Chapter 8: Conservation of Other Species Associated With Older Forest Conditions

Bruce G. Marcot and Randy Molina

Introduction

This chapter presents information on expectations and outcomes for species closely associated with older (late-successional and old-growth) forests (hereafter referred to as LSOG species), other than fish (see chapter 9) and northern spotted owls (see appendix for scientific names) and marbled murrelets (see chapter 7), that were considered as part of the Northwest Forest Plan (the Plan). Many of the LSOG species are rare and little known, and include fungi, lichens, bryophytes (mosses and liverworts), vascular plants, invertebrates (mostly mollusks, and selected species groups of arthropods), and a few vertebrates. We also review the Survey and Manage (SM) program established under the Plan to provide for rare and poorly known LSOG species.

In this chapter we discuss species outcomes and program outcomes pertaining to what was expected under the Plan, what occurred, and if there were differences between expectations and observations; the extent to which differences were caused by the Plan; and if the Plan assumptions are still valid. We summarize lessons to learn both in terms of conservation concepts and program activities over the last decade.

Biodiversity Was the Umbrella; Species Became the Focus

The Plan was instituted as an ecosystem management plan to attend, in part, to biological diversity. To this end, the Plan was expected to provide for functional LSOG forest ecosystems, including all associated species and all components of biodiversity. Biodiversity is generally defined (for example, DeLong 1996, Raven 1994) as the variety of life and its processes, and includes structure, composition, and function of multiple levels of biological organization ranging from genes through population, species, functional groups, communities, and ecosystems (Noss 1990). Under the Plan, however, the focus on biodiversity narrowed to addressing mainly the composition, amount, dispersion, and dynamics of old forest vegetation communities (see chapter 6) and the presence and persistence of specific species, namely salmonids, spotted owls, marbled murrelets, and a set of other LSOG-associated species.

In this chapter we mostly trace the recent history of species-level conservation and associated programs of work under the Plan. In the next sections we review the recent history of LSOG species assessments and the Plan provisions for conservation of LSOG species. However, at the end of the chapter we will return to the broader vision of biodiversity conservation, where we review recent trends in conservation biology and how they may pertain to lessons learned under the past decade of the Plan.

A Brief History of LSOG Species Assessments Under FEMAT and the Northwest Forest Plan

To help set the stage for much of the rest of this chapter, following is a brief summary of the rather complicated history of the assessments and administrative programs under the Plan pertaining to management of LSOG-associated species (fig. 8-1).

The Forest Ecosystem Management Assessment Team (FEMAT 1993) initially evaluated a list of 1,120 LSOG-associated species under option 9; this option, with some changes, became the basis for the Northwest Forest Plan under the 1994 final supplemental environmental impact statement (FSEIS) (USDA and USDI 1994a). The 1994 FSEIS then identified 4 sets of criteria (“screens”) by which the 1,120 LSOG species were further evaluated to determine

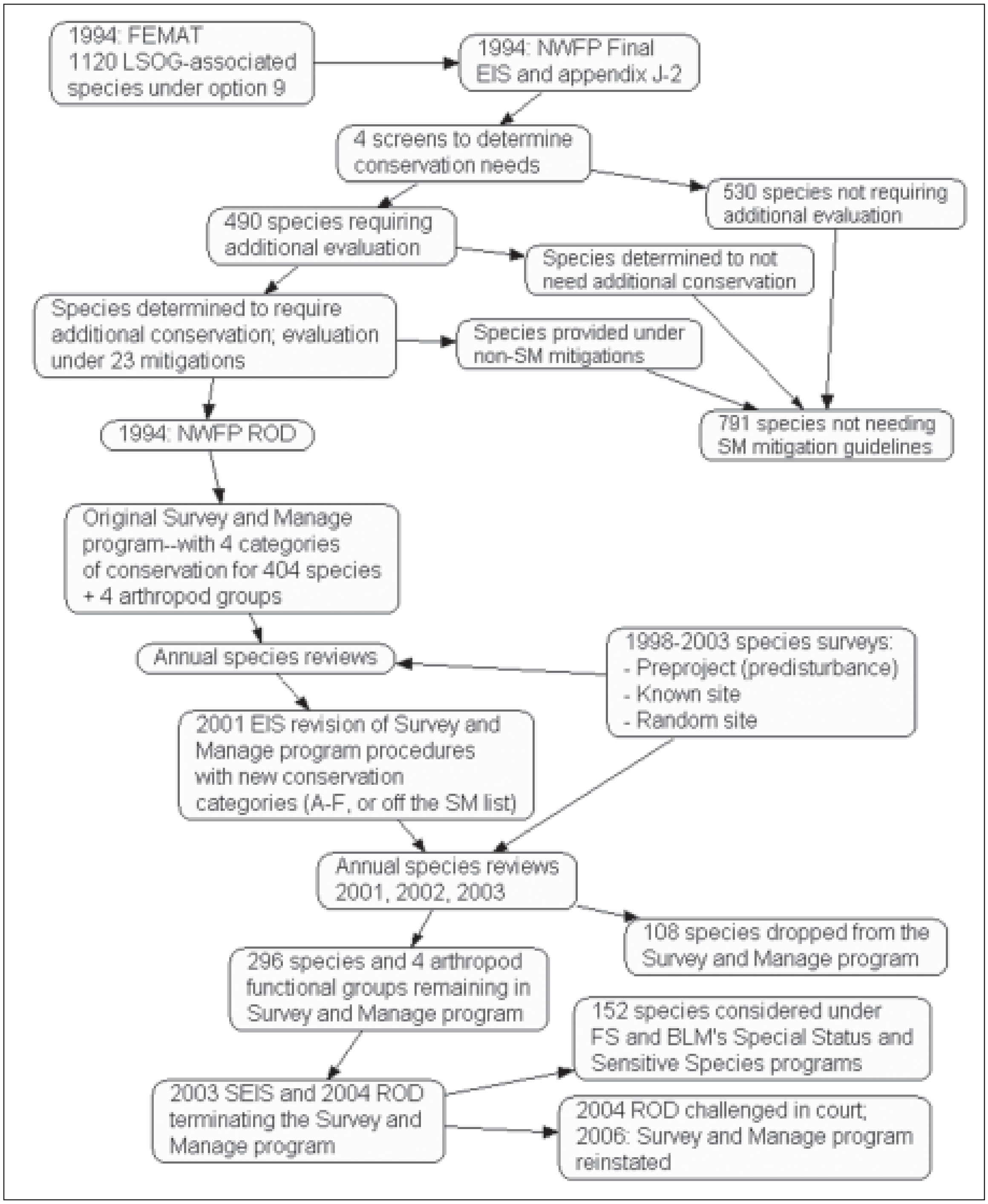


Figure 8-1—Lineage of administrative programs and National Environmental Policy Act environmental impact statement (EIS) and record of decision (ROD) documents under the Forest Ecosystem Management Assessment Team (FEMAT), the Plan (NWFP), and the Plan's Survey and Manage program (SM), addressing species associated with late-successional and old-growth (LSOG) forests on Forest Service (FS) and Bureau of Land Management (BLM) administered lands.

their appropriate conservation categories. The screens resulted in 791 of these species not being carried forward under mitigation for their conservation in addition to the Plan provisions, whereas the remainder of the species were determined to entail additional conservation and evaluation under further mitigation.

A set of 23 mitigations was evaluated in the 1994 SEIS (USDA and USDI 1994a) and 8 of these were adopted in the record decision (ROD) (USDA and USDI 1994b). One of the mitigations was the original SM species mitigation, which categorized each of 404[1] individual species and 4 arthropod species groups[2] according to four conservation classes, each class having a set of mitigation standards and guidelines. Standards and guidelines consisted of employing a variety of survey approaches (preproject or predisturbance, extensive, and general regional surveys) along with guidelines to protect (manage) known sites and to select high-priority sites for management. New information gained from surveys would address the uncertainty regarding species persistence concerns and would inform decisions.

In 2000 and 2001, a new FSEIS and ROD were issued (USDA and USDI 2000, 2001) to revise the SM species program procedures to specify greater details on conducting annual species reviews (ASRs), species management requirements, the use of strategic surveys, and an expanded classification of six species conservation categories. Subsequent ASRs held 2001-2003 used the new (2001) survey guidelines and evaluation procedures, and resulted in 108 SM species being dropped from the SM program because of the new data and evaluations. This left 296 individual species and 4 arthropod species groups remaining in the SM program. The SM program was removed after issuance of an FSEIS and its associated ROD in 2004 (USDA and USDI 2004a, 2004b[3]), which moved 152 of the remaining 296 SM species to the USDA Forest Service (FS) Sensitive Species Program and the USDI Bureau of Land Management (BLM) Special Status Species Program. In January, 2006, the court ruled that the SM program be reinstated according to the 2001 ROD.

A Summary of Northwest Forest Plan Provisions for LSOG Species

The Plan, as guided by the 1994 (and later, supplemented to 2001) ROD, contained several provisions for conservation of LSOG species. These included the delineation of late-successional reserves (LSRs) designed to accommodate populations of northern spotted owls, marbled murrelets, LSOG species, and other objectives; the delineation and protection of known sites of SM species found outside the LSRs in "mini" reserves (dubbed LSR3s in the Plan); delineation and protection of high-priority sites of selected SM species; and the expectation that some LSOG species locations and habitats would be provided for by other measures to protect older forest components such as the Aquatic Conservation Strategy and riparian reserves. In general, the major land allocations under the Plan were expected to provide habitat in appropriate amounts and distribution to support most LSOG-associated species.

What Was Expected Under The Northwest Forest Plan?

Expectations of Species Outcomes

Persistence of LSOG species and biodiversity— Under the Plan, the management guidelines and land allocations, particularly the LSRs, were expected to provide for persistence of most native LSOG-associated species

[1] In actuality, there were only 403 species, as the name of one species was inadvertently included twice (Holmes 2005). For the sake of consistency with the 1994 ROD, however, we will use the 404 figure here.

[2] The four arthropod species groups are canopy herbivores (south range of Plan area), coarse wood chewers (south range), litter- and soil-dwelling species (south range), and understory forest gap herbivores (USDA and USDI 1994b: C-1).

Although abandoned in 2004 through a SEIS and new ROD, the Survey and Manage program was reinstated in 2005 by court order following lawsuits brought by environmental groups. A new SEIS is currently in progress.

(and all other elements of LSOG biodiversity). This specifically included the 791 species not requiring mitigations of the SM program but that were expected to be provided for by the LSRs and other mitigations specified in the 1994 ROD (USDA and USDI 1994b), and the 404 individual rare and little-known species and 4 arthropod species groups that would require additional consideration and protection under the SM program. The Plan did not specifically define either "rare" or "little-known" in identifying these lists of species. As necessary, species- or taxon-specific assessments would be conducted to help determine where and what additional management guidelines would pertain to ensuring persistence of species and biodiversity elements not otherwise provided for.

Reduction of uncertainty and avoidance of listing—
For the 404 individual species and 4 arthropod species groups, it was generally expected that knowledge gained from SM program surveys, together with immediate protection of known sites, would help reduce scientific uncertainty, reduce risk of their extirpation, and increase overall chances for their persistence within the Plan area. Such mitigation activities under the SM program would be expected to stave off potential federal listing of LSOG-associated species.

