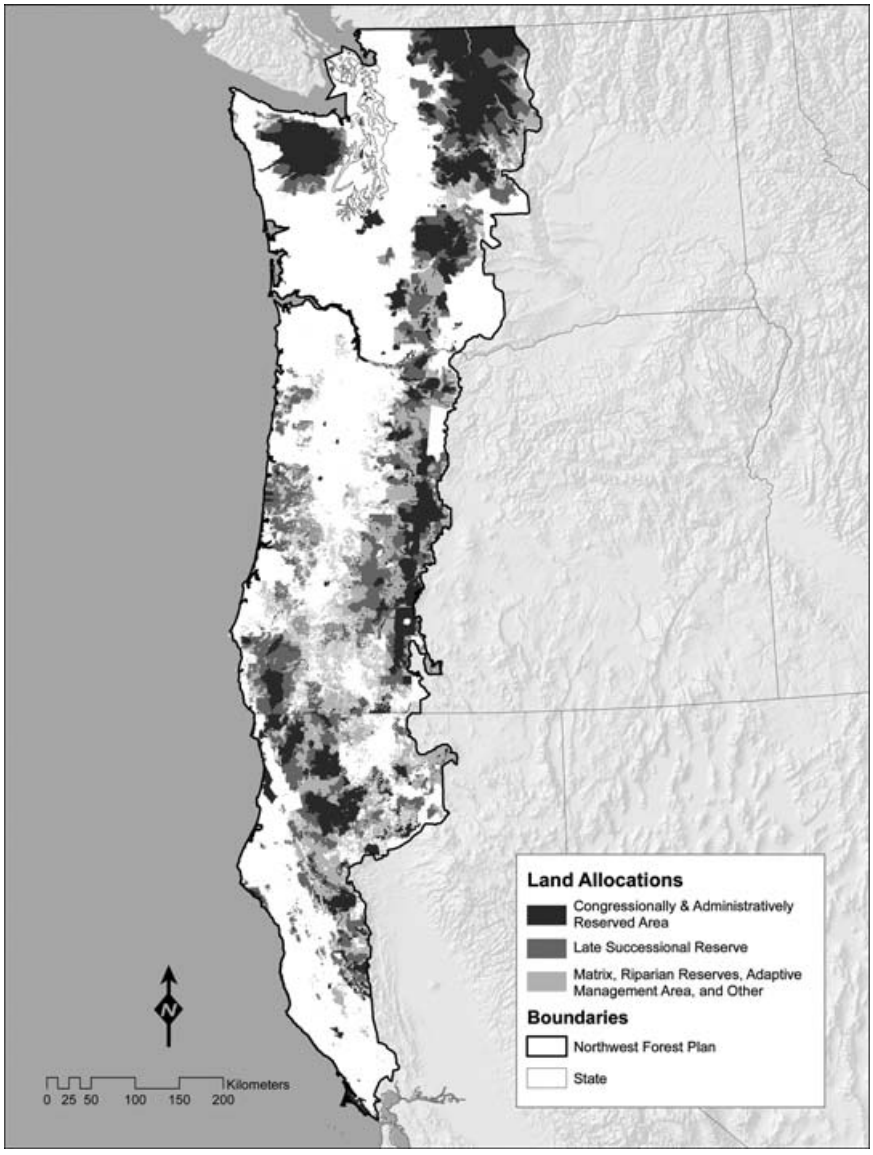

Figure 4. Major land-use allocations in the Northwest Forest Plan (source, NWP Regional Ecosystem Office 2005).

LSRs to reduce fuel loadings and restore characteristic LS/OG structure.

The Aquatic Conservation Strategy (ACS) was a second major part of the FEMAT's conservation strategy. The ACS had four main parts: (1) a system of riparian reserves defined, in the interim, by a distance equal to one to two site-potential tree heights on each side of perennial and intermittent streams; (2) key watersheds that would be a priority for restoration; (3) watershed analysis that would identify major issues and restoration opportunities and adjust the interim riparian reserve boundaries; and (4) a restoration program to coordinate and prioritize actions. Riparian reserves cover approximately 40% of the landscape outside LSRs and congressional and administrative withdrawals (11% of the total NWFP area; Table 2). See Reeves et al. (2006 [this issue]) for more discussion.