Expectations of Program Outcomes

Adaptive management framework—
Expectations under the 1994 ROD (USDA and USDI 1994b) included that the SM program would provide an adaptive management framework for collecting new information on the 404 species and 4 arthropod species groups, for the purpose of evaluating and revising their conservation management status as deemed appropriate to ensure their persistence; and that the SM program would be a practical and economically efficient means to this end, with adequate resources to accomplish its objectives. It was also expected that sites would be protected for those species of high persistence concern, and that management recommendations would be developed to guide site management, which would entail protection on the order of tens of acres (with some exceptions) and some management treatments (for example, prescribed fire for some vascular plants). The agencies would develop an interagency geographic information system (GIS) database to house the information for analysis.

Survey protocols and species surveys—
It was further expected that effective survey protocols would be developed. The 1994 ROD (USDA and USDI 1994b) required surveys for amphibians and the red tree vole to begin by 1997 and for all other "strategy 2" species (species for which predisturbance surveys were to be conducted) by 1999, and that protocols would be prioritized based on species risk level.

Predisturbance surveys would be conducted to avoid loss of sites for some species. Such surveys would start at the watershed analysis level to identify likely species based on habitat. For species for which predisturbance surveys were not required, likely sites would be identified at the individual project scale based on likely range and habitats. Multispecies surveys would be used as possible, and survey protocols and site management would be incorporated into interagency conservation strategies as part of ongoing planning efforts. This would include identifying high-priority sites for protection. Broad-scale (general regional) surveys would be implemented by 1996 and completed within 10 years, and major areas of scientific uncertainty on most species resolved during that period. The 2001 ROD noted that statistically-based "strategic surveys" (Molina and others 2003), together with other approaches including research and habitat modeling, would replace the previous extensive and general regional surveys, to provide more reliable scientific data on species rarity and habitat associations.

Changes in activities and no adverse effect on probable sale quantity—
It was also expected that changes of management activities under the SM program would include evaluating and

potentially altering schedules for conducting surveys, moving species from one category to another, and dropping the SM mitigation for any species whose status is determined to be more secure than originally projected. The SM program would be expected to not adversely affect probable timber sale quantity (PSQ) beyond levels noted in the FSEIS (USDA and USDI 1994a).

Annual species reviews—
As summarized above (also see fig. 8-1), the 2000 FSEIS and 2001 ROD (USDA and USDI 2000, 2001) instituted a revised SM program, which was expected to provide clarity to ASRs as an adaptive evaluation process. It was expected that the data-gathering and ASR procedures would likely result in removing some species from the SM species list, and that National Environmental Policy Act documentation would not be made for decisions made under the ASR process. The ASRs would apply criteria for species' persistence, rarity, and association with LSOG forests and reserves to judge the category of SM mitigation for each species. The 2000 FSEIS and 2001 ROD also provided criteria for potentially adding species to the SM list.

Biodiversity and rare species monitoring—
The 1994 ROD (USDA and USDI 1994b: E-6, E-8–E-11) explicitly called for effectiveness and validation monitoring of biodiversity and rare species. The 1994 ROD defined effectiveness monitoring as "evaluating if application of the management plan achieved the desired goals, and if the objectives of these standards and guidelines were met." It specified that "Success may be measured against the standard of desired future condition… Effectiveness monitoring will be undertaken at a variety of reference sites in geographically and ecologically similar areas. These sites will be located on a number of different scales…" (USDA and USDI 1994b: E-6).

The 1994 ROD specified effectiveness monitoring of biological diversity and late-successional and old-growth forest ecosystems including "forest processes as well as forest species." One evaluation question was stated in the 1994 ROD as: "Are habitat conditions for late-successional forest associated species maintained where adequate, and restored where inadequate?" The 1994 ROD stated that indicators for "assessing the condition and trends" include "seral development and shifts of forest plant communities," and that "key monitoring items" included "abundance and diversity of species associated with late-successional forest communities" and "species presence (to calculate species richness, that is, numbers and diversity" (E-8–E-9).

The 1994 ROD also called for validation monitoring, which it defined as determining "if a cause and effect relationship exists between management activities and the indicators or resource being managed." The 1994 ROD stated that validation monitoring asks "are the underlying management assumptions correct? Do the maintained or restored habitat conditions support stable and well-distributed populations of late-successional associated species?" The 1994 ROD also noted that key items to monitor include "rare and declining species" of plants or animals, including those federally or state listed, proposed, or candidate threatened or endangered, or listed by FS or BLM as sensitive or special status, or "infrequently encountered species not considered by any agency or group as endangered or threatened and classified in the FEMAT Report as rare." This validation monitoring would focus on "the type, number, size and condition of special habitats over time" to "provide a good indication of the potential health of the special habitat-dependent species" (p. E-10–E-11).

The 1994 ROD acknowledged that habitat requirements of species can vary with age, size, or life cycle of the species, and with season, and also that although stable habitats are "not proof that a special habitat-dependent species population is stable, a decrease in a special habitat type does indicate increased risk to that species population." The 1994 ROD also stated that "a monitoring program for rare and declining species will help to identify perceived present and future threats, increase future possibilities of discovering new locations, track their status and trends over time, and ensure that, in times of limited agency resources, priority attention will be given to species most at risk" (p. E-11).

The 2001 ROD (USDA and USDI 2001) stated that monitoring, including biological diversity effectiveness monitoring, should continue as specified in the original 1994 ROD. The 2001 ROD also specified that the strategic surveys and the ASRs would contribute toward the validation monitoring phase.

What Has Occurred and Were There Differences Between Expectations and Observations?

Species Outcomes

Focus on LSOG species—
The Plan was implemented as a set of guidelines for land management allocations, along with additional mitigation guidelines for the evaluation and disposition of LSOG species under the SM program. Implementation of the Plan for LSOG species focused on species and their habitat relationships, and not on other biodiversity parameters such as other levels of biological organization, ecosystem processes, and organisms' ecological functions. There has been no evaluation (including monitoring) of the degree to which the Plan has provided for these other aspects of biodiversity.

Evaluation of species rarity and persistence—
Under the ASRs, new data were collected on selected SM species and the species were reevaluated in an adaptive management framework to confirm or alter their conservation categories under the Plan. Although the term "rare" was never specifically defined by FEMAT or in the Plan, general criteria for determining species rarity were presented in the 2000 FSEIS and 2001 ROD (USDA and USDI 2000, 2001) that revised the SM program with new conservation categories. These criteria included consideration for total number of locations, habitat and population trends, habitat fragmentation and population isolation, ecological amplitude of the species, distribution limitations, dispersal capability, and other factors (table 8-1). None of the criteria, however, was quantified. Also, different and potentially conflicting sets of criteria were presented in the 2000 FSEIS and 2001 ROD for "rare" versus "uncommon" status of the SM species. Also, no specific criteria or procedures were presented for determining overall viability of the SM species (see later discussion on viability issues).

Results of forest vegetation monitoring (Spies, chapter 6 this volume) suggest a net increase in the total area of what is classified as late-successional and old-growth forest vegetation cover over the decade of 1994-2004. However, it is not known the degree to which this "in-growth" of the old-forest vegetation age class provides specific sites or microhabitat conditions used and selected by the individual species addressed in this chapter, nor if forests lost to fire and other causes over this same period eliminated any such sites and microhabitats.

Surveys of rare species conducted—
The original assumption that many of the LSOG-associated species are rare has been partially borne out by surveys conducted over the past decade under the Plan. Data collected over the last decade on number of locations of 399 SM species suggest that many of the species are known only from very few sites. About 42 percent of all species have been found from 10 or fewer sites (accounting for 6 percent of total sites in the database) (table 8-2). On the other end of the abundance spectrum, about 5 percent of the species account for most (two/thirds) of the sites and likely are not rare; these patterns held among all taxonomic groups (figs. 8-2 and 8-3).

The four arthropod functional groups were included in the Plan because of concern that catastrophic disturbance, particularly wildfire, in southern Oregon and northern California could jeopardize their persistence. Given the impractical nature of surveying for potentially tens of thousands of arthropods in the four functional groups (at least some of which are likely to be unnamed species), the arthropod team instead chose a research strategy with three components: (1) examine the effects of experimental thinning and burning on select functional groups in a long-term

Table 8-1—Surrogate measures of population persistence and disposition under the Plan, as specified in the guidelines for the annual species review of nonfish LSOG-associated species other than northern spotted owls and marbled murrelets

Parameter	Surrogates
Geographic range	Occurrence of species within or close to the Plan area Occurrence of suitable habitat within the Plan area
LSOG association	Abundance in LSOG Association with LSOG components Known association with LSOG forests Suspected by experts to be LSOG associated BLM or Forest Service special status species Listed by states as species of concern Federally listed by U.S. Fish and Wildlife Service as threatened or endangered U.S. Fish and Wildlife Service candidate species Adequacy of field data to determine LSOG association
Population persistence provided by the Plan	Likely extant known sites occurring in part or all of its range Total number of individuals Number of individuals at most sites or in most population centers[a] Estimated total number of sites[a b] Limitation of geographic range to the Plan area Distribution of habitat within the Plan area Distribution of individuals within the overall range of the species Proportion of sites and known habitats in reserves Proportion or amount of potential habitat within reserves Probability that habitat in reserves is occupied Whether all other guidelines of the Plan provide for population persistence
Data sufficiency	Sufficiency of information for evaluating basic criteria for including on SM species list Sufficiency of information for determining management for a reasonable assurance of persistence
Practicality of surveys	Predictability of the occurrence of the organism Visibility of the organism Limitation of expertise for identifying the organism Ease of identification of the organism Concerns for safety of surveyors Risk to the species from collection for surveys Surveyable in two field seasons Survey methods can be developed within 1 year

Table 8-1—Surrogate measures of population persistence and disposition under the Plan, as specified in the guidelines for the annual species review of nonfish LSOG-associated species other than northern spotted owls and marbled murrelets (continued)

Parameter	Surrogates
Species rarity	To determine if the species is "rare:"
	Limited distribution
	Distribution within its range
	Distribution within its habitat
	Dispersal capability on federal land
	Reproductive characteristics that could limit population growth rate
	Number of likely extant sites on federal lands
	Number of individuals per site[a]
	Population trend declining or not
	Number of sites in reserves
	Likelihood of sites or habitats in reserves
	Ecological amplitude
	Habitat trend declining or not
	Habitat fragmentation lending to genetic isolation
	Availability of microsite habitats
	Factors beyond the Plan affecting rarity
	To determine if the species is "uncommon:"
	Number of extant sites
	Number of individuals per site
	Restriction of distribution within range or habitat
	Ecological amplitude
	Likelihood of sites in reserves
	Population or habitat stability

Note: LSOG = late-successional and old-growth forests.

[a] Information derived from the random grid surveys (see text for explanation).

[b] Not explicitly included as a guideline in the 2001 ROD but added as a criterion to the annual species review.

Source: USDA and USDI 2001.

Table 8-2—Number of Survey and Manage program species and their total locations within range categories of known locations

Number of known locations per species	Number of species	Percentage of total number of species	Total locations
0	22	6	0
1	26	7	26
2-5	72	18	237
6-10	48	12	401
11-20	48	12	711
21-50	60	15	2,059
51-100	36	9	2,793
101-300	51	13	8,306
301-500	9	2	3,383
501-1,000	9	2	5,989
>1,000	18	5	44,347
Total	399	100	68,252

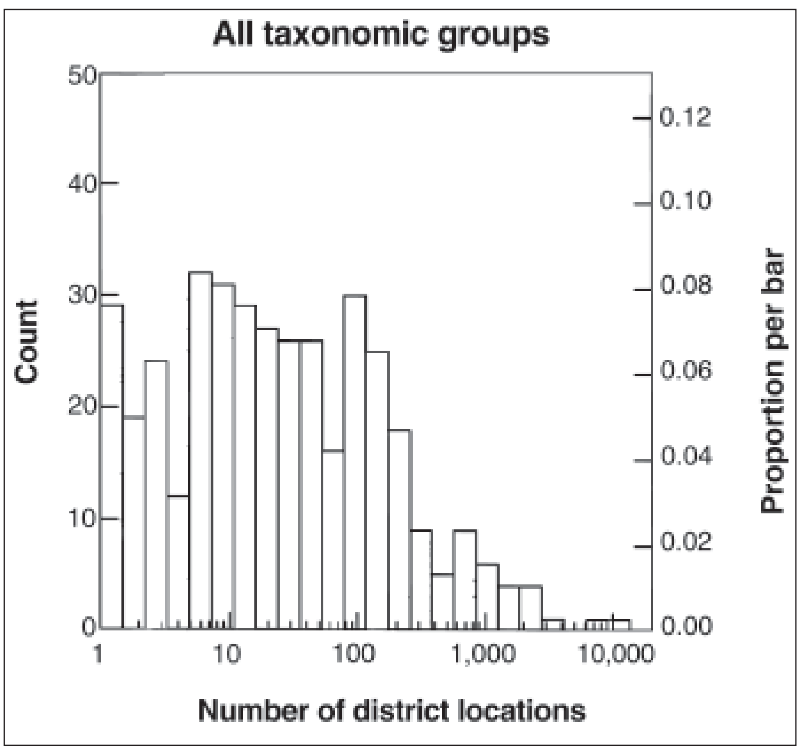


Figure 8-2—Species abundance distribution of number of distinct locations of Survey and Manage species (sites located through various surveys) within the Plan area, combined over all taxonomic groups. Note $\log_{10}$ scale on x-axis. Note that most species are rare, (known from very few sites), but some species are apparently more abundant.

Red Tree Vole

Red tree vole (*Arborimus longicaudus*) was a good example of a Survey and Manage (SM) species for which a great deal of work was done on developing survey protocols, conducting both strategic and predisturbance surveys for nests, and mapping nest locations to determine discrete population distributions for use in the annual species reviews.

One unique contribution to understanding and mapping distribution of this species came from Eric Forsman's research on northern spotted owls. The owl uses the vole as a primary prey item in a portion of the owl's range. Forsman was able to map the vole's distribution as a function of the appearance of the vole in owl pellets (Forsman and others 2004).

Other efforts on red tree voles included developing habitat prediction models and identifying high-priority sites. These tasks proved more involved and difficult than first envisioned because interpretation of the wide variety in the kinds of data available–including interpreting historical sites, potential nest sites, and active nest sites in terms of size and distribution of potential and active colonies—proved to be a challenge.

The red tree vole became one of the more problematic SM species because numerous nest sites were found through predisturbance surveys in the heart of its range in southwest Oregon on matrix land allocations. A large portion of timber harvest was planned for this area, and the presence of red tree vole nests interfered with that harvest, frustrating the management agencies. In the final 2003 annual species review, however, data from all of the combined survey, research, and modeling efforts provided the needed information for managers to decide to remove the red tree vole from the SM list, except for a small population in the northwest Oregon Coast Range. That population was later moved to the agencies' sensitive and special status species program in the 2004 record of decision.

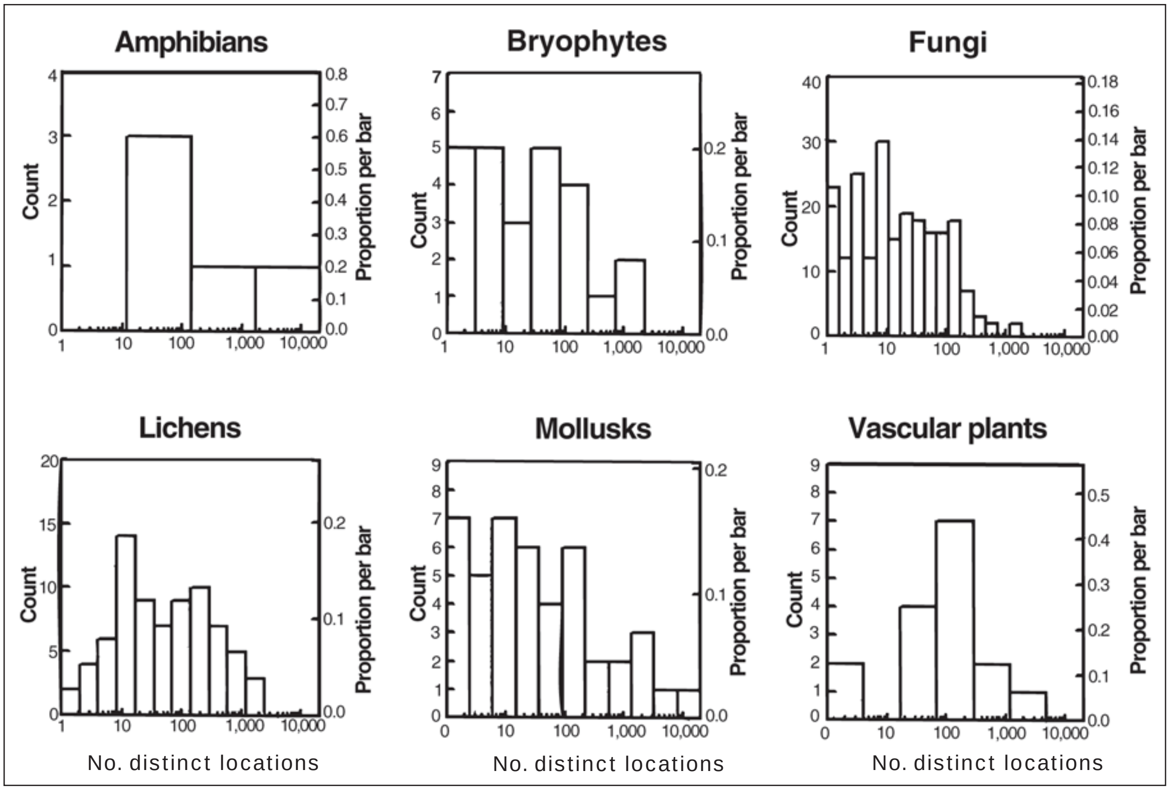


Figure 8-3—Species abundance distributions of number of distinct locations of Survey and Manage species (sites located through various surveys) within the Plan area, by taxonomic group. Note $\log_{10}$ scale on x-axis.

ecological research site in northern California and identify indicator species, (2) conduct retrospective studies of resilience and recovery of the functional groups in areas with different fire histories in southern Oregon, and (3) conduct extensive literature reviews of insects in the region to identify potential treats to persistence. These were multi-year studies funded at about $200,000 to $300,000 per year for 3 to 4 years, resulting in a set of publications and reports answering the basic three research components (for example, Niwa and Peck 2002).

Assumptions of persistence of some species—
The general assumption under the Plan that the 791 LSOG species not originally included in the SM mitigation are indeed viable and persistent (and thus not requiring SM mitigation) remains formally untested, although these species might have benefited from increases in LSOG and the reduced harvests over the past decade. No specific monitoring was established on these species under the Plan. Ancillary information may be available on some of these species under other research studies or agency programs (for example, the Demonstration of Ecosystem Management Options [DEMO] project, research studies of riparian-associated species, effects of retention, and effects of silviculture on suites of species), but this has not been compiled and analyzed.

Identification and protection of LSOG species habitats and locations—
The expectation that the Plan would protect suitable locations or environments for many of the LSOG-associated species is partially borne out by results of the surveys that suggest that many species locations occur within Plan reserves (fig.8-4). Many of the locations of fungi, lichens, bryophytes, and mollusks occurred outside

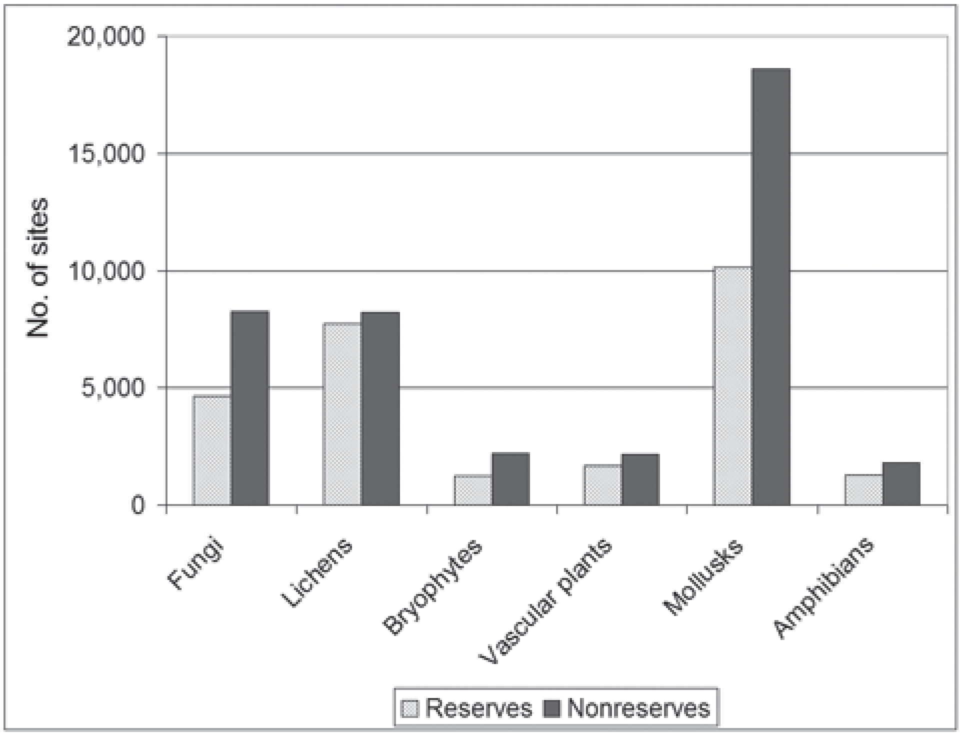


Figure 8-4—Number of known sites of species closely associated with late-successional and old-growth forests, located through various surveys, by reserve and nonreserve land allocations on Bureau of Land Management and Forest Service lands within the Plan area. Reserves include adaptive management areas, administratively or congressionally withdrawn areas, and late-successional reserves; nonreserve lands include riparian reserves (not separable in the database) and matrix lands.

Plan reserves. Survey and Manage species could occur within the Plan reserves, and within LSOG in those reserves, in part by chance. Some SM species likely occur in reserves and matrix sites in non-LSOG vegetation stands having some LSOG components, such as large standing or down wood legacies.

Regardless, the degree to which locations within the Plan reserves would suffice to provide for long-term viability of the other 791 LSOG species was not determined. Additionally, no monitoring per se was instituted for either the original set of 404 SM species and 4 arthropod species groups or for other aspects of LSOG biodiversity. Only various surveys have been conducted, mostly for predisturbance evaluation.