Two major categories of land were recognized outside of reserves: (1) adaptive management areas (AMAs) and (2) matrix. Both were expected to provide regularly scheduled timber harvest. The AMAs—approximately 6% of the NWFP area—were designated in various forest types and conditions to allow tests of alternative approaches to meet the goals of the plan. Matrix lands, approximately 16% of the NWFP area, were the remaining lands outside of reserves and AMAs. Both AMAs and matrix lands were open to timber harvest subject to the standards in the NWFP and in the individual forest and district plans, including retention of significant legacies at regeneration harvest.

Ten Years of Implementation of the NWFP

The NWFP provided direction for undertaking a set of actions. In addition, the scientists, specialists, and policy makers who constructed the plan expected certain outcomes from plan implementation. We summarize below how major actions and outcomes that occurred over the last decade compared with that expected under the plan.

Actions

Harvesting in unreserved lands (matrix/AMA) was below projections because of the economic and technical consequences of survey-and-manage protocols, challenges to plan implementation through various lawsuits (primarily from environmentalists), and public controversy over harvest of old-growth forest (Charnley 2006). Many timber sales were developed, challenged, and stalled.

Active management (thinning) in plantations within LSRs to encourage structural development in stands <80 years of age started slowly. It became a major focus of agency actions exceeding expectations (Bormann et al. 2006), however, because it faced less resistance and often received support from environmental groups.

Less fuel reduction than planned has occurred in LSRs on sites characterized by frequent low- or moderate-severity wildfire (Bormann et al. 2006). Among the causes of these delays in fuel treatments in LSRs were cumbersome bureaucratic processes, budget limitations, public protest, and scientific debate over appropriate activities. The condition of these reserves relative to uncharacteristic stand-replacement fires has worsened and some have burned in stand-replacing fires (Thomas 2002).

Very few of the interim riparian reserves along streams have been modified following watershed analysis, falling significantly short of expectations. See Reeves et al. (2006) for more discussion.

Only modest amounts of experimentation and innovation (Stankey et al. 2003) have occurred on AMAs. Most AMAs have been managed similarly to matrix. There have been some successes, but restrictions on AMA management in the NWFP, reluctance of regulatory agencies to approve habitat modifications or departures from the overall plan, and lack of financial support have limited experimentation (Stankey et al. 2003). Also, general lack of flexibility and adaptability in application of the NWFP has been a disappointment (Stankey et al. 2003).

Some investment has occurred in watershed restoration activities as called for by the ACS (Bormann et al. 2006). For example, 10 miles of road were decommissioned for each mile built, but budget constraints limited restoration activities. See Reeves et al. (2006) for more discussion.

A comprehensive, region-wide monitoring program assessed ecological effects, supplying many of the findings on effects discussed in the next section. A more modest program traced economic and social effects (Haynes et al. 2006).

In sum, the NWFP has been more successful in stopping actions thought to be harmful to conservation of LS/OG forests and aquatic systems than it has been in promoting active restoration and adaptive management and in implementing economic and social policies set out under the plan.

Outcomes

The net increase in LS/OG forest was greater than expected—a 1.9% annual increase compared to an expected 1.1% (Spies 2006). More forest developed into LS/OG conditions than expected because the area of LS/OG harvested was less than expected, losses to wildfire were slightly below predictions, and more than expected young forest developed into LS/OG conditions. Two qualifications must be made to these conclusions: (1) in some cases old growth was cut/burned and younger forest achieved LS/OG structural conditions (primarily minimum tree size) and (2) the effects were not spread evenly over the provinces—a few provinces suffered significant losses in LS/OG owing to wildfires (Spies 2006).

The NWFP projected a short-term decline in Northern Spotted Owl habitat, due to some harvest of LS/OG forest

in the matrix, followed by a long-term increase. With the greater-than-expected increase in LS/OG forests, the decline in owl habitat was less than projected (Bormann et al. 2006). The projected short-term decline in owl habitat was expected to result in further declines in owl populations. Actually, owl populations in the northern part of the range decreased more than expected, possibly because of nonhabitat factors such as competition from the Barred Owl (*Strix varia*), whereas owls in the southern part of the range decreased less than expected (Bormann et al. 2006). For the first time in decades, loss of federal habitat through timber harvest was not seen as the primary factor in owl declines.