A total of 67,891 locations are known within the area of the Plan on all originally listed 404 SM species of all taxonomic groups, among all types of surveys (predisturbance, random grid, and other). Of this total, 26,676 locations (39 percent) are in reserves. Among taxonomic groups, the proportion of all locations from reserves ranges from 35 percent (10,125 of 28,730 locations) for mollusks to 49 percent (7,742 of 15,942 locations) for lichens. These results are likely biased toward locations outside reserves (viz., in matrix lands) where predisturbance surveys were conducted. Of the total surveys conducted, 79 percent are predisturbance surveys. Protecting SM species sites in matrix lands had a far greater perceived impact on PSQ than expected. This was primarily due to the 5 percent of the species noted previously that turned out not to be rare and were found with predisturbance surveys at nearly 40,000 sites, mostly in matrix lands (see lessons learned for further discussion on implications of the predisturbance survey approach).

Turley (2004) estimated that 67 percent of the federal land base of the Plan area consists of reserves, which include administratively and congressionally withdrawn areas, late-successional reserves, and managed LSRs. The remaining 33 percent consists of matrix lands, which here include timber management matrix lands, adaptive management areas, and riparian reserves designated under the Aquatic Conservation Strategy of the Plan. Not all LSOG forest occurs in reserves, and not all reserve lands are LSOG forest; USDA and USDI (1994a) estimated that 86 percent of existing late-successional forests are in reserves, so 14 percent are in matrix lands.[4]

Program Outcomes

Adaptive management approach and annual species reviews—

In general, the SM program did provide a useful adaptive learning framework by which new inventory and scientific information on the SM species was collected and analyzed, such as on number of locations from predisturbance surveys (figs. 8-5a, 8-5b) and other survey and information gathering efforts. The new information was used in the ASR procedures to reevaluate the conservation management status of each SM species, leading to the removal of some hundred species (about 25 percent) from the SM list during the overall SM program (fig. 8-6). This was a significant achievement, based on an unprecedented, massive database on species locations.

The ASRs also served to reassign some species to different conservation categories as a function of new scientific information mostly on their distribution and habitat associations. For example, the 2003 ASR evaluations resulted in removing from the SM program 29 (16 percent) of the 181 species evaluated that year, based on new scientific information. The 2003 ASR also reassigned 65 (36 percent) of the species to a more conservative category, kept 75 (41 percent) of the species in the same conservation category, and moved 41 (23 percent) of the species to a less conservative category, with no voting bias detected among the ASR panelists (Marcot 2003, Marcot and Turley 2003). These changes–again, part of the adaptive management approach–were scientifically supported by findings from the vast inventories conducted through the SM program.

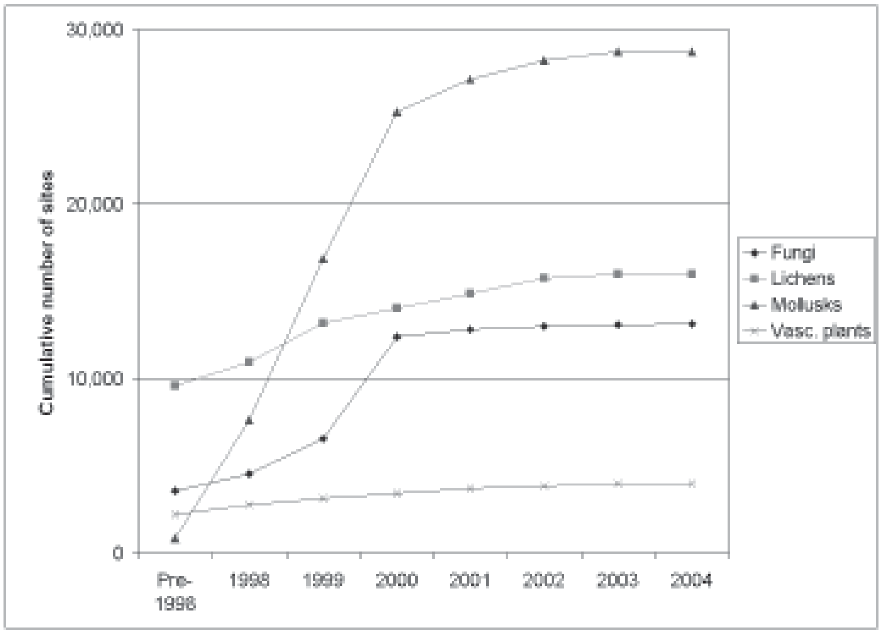
Effective survey protocols and species surveys—

Many expectations for the SM program were met, particularly for developing and instituting effective species survey protocols, conducting predisturbance and strategic (including random-grid) surveys (Molina and others 2003), accreting new data on species locations, developing databases and GIS information bases (with about 68,000 records), synthesizing science information for individual species into management recommendations and applying those recommendations to project plans, and identifying sites for which protection outside LSRs would be provided. Multispecies, probabilistic regionwide surveys called for in the 2001 FSEIS were developed and implemented that provided opportunities to examine regional species distributions in reserves and their rarity.

Development of species evaluation tools—

Also, useful tools, such as decision models based on the 2001 ROD evaluation criteria, were developed and successfully used to aid decisionmaking during the ASR process (Marcot and others, n.d.). Other models (viz., potential natural vegetation GIS models, for example,

[4] The riparian reserves have not been fully mapped, so there is no individual estimate of their areal extent nor the percentage of LSOG forest therein. However, USDA and USDI (2004b: 11) noted that “matrix and adaptive management area” land allocations constitute 19 percent of the Plan area. Presuming that “matrix” lands here do not constitute riparian reserves, one could estimate that riparian reserves might constitute 33 - 19 = 14 percent of the Plan area. Added to the other reserve lands, this totals 67 + 14 = 81 percent of the Plan land area in reserves including riparian reserves. There is no mapped information, however, on the extent of LSOG forest in riparian reserves.



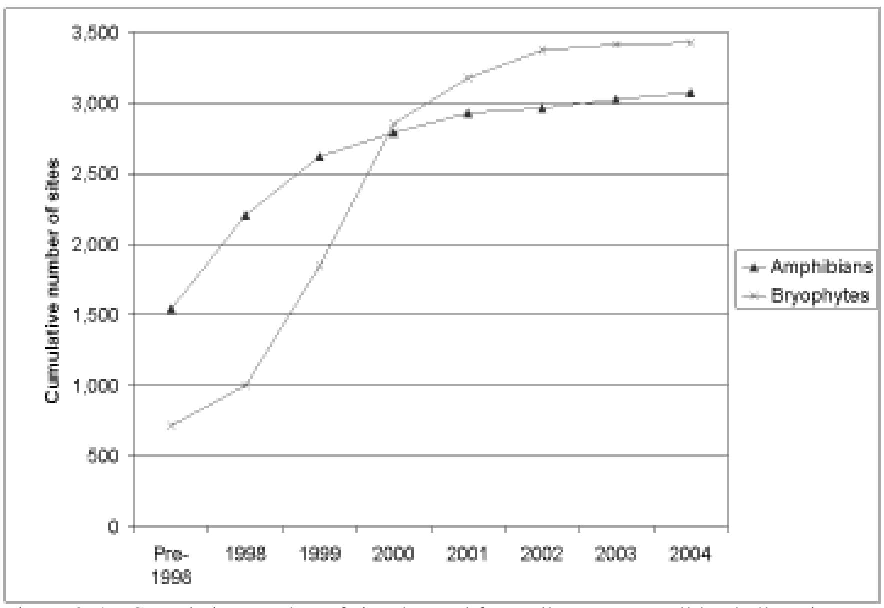
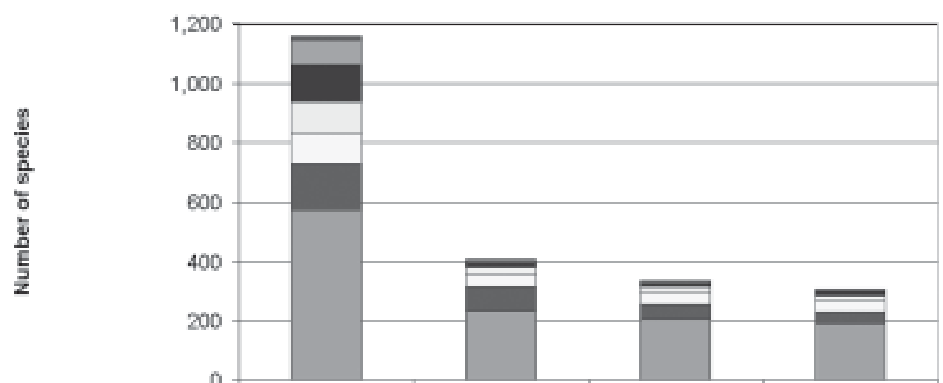


Figure 8-5—Cumulative number of sites located from all surveys on all land allocations (reserves and matrix lands), by taxonomic group and year. Substantial progress was made in locating sites particularly between 1998 and 2000.



	FEMAT analysis	Original guidelines	Revised guidelines	Current
Arthropod groups	15	4	4	4
Vertebrates	82	6	6	5
Vascular plants	124	17	12	12
Bryophytes	106	23	17	15
Mollusks	102	43	43	39
Lichens	157	81	48	43
Fungi	572	234	208	189

Figure 8-6—Number of species assumed closely associated with late-successional and old-growth forests as listed by the Forest Ecosystem Management Assessment Team (FEMAT) in 1994, in original guidelines of the 1994 Environmental Impact Statement (FSEIS) and Record of Decision (ROD) that instituted the Survey and Manage (SM) program under the Northwest Forest Plan, in the revised guidelines of the 2001 FSEIS and ROD that revised the SM program and its annual species review process, and “current” in 2004 at the termination of the SM program. The decline in number of species was because of new information used in the adaptive management process of the annual species reviews.

Lesher 2005; and Bayesian belief network models, Marcot, n.d.) for evaluating likelihood of habitat suitability for specific SM species had been developed but were only partially integrated into the program.

Some shortcomings in surveys—
Some expectations for the SM program were not met, however, including the following. The SM program, particularly the predisturbance surveys and ASR procedures, proved to be far more expensive and administratively complex than initially expected. Except for a few species, high-priority sites were not identified for protection, as called for in both the 1994 and 2001 RODs. Data on absence (lack of presence) of species from field surveys, particularly from predisturbance surveys, were not recorded, which was a major loss of otherwise useful information to build and test prediction models of species-habitat associations. Little habitat or species abundance data were collected in predisturbance surveys, similarly impeding the ability to construct habitat models or incorporate population attributes into conservation plans.

What Was the Extent to Which Differences Were Caused by the Northwest Forest Plan?

Species Outcomes

Conservation of LSOG species—
Many or most of the 1,120 LSOG-associated species originally identified by FEMAT are likely far better

conserved owing to the Plan, simply by dint of conservation of LSOG forests and forest elements in LSRs, riparian reserves, and matrix management guidelines providing for protection of known locations of some LSOG species. Much information has been collected on the number of sites that were protected for each species. Although that information does not translate to population outcomes, it is nevertheless a significant finding. However, the specific population outcomes, especially of the rarest of SM species, are largely still unknown.

Little information on species persistence—
Much of the implementation of the Plan for other species has focused on procedures for identifying and, where appropriate, protecting locations of rare and little-known, LSOG-associated species, and gathering new information on their associations with land allocations and habitat conditions. Little work has been done on species trend monitoring, and on validation monitoring of the expectations that the Plan has provided for their long-term persistence and viability.