Watershed condition improved across the federal landscape as expected. It is too soon to assess the effect on salmon stocks (see Reeves et al. [2006] for more discussion).

The NWFP has provided the core element of a regional program for conserving LS/OG forest biodiversity, especially federally listed species, thereby providing regulatory stability for private and state landowners and limiting restrictions on their actions (Pipkin 1998).

Federal timber harvest volume from the unreserved lands (matrix/AMAs) in the first 9 years of the plan was approximately 50% of expected. Expected harvest started at 6.4 million m^3/year and then was recalculated as 5.2 m^3/year million partway through the period, whereas actual harvest averaged 2.8 million m^3/year (Charnley 2006). Matrix/AMA harvest was near projected likely harvest from 1996 to 1998 but then declined sharply to approximately 35% of projected harvest from 1999 to 2003 as the effects of "survey and manage," litigation, and public protest accumulated (Charnley 2006). Federal harvest for western Oregon, location of approximately half of the projected harvest under the NWFP, exhibited this trend (Fig. 2). The NWFP did not estimate likely harvest from reserves to achieve ecological objectives so that pressures would not develop to harvest in reserves to meet timber targets. Harvest from reserves approximated 20% of the harvest from the matrix/AMAs (Charnley 2006).

Private harvest did not increase to offset federal declines. Thus the overall harvest level dropped roughly proportionate to the federal decrease, as illustrated by the harvest in western Oregon (Fig. 2).

Thousands of workers were displaced from the wood-products sector in the Northwest during the 1990s, with a resulting reduction in wage for workers who found employment in other sectors (Helvoigt et al. 2003). Contraction of the federal timber harvest, recession, and decline in the Asian export market all contributed to this change (Helvoigt et al. 2003). Automation, which reduced employment in the 1980s, does not appear to be a significant cause of wood-product employment declines in the 1990s as the number of employees needed per unit of production stabilized and slightly increased (Bormann et al. 2006).

The USFS workforce experienced a reduction significantly greater than expected, hampering achievement of plan goals. The BLM workforce reductions, on the other hand, were slight and in line with expectations (Bormann et al. 2006).

The economic effect on communities was mixed. The contribution of timber-based and restoration-based employment was less than expected and the decline in the federal workforce was more than expected. Still, many communities, especially those along major transportation routes, recovered fairly rapidly from the loss of timber jobs, benefiting from the overall robust growth of the Pacific Northwest economy. A few communities experienced significant economic shocks and have faced a difficult recovery (Haynes et al. 2006).

The contraction in timber supply in the Pacific Northwest in the early 1990s was accompanied by an increase in softwood production in other parts of North America—especially the southern United States and Canada (Haynes 2003). These outcomes were acknowledged and anticipated in FEMAT (1993), but the potential environmental effects of such shifts were not considered.

Recent Developments

President Bush's election in 2000 raised questions about whether he would continue the NWFP. President Bush, however, endorsed the plan, saying that he would make it work to deliver on its promise of a timber harvest of at least 6.4 million m^3/year. So far that objective has not been achieved. The Bush administration, however, has worked to remove obstacles to "redeeming" that promise by (1) attempting to reduce the effects of "survey and manage" and of the ACS on timber harvest, (2) reviving and settling a lawsuit over interpretation of the BLM's mandate and directing the BLM to develop new plans with at least one option that does not use reserves, and (3) altering the appeal regulations to allow declaration of an "economic emergency" to expedite postfire salvage within LSRs (e.g., those of the Biscuit fire of southwestern Oregon) without settlement of appeals. Only the postfire economic emergency provisions have been effective in expediting timber sales, although at the cost of protests not seen since the early 1990s.

Suggestions for the Future

We offer suggestions for better achieving the goals of the NWFP based on what we have learned over the last 10 years. The suggestions may require decisive action, including possibly congressional action. We have grouped suggestions under three major themes: (1) recognize that the NWFP has evolved into an integrative conservation strategy, (2) conserve old-growth trees and forests

wherever they are found, and (3) manage NWFP forests as dynamic ecosystems.

In making these recommendations we reaffirm the virtues of the NWFP. It precipitated the first large and serious attempt to manage whole forest landscapes in an integrated way so that all forest values are maintained and triggered an enormously useful and beneficial surge of forest science as a result of the effort to monitor the plan's progress.