Thus, it is difficult to conclude whether the Plan has indeed provided for the long-term persistence and viability of these species, although (1) protection was afforded to specific matrix land locations when identified through predisturbance surveys and (2) much of the managed landscape occurs as reserves in which a significant amount of LSOG forest remains and LSOG species locations occur. The assumption that the Plan has provided for viability—or conversely, that it has not adequately provided for some species—is still a hypothesis to be tested, at least by monitoring trends in species' locations over time, although we have some incremental, useful insights on locations and number of occurrences of some species from the various surveys.

Much uncertainty remains on whether the Plan has indeed provided for the long-term persistence and viability of a number of the LSOG-associated species and their ecosystem functions, particularly for the more rare of the SM species. A number of the less rare SM species, however, were removed from the SM species list by the annual species reviews, and these species were deemed to be secure under the Plan.

Some major reductions in uncertainty—
Although much remains to be learned about life histories and ecological functions of most LOSG species, knowledge gained on specific distribution and abundance of many of these species has helped greatly reduce scientific uncertainty. In turn, as used in the ASR process, this information helped reduce management uncertainty and increased reliability of management decisions on the conservation requirements of these species. This has not been a trivial accomplishment.

Still, some scientific and management uncertainty remains, including on SM species that were "downgraded" in conservation status under the SM species program, because only indirect, surrogate measures were used to judge the species' persistence. For some species, better data were gathered by use of random grid (strategic) surveys, species-habitat modeling, and other efforts. For these species, some of the uncertainty in their projected persistence was greatly reduced.

Program Outcomes

Perceived impact on timber PSQ—
The predisturbance surveys and their results impacted matrix land management and were viewed as being largely responsible for a far greater impact on PSQ than initially expected (see lessons learned for more details).

Organizational complexity—
Working across agencies to evaluate the entire federal land base (BLM + National Forest System) created a layer of organizational complexity that (adversely) affected timeliness in getting work done, and also in running a regional program that had a large component independently implemented by field staff. We discuss organizational issues further under lessons learned.

Avoiding federal species listings—
The expectation that the Plan would help stave off federal listing of LSOG-associated species has been largely borne out, although listing petitions have been advanced for a few species including lynx and fisher. It is unclear, however, whether the lack of listing petitions for other LSOG-associated species was directly a result of the Plan, although the Plan likely contributed to this outcome.

Are the Northwest Forest Plan Assumptions Still Valid?

Species Outcomes

Most LSOG species protected—
The initial projection that the main elements of the Plan would provide LSOG environments for most, but not necessarily all, species is still valid. Population persistence of the 404 SM species and 4 arthropod species groups–as well as the 791 species deemed to be effectively cared for under the Plan–is still untested.

Protection of some of the rarest species provided, others still uncertain—
The expectation that some species might garner additional conservation attention beyond the main elements of the Plan (Aquatic Conservation Strategy, riparian reserves, LSRs, matrix guidelines) was validated by the work of the annual species reviews. That is, based on the outcome of the ASRs, the late-successional and riparian reserves might **not** suffice to fully ensure protection and persistence of all LSOG species. Additional, species-specific assessments and considerations, as were conducted under the SM program and ASRs, likely are part of meeting this goal. This is particularly true for the rarest species (that is, those known from <20 sites) that had known locations outside of reserves. Thomas and others (1993) provided a detailed example of increased levels of protection granted to species with the addition of each new layer of a multilayered plan such as the Plan. One of the successes of the SM program was identification of known sites for protection of the rarest species outside reserves.

Program Outcomes

Disposition of the SM program—
Final consideration of the validity of Plan assumptions for the SM program is problematic because the SM standards and guidelines were removed from the Plan in 2004 (USDA and USDI 2004b). The SM program was controversial since its inception, resulting in litigations with different publics and eventual development of two SM FSEIS analyses and RODs to deal with implementation issues. Some of those issues were noted above, particularly the adverse impact on PSQ of management decisions not to continue projects (for example, timber harvest) in numerous matrix sites where SM species were detected through predisturbance surveys. The 2001 ROD (USDA and USDI 2001) also documented the adverse impact of SM mitigation activities on ability to conduct healthy forest and fire reduction projects in much of the Plan area.

In response to a 2001 lawsuit brought by the timber industry (Douglas Timber Operation, and others v. Secretary of Agriculture. Civil No. 01-6378 – AA), the administration settled and agreed to conduct a new EIS on the SM program wherein one alternative would consider movement of SM species to the agencies' special status and sensitive species programs (SSSSP). In the resulting 2004 SM FSEIS (USDA and UDSI 2004a), the agencies described their many frustrations in implementing the SM program mitigation and overall adverse impact it had on meeting other important Plan objectives (for example, PSQ, healthy forest restoration, and other management projects) and the high cost of the program. They selected a preferred alternative that removed the SM standards and guidelines developed in the 1994 and 2001 RODs (USDA and USDI 1994b, 2001) and moved 152 of the remaining 296 species into the BLM and FS SSSSP; 57 species not added to the SSSSP were projected to have insufficient habitat for persistence under this preferred alternative compared to a projection of sufficient habitat under the 2001 SM ROD (USDA and USDI 2001). The 2004 FSEIS and ROD clearly described the risks to species extirpation and management risk tolerance in making these decisions. The agencies emphasized the probable contributions of the Plan area in LSRs (80 percent of the Plan area), the risks to rare species persistence inherent in dynamic landscapes, and the stated desire to balance the uncertain nature of conserving these rare and little-known species with meeting other critical Plan objectives (see USDA and USDI 2004b: 9-13, for more details). Costs and benefits of the SM program were also given detailed analyses.

The 2003 FSEIS and 2004 ROD provided detailed effects analyses on the risk of extirpation of SM species under the three alternatives based on available data and expert opinion. The overall objectives of the SSSSP differ from the SM program, and SSSSP coordinators and field managers face many of the same challenges that SM staff did in conserving these species; many of the SM taxa such as fungi have not previously been included in the SSSSP. Therefore, the SSSSP could take advantage of the known site database, distribution maps, science documents, management guidelines, survey protocols, and conservation strategies pioneered and developed by the SM program. In approving the 2004 ROD, the regional executives apparently clearly understood the challenges and impact of moving 152 SM species to the SSSSP in Oregon and Washington, and have supported this transfer of knowledge gained from SM. They also have increased resources (funding and permanent regional staff) to accomplish the increased workload for these and other tasks. A section that follows on information gained and lessons learned from the SM program further supports the potential value of transferring key findings. The 2004 ROD was challenged by environmental groups, and in January 2006, the court ruled that the SM program be reinstated according to the 2001 ROD. It remains uncertain how the agencies will restart and continue the SM program and how a new FSEIS now underway will modify the program.

Information Gained and Lessons Learned

Information Gained on Rare and Little-Known Species

One of the underlying challenges, and indeed an underpinning for the adaptive approach of SM, was lack of fundamental information on species presence, distribution, abundance, biology, ecology, and conservation status: How rare are they? How are they distributed throughout the Plan area? How abundant are their populations? What are their primary habitat requirements? What factors are influencing their risk of extirpation? Answers to these questions are fundamental to discovering how well the Plan provides habitat for maintaining well-distributed, viable populations (that is, meeting the original mission objective for LSOG-associated species) and how to best manage, protect, or restore habitat to meet that original objective. The collection of nearly 68,000 known site records for all SM species over 10 years of Plan implementation provided the basis for unraveling some of this uncertainty for many species and allowed for informed science-based management decisions on their conservation.

Given new information on rarity, distribution in reserves, degree of LSOG-association, and persistence concerns, over 100 species were removed from the SM list because they no longer qualified for the SM mitigation. Many of these species were removed because they were not as rare as originally believed. The removal of these less rare species was an important adaptive decision because they accounted for many thousands of sites in the matrix; once removed from SM, these sites were released to meet other forest harvest and management objectives.

Known site data also showed that most SM species were rare; 54 percent of the species were known from 20 or fewer sites, 42 percent from 10 or fewer sites, and 31 percent from 5 or fewer sites. The SM database includes sites from both federal and nonfederal forests. When nonfederal sites are removed from consideration, the percentage of actual sites protected under the Plan was smaller. Given the high percentage of species that showed such rarity, these data support the assumption made during

Del Norte Salamander

At the initial implementation of the Plan, the del norte salamander (*Plethodon elongatus*) was thought to be a rare species endemic to southwest Oregon and northwest California. Predisturbance surveys were required for the del norte salamander starting in 1996, and by 1999 approximately 882 sites were located, 36 percent occurring on matrix land allocations (Nauman and Olson 1999). The number of sites increased to 1,000-1,500 over the next few years. Considerable reserve land also occurred within the range of the del norte salamander, but the reserve land had received little survey effort. It remained unknown how well the reserves were contributing to the persistence of the species. In 2000, a strategic survey was conducted in the region to examine del norte salamander distribution in reserves. Approximately one-third of all surveys conducted in the reserves yielded presence of the salamander. This new information on potential distribution in reserves, together with the high number of known sites (that is, less concern about rarity) provided support for removing the salamander from the SM list during the 2001 annual species review. This adaptive decision released many hundreds of sites in matrix lands for subsequent timber harvest and other management activities. This exemplified the ability of targeted, strategic surveys to supplement the typically biased records from predisturbance surveys and provide the underpinning for making better science-based decisions on species persistence and management needs.

FEMAT and the 1994 FSEIS (USDA and USDI 1994a) that application of a fine-filter strategy, in this case protection of known sites, would be an important strategy to maintain their viability. The discovery of many of these rare sightings outside of reserve land allocations further supported the protection of the few known sites to meet the objective of helping ensure conservation of these species.

Although the nearly 68,000 records allowed for better informed decisions, the data had shortfalls that limited their utility for answering the many questions noted previously. Lessons learned emerge from understanding the usefulness or limitations of the data. The vast majority of records are simply site locations with little or no information on habitat characteristics or species abundance. Thus, even though distribution maps could be generated, they could not be used directly to analyze population trends and dynamics, nor to predict potential habitat or its distribution. Collecting information on species abundance or habitat characters represents a significant expense compared to noting only presence.

It is important to carefully weigh what information helps to meet conservation objectives and the cost and benefit of obtaining that information in future inventory or monitoring surveys. If surrogate metrics are used to gauge species persistence and to reduce survey cost (for example, using rarity alone without species abundance data), the science panel evaluations of the SM program's annual species reviews taught the importance of knowing the limitations of the data and integrating its uncertainty into management decisions (see later discussion on use of surrogates in species viability analyses).

There was also significant bias in the nearly 68,000 records because most were from predisturbance surveys conducted primarily in matrix land allocations. This bias would be considered when addressing questions of how well the Plan, particularly the reserves, provided habitat for well-distributed, viable populations. The course change documented in the 2001 SM ROD toward more reliance on strategic (including random-site) surveys than on pre-disturbance surveys was directed at resolving this issue.

Regardless of these shortcomings, on a regional scale, the nearly 68,000-record database is one of the largest and richest of its kind for poorly known taxa such as fungi, lichens, bryophytes, and mollusks. It could serve not only as a valuable resource for the SSSSP of Oregon and Washington, but the rigorous procedures for inventory and amassing survey data could help in developing conservation strategies for rare and little-known taxa in other regions.