Recognize the NWFP as an Integrative Conservation Strategy

Federal forest planning historically operated under two social models of how to best achieve the purposes of the national forests. One called for use of the resources of the national forests—especially wood, water, and forage—at a sustained rate to assist in the economic development of the West. Another social model came from those who treasured the wild, untamed glory of these forests and attempted to preserve them through wilderness designation. The NWFP can be seen as an attempt to merge these two models—retain the wild structures, processes, and functions of the forest through the identification of conservation areas (LSRs and riparian reserves) while allowing a regular allowable cut from the rest of the forest. We need to move beyond that model in three ways.

Look outward to understand the unique contributions of the federal lands. Federal forest planning has traditionally treated the national forests as a self-contained unit that needed to provide the full suite of multiple uses. The NWFP recognized, at least crudely, that the federal lands exist in a broader landscape in terms of the important contribution they would make to ecological, economic, and social sustainability, and that approach should be continued and broadened. Recent work in the Oregon Coast Range (Spies et al. 2006; Thompson et al. 2006) highlights the special conservation role of the federal forests, as do recent state conservation plans (Pipkin 1998). Future planning such as the development of new BLM plans needs to place federal forest management in this larger context and recognize the special mandates of the different land-management agencies.

Conserve important features across the landscape. The idea that areas could be recognized on federal lands in which timber production would be the dominant goal has disintegrated in the face of NWFP implementation. Rather, federal agencies have implemented a strategy in which they conserve important features wherever they find them. Although this has focused on old forest so far, as do our recommendations below, the approach is useful for other forest types and structures.

Focus effort on activities that contribute to all facets of sustainability. In general, activities that receive sufficient public support to be implemented achieve ecological goals as well as economic and social ones. Examples are thinning in LSRs to accelerate development of structural diversity and thinning and prescribed fire in dry forested LSRs to reduce uncharacteristic fuel loads. Ecologically sound actions that contribute to human safety also have been supported, especially in communities surrounded by a buildup of forest fuel. The boundaries among the land allocations do not mean as much as the demonstration of forest management that contributes to all components of sustainability. Perhaps the greatest challenge will be to produce revenue to contribute to underwriting these activities; without such revenue we are pessimistic that actions will continue.

Conserve Old-Growth Trees and Forests

Since implementation of the NWFP, cutting timber from old-growth stands has become evermore unlikely (Dombeck & Thomas 2003). Decreases in the number of pairs of nesting Northern Spotted Owls are likely to increase the value of any remaining old-growth forest to their welfare. Those who love old-growth forests will fight mightily to prevent remaining large, old trees and forests from being cut. Relatively few sawmills remain that depend on old-growth logs. The continuing fight is draining away time, money, energy, and political capital needed to address more pressing problems. Thus we believe that, as a practical matter, the issue has changed from whether to conserve old-growth forests to how to conserve them. Toward that end, we have two suggestions.

Reserve classic old-growth forests of the wetter habitat types. The classic old-growth forests (large, multistoried older forests of Moeur et al. [2005]) of western Washington and Oregon, including portions of the Klamath Province, evolved with infrequent high-severity fire. They can survive for very long periods without human intervention except, perhaps, to suppress fires. The agencies should seek to conserve these forests wherever they occur.

Undertake the appropriate fuel treatments in the threatened old-growth forests of the drier habitat type. These habitat types include the ponderosa pine and dry mixed conifer plant associations. High densities of younger trees—some quite large—now inhabit old-growth stands of these types as a result of a century of human activities, including fire suppression and timber harvest. These conditions create the potential for uncharacteristic stand-replacement fires, which kill old trees. Even without wildfires these high densities of younger trees stress the old-growth trees and thus increase the risk of loss to bark beetles. Restoration treatments are needed and should focus on removal of young trees and protection—not just retention—of all old trees.

Adding to the importance and urgency of these treatments is the possibility that the dry forests may be critical to survival of Northern Spotted Owls. These forests need a landscape plan that will sustain both forest and owls, perhaps by retaining large, dense patches embedded in a matrix in which stand densities have been reduced to

limit the potential for stand-replacement fire and competitive pressures on old trees.

Manage the NWFP Forests as Dynamic Ecosystems

Sustainability of old-growth ecosystems, in the end, depends on forest managers understanding and using dynamic management approaches. Toward that end, we have three suggestions.