Information Gained and Lessons Learned From the SM Program

The SM program ploughed new ground in the science and conservation management of rare and little-known species. Results of the SM program are pertinent not only to the stated objectives of the SSSSP, but also to conservation programs worldwide that are grappling with similar challenges in conservation of rare and little-known species. In identifying the challenges of managing biological diversity in Oregon and Washington as part of the PNW Station's Biodiversity Initiative (Molina 2004), Nelson and others (2006) found that numerous clients from inside and outside federal agencies voiced the desire to summarize and make available results from the SM program. We highlight here some of the major results and accomplishments of the SM program with a focus on lessons learned for potential use in future conservation efforts.

Management recommendations, survey protocols, and field guides—

Developing science-based management recommendations was critical to meeting the assumption that agencies could provide immediate site management for species of high concern. The management recommendations documents served two major functions. First, they summarized the best knowledge available on the biology, ecology, and natural history of the species. Second, they synthesized and integrated this knowledge into flexible guidelines so that managers could manage sites within their overall planning objectives. Recommendations focused on guidelines to maintain suitable habitat for species at the site scale.

Survey protocols identified when and where surveys were to be done, and the sampling procedures, the information to collect, and the survey skills required. Field guides for collection, identification, and processing of fungi and mollusks, two of the more difficult taxa, also were developed (for example, Castellano and others 1999, 2003; Frest and Johannes 1999). All management recommendations, survey protocols, and field guide documents are available on line (www.or.blm.gov/surveyandmanage) and provide the most extensive management guidance to inventory and manage habitat for these taxa. These documents are available for the SSSSP efforts.

Development of an interagency species database—

As directed under the 1994 ROD, the SM program strove to develop an interagency database capable of mapping known locations through GIS procedures to aid analysis of other critical habitat and species attributes.

Development began as a simple "known site" database with much of the information coming from herbaria, museums, and agency data collected as part of the FEMAT and the Plan processes. In 1999, the new database (called the Interagency Species Management System or ISMS) came on line with full-time staff. After extensive training of field staff on ISMS use, new data were entered and analyses conducted as part of the annual species review process. At the conclusion of the SM program nearly 70,000 survey records were housed in the ISMS database. This is the largest known assemblage of site and habitat data for these particular taxa.

The data, resulting maps, and analyses were used in the ASR process and, later, by the Natural Heritage Program to place species into the agencies' SSSSP when the SM program was terminated. The ISMS database has now migrated to the new interagency Geographic Biotic Observations (GeoBOB) database and provides the framework for future GIS analysis and planning for the conservation of species in the SSSSP program and elsewhere.

Predisturbance surveys—

The intent of predisturbance surveys was to avoid the inadvertent loss of sites to maintain species persistence, particularly for rare species found outside reserves in matrix lands. As noted previously, predisturbance surveys became the most costly and controversial part of the SM program.

The 1994 ROD stated that most preproject surveys would begin with a watershed analysis and would identify likely habitat therein that required survey of the SM species. However, because so little was known about the habitat for these species, most surveys were conducted at the project level (that is, nearly all management projects required preproject surveys, often for multiple species). Surveys often were expensive and constrained by lack of trained personnel, and some species survey protocols were difficult and time consuming.

Field managers often stalled or cancelled projects because of the presence of SM species at the project sites. Eventually many of these species that turned out not to be as rare as previously known were removed from the SM program, but not until late in the program. The end result was a major impact on meeting the timber PSQ.

Although the conduct of predisturbance surveys met the expectation of avoiding inadvertent loss of sites, it became an unintended dominant aspect of the program. About 75 percent of all ISMS records were from preproject surveys, and these were only for about 10 percent of all SM species. When survey protocols were developed, data on habitat features and species abundance were not required, so these survey records mostly consisted of only a “known site” location. Nor were negative findings typically recorded from these surveys. The predisturbance survey data did not aid understanding of species’ habitat requirements and had limited utility for building habitat models of species’ habitat associations by which to predict occurrence on the landscape.

Three valuable lessons emerge from the predisturbance survey effort: (1) Predisturbance surveys can locate new sites and aid in rare species protection, but often provide biased data of limited value in understanding species distribution, habitat selection, persistence, and conservation management. (2) Presence/absence data is of limited value in understanding species viability and conservation management; data on habitat and species abundance are required to better inform decisions on management for species persistence. (3) An adaptive process to quickly review and evaluate the effectiveness and cost/benefit of survey strategies is important to meet long-term goals. The 2001 ROD recognized some of these issues and emphasized that strategic surveys that would focus on reserve lands were required.

Strategic surveys—

Strategic surveys, which were to be conducted on both matrix and reserve lands as well as in LSOG and non-LSOG, were developed as an underpinning for the 2001 SM ROD for three reasons. First, the agencies recognized that predisturbance surveys were not targeting reserve lands because most projects occurred in the matrix. A fundamental uncertainty of the SM mitigation was how well the reserves provide for species persistence. Second, little habitat or abundance data were collected in preproject surveys; this information is vital to understanding habitat association and designating high-priority sites as part of conservation plan development. Third, the SM program was based on an organizing principle and vision tool to work through the priorities of the SM program to bring better balance to meeting species conservation with other Plan objectives such as timber harvest. The strategic survey effort together with the newly defined annual species review process was designed to address these issues.

The strategic survey effort followed the adaptive framework developed by Molina and others (2003). The framework represents an iterative process that identifies specific information gaps, prioritizes species based on biological or management gaps, designs and implements efficient survey approaches, and then analyzes the survey findings as part of the annual species review. A new set of information gaps is identified from these analyses and the planning and implementation process is repeated. The strength of this approach is that it is designed to address specific questions that reflect priority information gaps.

Strategic surveys included a wide variety of approaches to fill information gaps, including research and modeling approaches. This variety of approaches increases flexibility of the overall program and enhances opportunities for partnerships between managers and researchers. Such a flexible "strategic" approach could enhance the effectiveness of the SSSSP, particularly in dealing with species such as fungi where predisturbance surveys largely remain impractical. Landscape-scale surveys, for example, that cross BLM and FS district boundaries and that use a statistically designed sampling scheme, could help field managers to share resources for collecting and analyzing data throughout a significant portion of a species' range. We provide results below from one example of this approach, the random grid survey.

Random grid surveys—

In 1999, regional leadership requested development of a broad-scale survey throughout the Plan area that would provide valuable information on all SM species (that is, use a multiple-species approach) concerning their rarity and distribution in LSOG habitat and reserves. The survey would be statistically designed to allow for use of probabilistic inferences of species' occurrence across the Plan area. Working in consultation with a team of statisticians, a strategic survey workgroup developed what is called the random grid survey (see Cutler and others 2002 and Molina and others 2003 for a discussion of the strengths and weaknesses of this survey approach).

The random grid survey uses permanent points on the landscape (the forest inventory and analysis [FIA] and current vegetation survey [CVS] grid) that contain a wealth of information on stand age, composition, and structure (for example, amount of coarse woody debris and number of snags). Seven hundred fifty randomly selected sampling points were stratified into LSOG vs. non-LSOG (LSOG = forests >80 years) and reserve vs. matrix lands to address the primary questions of LSOG and reserve association of each species. Occurrence estimates of each species were calculated by extrapolation of the number of sites at which the species was found to predict occurrences over the survey area. Implementing this survey for about 300 species was extremely complex and expensive (about $8 million) and took over 2 years to complete. Nearly 240 people were involved in planning, execution, specimen identification, analysis, and reporting. Final results are still in the reporting stage so we can only provide a limited summary at this time.

Overall, it appears that the random grid survey met some of the original expectations and objectives. Approximately 3,000 new records were added on 179 SM species, roughly one third on lichens and another third on fungi. Figure 8-7 shows, however, that most species were found from only 10 or fewer sites each, one third were found from 1 or 2 sites, and 40 percent of the species were not found at all. This is the general result predicted by Cutler and others (2002) who noted that this broad-scale type of survey would likely not detect extremely rare species. Although that was true overall, a few very rare species (that is, known from only a few sites) were detected in the survey.

Results from the random grid survey also helped expand the known overall distribution of several species. However, evaluating the degree of association of the SM species with LSOG or reserve lands proved difficult because these analyses require at least 10 detections for a reasonable amount of certainty. Of the 41 species with 10 or more detections, about 30 showed a statistical association with LSOG and 7 with reserve or matrix land allocations (two with reserves and five with matrix). Regardless of statistically significant results, knowing that species were detected in reserves may be useful because this information was previously lacking in the ISMS database.

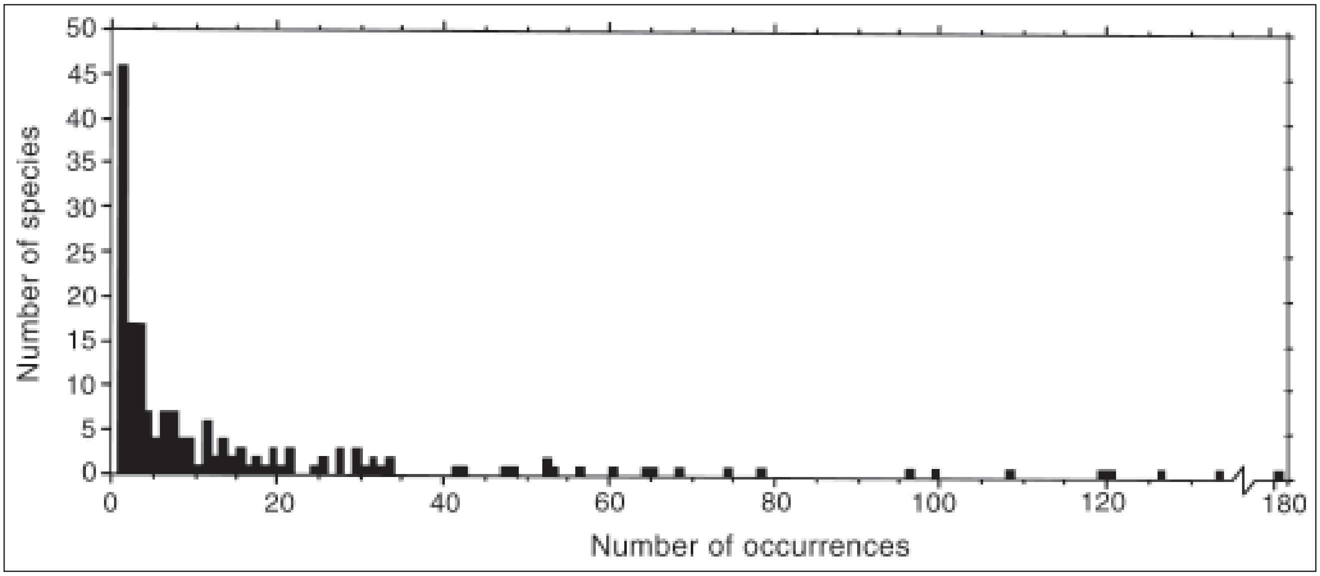


Figure 8-7—Distribution of number of species found at sampled random grid survey points. Data represent a total of 2,985 occurrences found among 179 species of bryophytes, fungi, lichens, and mollusks sampled on 660 grid points throughout the Plan area.

Figure 8-7 also shows that several species were detected frequently on the random grid. Most of these species had already been removed from the SM list or were being viewed in the annual species reviews as not rare.

Although the random grid survey data analyses were not completed prior to the termination of the SM program, preliminary results were used in the annual species review. For example, some species were removed from the SM species list in part because the random grid surveys suggested the species were not rare within the Plan area.

Given the mixed results (few to no locations of very rare species, but useful information on other species on LSOG and reserve association) and great expense of the random grid survey, the SSSSP may wish to carefully review the findings and identify advantages of this survey approach, to help meet program objectives (see Edwards and others 2004 for further discussion).

Annual species reviews—

One of the more successful outcomes of the SM program was the annual species review (ASR), designed as an adaptive decision framework to address uncertainty and provide new information to guide SM species conservation decisions (fig. 8-8). The 2001 ROD revised and expanded the ASR process and provided specific criteria and guidelines by which panels of species experts and evaluators would summarize and interpret ecological attributes of each SM species for reevaluation of the species' conservation status under the Plan.

Bruce G. Marcot

Figure 8-8—Annual species review panel of the Survey and Manage program being led by Russ Holmes. The panels were used in a successful adaptive management process to evaluate species conservation status under the Plan.

Using this process, the agencies removed about one quarter of all SM species from the list, and changed categories of several species to either a more or less conservatory status to reflect mitigation. Decisions to remove some species provided the agencies with the latitude to permit other management activities to proceed on those sites.

The ASR process was not a formal population viability analysis but rather a decision process that used a number of surrogate factors that represented species rarity and persistence. It is unlikely that traditional population viability analyses—which demand data on demography, population genetics, community interactions, and other ecological factors—could be conducted on most of the SM species owing to the species' rarity and to the dearth of quantitative information. Thus, it was vital to ensure that the ASRs served as a rigorous decision analysis procedure. To this end, the 2001 ROD guidelines specifying the criteria for the ASR species evaluations were formalized into a set of decision models (Marcot and others, n.d.). The models were used by the ASR evaluation panels to determine which categories of conservation status, if any, might pertain to each species given the scientific data. The models clearly showed how the surrogate factors were used to judge potential conservation status categories, and the ASR evaluation panel fully documented their use of the data and model outcomes in their recommendations. Thus, the overall ASR process was trackable, rigorously conducted, and fully documented. Many of the processes used in the ASR may prove valuable in assessing SSSSP species status and trends.

Selecting high-priority sites for management— The 2001 ROD also specified identifying high-priority sites for some of the SM species categories (for uncommon species whose status was not determined). Selecting high-priority sites for management was intended to provide a measure of protection for the species but also allow some sites to be used for other management objectives such as forest stand thinning and timber harvest.

This aspect of the SM program was slow to be implemented, and by the end of the SM program, plans were still in developmental stages for only a few species. This was an unfortunate outcome because developing these plans (that is, selecting high-priority sites for management) was a key process to release known sites in the matrix for other management objectives.

The plans under development used information from watershed analyses to determine where critical sites occurred in relation to nearby reserves with suitable habitat. These plans and the process used to develop them may provide useful tools for the SSSSP, particularly in evaluating the degree to which reserve lands could provide for species and could thereby defer the development of site-specific protection measures.

Program organization and implementation— Implementing the SM mitigation became a far more complex, expensive, and process-driven program than originally envisioned by the FEMAT and EIS writers (Holthausen 2004). Reasons for this are many and varied. Although some aspects of the SM program were expected to be expensive (tables 8-3 through 8-6), final costs exceeded expectations, particularly in conducting pre-project surveys throughout the region by field units (see USDA and USDI 2001 and 2004a for details on program costs). Available information makes it difficult to compare projected and actual costs.

The 1994 ROD provided little guidance for SM program organization and implementation. None of the original FEMAT or EIS team members who developed the standards and guidelines of the Plan program participated in early development or design of the SM program, so original intentions may have been lost or overlooked. A group of interagency specialists eventually formed a core team to develop the SM program of work. Most of these specialists were assigned only part time to this project, with some members coming and going as details ended. A shortage of taxa expertise within the management agencies surfaced early in SM program implementation and affected the

Noble Polypore


Forest Mycology Team

The noble polypore (*Bridgeoporus nobilissimus*) was unique among the original 234 SM fungal species. It forms large conks or shelf-like fruiting bodies up to a meter across at the base of large trees (it is a heart-rot fungus) that are perennial. Because the fruiting bodies of the noble polypore are always present and easy to detect, the species was listed under the original category 2 conservation status—survey prior to ground-disturbing activities. No other fungal species were placed in this category because of the difficulty in locating them through surveys in any given year.

The noble polypore was only known from six sites at the time of FEMAT, and two of those sites had no protection because they existed outside of reserve land allocations. Those two known sites were given unique protection in the original SM standards and guidelines: "Management areas of all useable habitat up to 600 acres are to be established around those two sites for the protection of those populations until the sites can be thoroughly surveyed and site-specific measures taken" (USDA and USDI 1994b: C-5).

Over the next several years those original sites were surveyed by the survey and manage mycology team and several new records of fruiting conks were noted. More importantly, detailed habitat data were collected at these known sites. A better understanding of required habitat emerged, which allowed for construction of habitat models (Marcot, n.d.) and targeted, purposive surveys into potential habitat in the region. A critical finding, for example, was the specific association of noble polypore conks with large stumps of *Abies procera* Rehd. in the Oregon Coast Range and *Abies amabilis* Dougl. ex Forbes in the Cascade Ranges of Oregon and Washington as well as the Olympic Peninsula. Subsequent surveys by expert mycologists found several new sites, approximately tripling the number of known sites and extending the known range. The species was not located in predisturbance or random grid surveys.

This provides a good example of using expert knowledge to build habitat models to better target regional surveys. The noble polypore was transferred to the agencies' Sensitive and Special Status Species programs in the 2004 record of decision.

Table 8-3—Projected (anticipated) costs for survey activities over the life of the Survey and Manage program[a]

Survey activity	Projected costs
	Thousand dollars
Bryophyte extensive and general regional surveys	100
Lichen extensive and general regional surveys	500
Vascular plants preproject surveys	330
Known locations for rare, endemic fungi (over 3 years)	1,000
Fungi extensive and general regional surveys (over 10 years)	10,000
Arthropods, 20 watershed surveys	9,000
Total	20,930

[a] Extensive and general regional surveys were expected to take at least 10 years.

Source: USDA and USDI 1994a, Appendix J2. Values do not include regional program implementation costs or predisturbance survey costs.

Table 8-4—Approximate regional expenditures of implementing the Survey and Manage program from 1994 to 1999

Cost element	Cost
	Thousand dollars
Program management	600
Preparation of survey protocols, management recommendations, and field guides	1,905
Training and species identifications	1,566
Extensive and general regional surveys[a]	2,875
Known-site database	610
Interagency Species Management System	1,100
Overhead	1,904
Subtotal regional program costs	10,560
Predisturbance surveys 1994-1998	1,000
Predisturbance surveys 1999	8,500
Total	20,060

[a] Did not begin until 1996.

Source: USDA and USDI 2000: 410-412.

Table 8-5—Annual projected (anticipated) short-term (1 to 5 years) and long-term (6 to 10 years) cost, projected from 2001 onward, to implement the preferred alternative for the Survey and Manage program

Program level	Cost element	Short-term cost	Long-term cost
		Thousand dollars	
Regional	Strategic surveys[a]	7,700	1,000
	Field guides, management recommendations, survey protocols	600	300
	Program management	500	500
	Data management	400	400
	Training, species identification	600	600
	Subtotal	9,800	2,800
Field	Predisturbance surveys for timber	8,200	6,100
	Predisturbance surveys for fire	10,300	7,700
	Predisturbance surveys for other	400	300
	Subtotal	18,900	13,400
	Total	28,700	16,900

[a] Beginning in 2001, strategic surveys replaced the extensive and general regional surveys.

Source: USDA and USDI 2000: 417-419.

Table 8-6—Approximate expenditures of the Survey and Manage program 2001–2004

Fiscal year	Regional program	Predisturbance surveys	Total
		Thousand dollars	
2001	10,400[a]	—[b]	—
2002	8,300[a]	7,700[c]	16,000
2003	6,100[a]	—	—
2004	5,200[d]	—	—
Total	30,000	>7,700	>16,000

[a] Source: 2003 Survey and Manage annual report, p. 8: http://www.or.blm.gov/surveyandmanage/AnnualStatusReport/2003/S_and_M-2003.pdf

[b] Data unavailable in existing documentation.

[c] Source: USDA and USDI 2004a: 215 noted that the level of expenditure for fiscal year 2002 fell short of predicted costs owing to less predisturbance surveys that year and stated that the total spent for the program was $16 million. The 2003 Annual Report shows program costs at $8.3 million, so the predisturbance cost was calculated from the difference between total and regional costs.

[d] Source: Survey and Manage program expenditure spreadsheet. On file with: Forest Service, Pacific Northwest Regional Office, Portland, Oregon 97208.

ability of the SM program to develop science-based products (for example, management recommendations and survey protocols) for over 400 poorly known, taxonomically diverse species. This shortage of expertise was especially critical on some taxa such as mollusks and fungi. Shortage of expertise also affected ability to develop products within deadlines envisioned by original planners. Nevertheless, the early SM organization struggled successfully to develop these essential products and to initiate broad regional surveys.

In 1999, as agencies began the EIS process to redefine the SM mitigation (eventually resulting in the 2001 ROD), a new SM organization was established with permanent staff that was responsible for all aspects of program implementation. Permanent positions included a program manager, strategic survey coordinator, conservation planner, and annual species review coordinator. A team of four agency representatives continued to provide support for many tasks. Approximately 90 specialists from BLM and FS field units (totaling 35 full-time equivalents) worked on taxa teams to develop species-specific products and to conduct species evaluations. An interagency group of intermediate managers provided direct oversight and leadership, thus enabling more efficient policy and management decisions. This new organization and leadership support greatly improved the efficiency and effectiveness of the program.

Much of the complexity and process-laden aspects of the SM program grew from the enormous task of building a science-based approach for conserving 400 poorly known species that required gathering new information over a 24-million-acre planning area. Working across BLM and FS agency boundaries, both organizationally and physically on the landscape, added another layer of complexity. Many SM tasks such as development of management recommendations and protocols, database development and analysis, and species status evaluations, required regional oversight; other tasks such as conduct of preproject surveys and data collection were the responsibility of field units. Successfully implementing these tasks required new ways of communicating between agencies and between regional headquarters and district offices. In the end, the ability of agencies to cross these boundaries and overcome many of the challenges was perhaps one of the more successful aspects of the SM program, particularly after formation of the new SM permanent organization. Six federal agencies shared personnel and resources over several years to accomplish these many difficult tasks, thus meeting one of the primary goals of the Plan in working together to manage resources at a regional scale.

Several important lessons emerge regarding the organization of an effective science-based management conservation program. First, and most important, is having a long-term vision that clearly articulates both short- and long-term objectives for the program. Such a vision was lacking in the early years of SM implementation so it was difficult to pull together the complex tasks into a cohesive framework to measure success. Secondly, permanent expert staff assigned to the program provided continuity and accountability for meeting expectations far more efficiently than did staff temporarily assigned as detailers from other units. The SM program significantly enhanced its productivity and accountability with the development of a recognized program with permanent positions. The recent additions of new positions to the regional SSSSP is an important step in that direction. Third is development of effective communication between regional and field staff to provide timely information sharing of ongoing tasks, deadlines, and accomplishments. The SM Web site (www.or.blm.gov/surveyandmanage), annual reports, data calls, and field training workshops are good examples. Finally, connecting the program to a regional vision to conserve biodiversity would help to place the conservation of rare species in a broader agency mission context.