Achieve a better balance of short-term and long-term risk. Minimization of short-term risks (the modus operandi of regulatory agencies and the federal courts) has a price tag, and a very big one, related to significantly increased longer-term risks of failure to meet objectives over very long time frames. Unless the federal agencies consider the peril of inaction equal to the peril of action, the goals of the NWFP will not be reached.

Recognize the continuing need for all structural stages across the landscape. Every successional or structural stage of forest development makes unique and important contributions to biological diversity and ecological function. Early successional ecosystems that occupy forested sites following disturbances, as an example, typically have high species diversity. In fact, structurally diverse early successional ecosystems may be the scarcest forest habitat in the Pacific Northwest (Franklin & Agee 2003), especially because private forest lands will be unlikely to produce this habitat under current forest-practice rules (Spies et al. 2006). Creation of early successional ecosystems will occur through natural disturbances such as wildfire or windstorms. Their value and persistence can be enhanced by limiting timber salvage and plantation-style reforestation practices. Such ecosystems can also be created by silvicultural practices that retain high levels of structural diversity.

Mature forest, typically in the age range of 80 to 200 years in the Douglas-fir region, is another important successional stage. Perhaps two-thirds of the remaining LS/OG in the Pacific Northwest is actually mature—rather than classic old-growth—forest (Moeur et al. 2005; Spies 2006). Debate over disposition of the mature forests is likely to be intense because they contain large volumes of timber and are gradually growing into additional and replacement old-growth forest (Spies 2006). Many mature forests also have moderate to high value for many old-growth species. Public support for harvest of mature forest will depend partially on ecological justifications for such activities and partially on social concerns.

Focus species-specific protection on endangered, threatened, and at-risk species. Management plans can cope with only a limited number of individual species if they are to be effective. Franklin (1993), for example, argues that "larger-scale approaches—at the levels of ecosystems and landscapes—are the only way to conserve the overwhelming mass—the millions of species—of existing biodiversity." Thus, we generally advocate a coarse-filter approach in which we rely on ecosystem diversity to provide for maintenance of species diversity. We recognize, however, that additional species-level criteria will often be needed. Clearly a fine-filter approach is required for federally threatened and endangered species. It is also prudent to recognize species whose habitats, without special consideration, might deteriorate sufficiently so as to require listing under our Endangered Species Act. The new USFS planning rules and directives provide an example of this approach (USDA 2005; USDA Forest Service 2005). They call for forest plans to provide for appropriate ecological conditions for threatened and endangered species and species of concern, with "species of concern" being those species that might require listing as threatened without special action. Furthermore the directives suggest use of lists from credible independent sources ("NatureServe") in making that determination.

Conclusions

In only 5 years, from 1989 to 1994, the dominant goal for management of national forest and BLM lands within the range of the Northern Spotted Owl shifted from sustained yield of timber volume to protection of biodiversity with an emphasis on endangered species. This change was difficult. It disrupted the federal agencies and the lives of thousands of people who had gained their livelihood from the harvest of the federal forests. In retrospect, the shift may have been inevitable, but the outcome was in no way clear to those in the midst of the debate.

The FEMAT report, and the studies that came before it, were important in reshaping the public's perception of the compatibility of forest conservation and timber harvest: they showed that the more area available for harvest, the more species would be at risk (Fig. 3). We believe it is time to reshape that image and impression once more to recognize that timber harvest, in certain conditions and done in certain ways, is compatible with, and essential for, conservation of some types of forests and the species within them.

We also believe it is time to contemplate a future in light of the NWFP experience, in the sense that the shift from a timber focus to a biodiversity focus will probably not be the last major shift in public perception, professional and scientific opinion, and political action. National security has been operationally redefined during the term of the NWFP by 9/11 and other events (e.g., climate change), and natural resources are seen by some as the ultimate determinant of the security of nations (Diamond 2004). Population growth, human health, and urbanization are increasingly seen to affect forests, with reciprocal effects on human populations in both social and biological dimensions; consider, for example, urban sprawl and Lyme disease. Thus we should not be surprised if the next big "forest awareness and opinion change" considers neither

timber nor biodiversity the main issues. Even more important, we should put a substantial portion of our science and policy effort toward considering and preparing for futures we cannot predict but might help create.

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