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Figure 8-9—This rare Survey and Manage species is Van Dyke's salamander (*Plethodon vandykei*), found mostly in southwest Washington.

Considerations

Efficacy of Large Reserves for Conservation of Rare Species and Biodiversity

A central tenet of the Plan was that the system of late-successional reserves would largely suffice to provide for species and biodiversity components associated with late-successional and old-growth forest ecosystems. We have found that, to an extent, this is likely true. However, the degree to which late-successional reserves–along with the set of other Plan land allocations (for example, riparian reserves in matrix lands)–suffice varies considerably by species and biodiversity component. It also likely varies by the specific locations chosen for the late-successional reserves–such as whether they happen to intersect unknown sites of particular species or communities, and if they happen to contain microenvironmental conditions and specific habitat elements used and selected by those species or communities (figs. 8-9, 8-10).

Bruce G. Marcot

Figure 8-10—Typical streamside habitat of Van Dyke's salamander on Gifford Pinchot National Forest in the southern Washington Cascade Mountains, being studied by research wildlife biologist Charlie Crisafulli.

Initial findings (Turley 2004) of the random-grid survey study on SM species suggest that both Plan reserves and LSOG forests within and outside reserves may play key roles in providing habitat for many species. Out of a total 394 SM species targeted for survey in this study, sufficient data were gathered on 108 species (bryophytes, fungi, lichens, and mollusks) by which to determine degree of association with reserves and with LSOG. Of these 108 species, 41 species had 10 or more detections. These results alone suggest that most of the 394 SM species were seldom if ever encountered during the random grid survey, and thus results of this study pertain largely to the more abundant species. Of the 108 species tested for association with reserves, only 2 species (2 lichens) were significantly or marginally statistically associated with reserves, and 5 species (1 bryophyte, 1 fungus, 3 lichens) with matrix lands; the rest of the species showed no association with either reserve or matrix lands (figs. 8-11, 8-12). Of the 108 species


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Figure 8-11—A Survey and Manage species of lichen, *Lobaria pulmonaria*, "lungwort" or "lung lichen," so named because it reminded medieval European doctors of lung tissue. It grows on trees, shrubs, and mossy rocks in moist low- to mid-elevation forests mostly in coastal influence zones (McCune and Geiser 1997). It is used in Britain as an indicator species of undisturbed forest ecosystems.

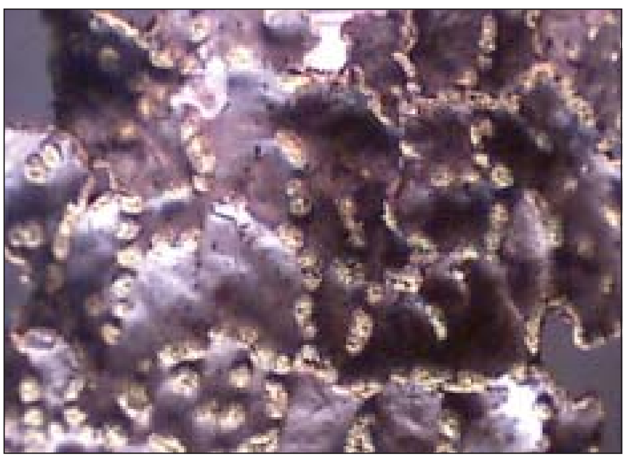
Bruce G. Marcot

Figure 8-12—This Survey and Manage lichen is *Pseudocyphellaria crocata.* The round yellowish edges are structures called soralia, where algae enclosed in fungal threads are produced for asexual reproduction. This lichen grows on bark and wood of hardwoods in low- to mid-elevation forests in the western Cascade Mountains (McCune and Geiser 1997). The species is sensitive to, and can be used to indicate, air pollution.

tested for association with LSOG, 30 species (3 bryophytes, 6 fungi, 20 lichens, 1 mollusk) were significantly or marginally statistically associated with LSOG, and 1 species (1 lichen) with non-LSOG lands; the rest of the species showed no association with either LSOG or non-LSOG.

These results suggest that about one third of all species that could be tested (again, being the more abundant of the SM species) were marginally to closely associated with LSOG, but only one SM species showed such association with reserves. This provides evidence that LSOG is important for at least 30 SM species–which is useful information not available before the study. However, no information is available on most (73 percent) of the more rare SM species (286 species), which were not found or which were undersampled for statistical analysis.

For all SM species combined, reserves per se were not specifically selected for; over all species detections from this study, 81 percent were found in reserves, compared to 80 percent of the land base sampled being in reserves. Still, the data on 10 species selecting for reserves was new and significant information. Also, lack of association with reserves should not necessarily be construed as reserves not providing important habitat for species persistence, particularly for those species that do show association with LSOG. Late-successional and old-growth occurs in both reserve and matrix lands, and over time if LSOG regrows within reserves and is reduced in matrix lands, such a study as this could detect greater association with reserves per se.

In general, to maintain a large component of late-successional forest species and biodiversity elements, a reserve system may be viewed as a major "coarse filter" component, although additional "fine filter" evaluations and guidelines for some species and biodiversity elements also may be included (see below).

Recent Trends in Conservation of Biodiversity

Alternative approaches to biodiversity conservation and their efficacy for rare species conservation—
In the past decade, much has been written on methods and approaches to biodiversity conservation. A main focus has been on species conservation, with emphasis on maintaining or restoring viability of rare, declining, or listed species, although other dimensions of biodiversity besides individual species also have been addressed.

One example is the concept of coarse and fine filters in biodiversity conservation (Armstrong and others 2003, Reyers and others 2001). These terms have been used in a wide range of contexts but, in general, coarse filter refers to management of overall ecosystems and habitats and fine filter refers to management of specific habitats or sites for selected individual species. In a sense, the Plan follows this approach where the overall LSRs, riparian reserves, and guidelines for old-forest conservation and restoration constitute the coarse filter, and the SM program's focus on selected habitats and sites of rare species constituted the fine filter. The literature generally concurs that a combination of both coarse and fine filter elements better ensure conservation of a fuller array of species and biodiversity elements (Dobson and others 2001, Kintsch and Urban 2002). That is, applying just coarse-filter management of general ecosystems and habitats alone would not suffice to ensure conservation of all biodiversity elements including rare species associated with uncommon microhabitats and environmental conditions (Lawler and others 2003).

Another approach to biodiversity conservation has been delineation of hot spots of high species richness or of locations of endemic or at-risk species, and use of "gap analysis" to determine where such hot spots fail to coincide with conservation-oriented land allocations (Flather and others 1997, Root and others 2003). Reliability of hot spot locations and gap analyses depend on the accuracy of underlying species distribution maps. Some studies suggest that the hot spot approach alone does not necessarily ensure protection of rare species and that focus on a diverse set of species representative of a range of variation within ecological communities may be a more effective approach (Chase and others 2000).

Other recent approaches to biodiversity conservation have been devised to use many forms of surrogate species, such as umbrella species, management and ecological indicator species, flagship species, species functional groups, ecosystem functioning (for example, Hooper and others 2005), and others. Few of these approaches alone have proven fully reliable for ensuring conservation of rare species.

The conclusion is that, unless specifically targeted to address conservation requirements of rare species, alternative approaches to biodiversity conservation generally do not suffice to fully ensure persistence and protection of all rare species.

Monitoring of biodiversity—
The original ROD (USDA and USDI 1994b) called for effectiveness monitoring of biological diversity and late-successional and old-growth forest ecosystems. Beyond the species-specific owl and murrelet population studies and the surveys conducted of SM species, little information has been gathered on the ecology of these species. Even at the species level, little information has been gathered on ecosystem functions of rare and little-known LSOG species, including SM species, especially in terms of their contribution to overall ecosystem processes. However, such information would be very difficult to gather. Any effort to monitor biodiversity would do well to consider the specific utility of such information in guiding forest management, and selection of surrogate measures for difficult parameters used for adaptive forest planning.

Considerations in Developing Species Conservation Programs

Although the Plan was considered a science-based plan, there remained significant uncertainties and untested assumptions after implementation. This was particularly true for the SM program because this mitigation grew out of the uncertainty surrounding the viability of the species and how well the overall Plan (especially the reserve systems) provided for species persistence. Furthermore, most of the taxa listed for protection were rare or little known, so available science was meager on how best to conserve these species. These issues point to the benefits from partnering with research agencies and universities in developing the science basis for conservation programs. Indeed, some of the conservation issues may call for specific research approaches to develop new knowledge on specific areas of concern (for example, from understanding individual species ecology to developing landscape sampling designs). From experience gained we offer the following considerations:

Research partnerships—

- Consider including research partners in initial program design.
- Consider clearly defining the role of research in adaptive management and decision processes.
- Consider identifying specific information gaps and developing appropriate research studies to fill those gaps.

Coarse- vs. fine-filter approaches—

- Consider carefully defining what is meant by coarse and fine filter (that is, what elements these represent).
- Consider clearly laying out in your conservation program the contributions expected from these two approaches (for example, role of reserves and protecting specific sites).

Species viability and persistence—

- If these represent species management goals, consider clearly defining the terms and how you will measure obtaining that goal.

Value of metrics—

- Consider clearly designing metrics to meet specific objectives.
- Consider the limitations of surrogates (for example, indicator or focal species) for meeting broad conservation objectives.
- Consider validating the use of surrogates in meeting conservation objectives.

Database—

- Consider designing an effective database for data storage and analysis that will meet both short- and long-term objectives.
- Consider developing a robust database that is easy for diverse users to query.
- Consider the types of analyses that are required from the data.
- Consider adequately staffing this function to provide for quality stewardship and timely analyses.

Survey design—

- Consider developing a framework and process to strategically focus resources on key information gaps.
- Consider exploring a variety of survey approaches and analyze these for efficiencies in terms of cost and information gained.
- Consider the value that certain types of surveys provide or do not provide (for example, predisturbance surveys typically provide biased data on species distribution and abundance).
- Consider looking for efficiencies by designing surveys to include multiple species.
- Consider collecting information that is critical to meeting specific conservation objectives (for example, habitat information for modeling, species abundances for population considerations).
- Consider using statistically designed surveys when possible that allow for extrapolation of results to larger landscapes.

Habitat modeling—

- Consider exploring different habitat modeling approaches to meet specific conservation objectives.
- Consider the limitations of habitat modeling.

Decision support—

- Consider developing decision-support models that integrate relevant information.

Monitoring—

- Consider developing a monitoring framework that will enable you to measure how well you meet specific objectives (for example, species persistence, minimizing management effects, evaluating trends, etc.).

The Future

The Plan has been a remarkably ambitious effort designed, in part, to conserve a wide array of rare and little-known species across multiple taxonomic and ecological groups. Although the charge for the conservation of most species now falls into another program (SSSSP), lessons learned from the Plan on species responses and program implementation can help guide successful outcomes.

The broader expectations for demonstrating conservation of forest biodiversity elements beyond rare species, and the direction in the Plan to address biodiversity issues through effectiveness monitoring (Ringold and others 1999), however, still remain as mostly unmet challenges.

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