PNW
Pacific Northwest Research Station

Science FINDINGS

issue sixty one / february 2004

INSIDE

"Science affects the way we think together."
Lewis Thomas

CONSERVING HIDDEN DIVERSITY
THE UNPRECEDENTED CHALLENGE OF THE SURVEY AND MANAGE MANDATE

"Why should we care? What difference does it make if some species are extinguished, if even half of all the species on earth disappear? Let me count the ways."

—E.O. Wilson, *The Diversity of Life*

How do you take care of species you don't often see, typically haven't counted, and frequently don't know anything about? Crudely put, this was the challenge that was delivered whole to public lands managers with the Northwest Forest Plan record of decision in 1994.

Because viability evaluations suggested that as many as 1,000 old-growth-associated species might not be sustained over time, closer analysis of the plan's network of land allocations was required. Across the 24 million acres of land in question, ultimately around 400 species of amphibians, bryophytes (mosses), fungi, mollusks, vascular plants, arthropods, and one mammal, were included in the effort to conserve "hidden diversity."

These species tended to be rare and specific in their habitat requirements, but there was a high degree of uncertainty about their status and needs. "A recurring mitigation theme across many of the taxonomic groups was the need to acquire additional information through field surveys, and to manage sites of the species. This was the origin of the standard and guideline known as 'survey and manage,'"explains Randy Molina, a research botanist at the PNW Research Station, who subsequently became a key member of the interagency strategic survey workgroup convened to grapple with the unprecedented scale and complexity of the implications of survey and manage requirements. He remains team leader of forest mycology at the Station's Corvallis laboratory.

Red tree vole (photo credit: Marty Raphael).

The crying need to survey these species before enough was known to manage them wisely led naturally into an adaptive loop, Molina recalls. But what do we need to know to make wise adaptive decisions? "We had to get answers to some key questions about persistence concerns and levels of existing knowledge for each species."

By comparison with the highly visible and well-understood northern spotted owl, slugs and lichens didn't offer much to love. But it was obvious that some of these species would suffer without protection, it was known they were essential for forest ecosystem function, and the law came down.

IN SUMMARY

When the Northwest Forest Plan became law via the record of decision in 1994, it contained an unprecedented provision for conducting regionwide surveys of poorly known and usually ignored taxa, such as fungi, mollusks, lichens, and mosses. The purpose was to enhance the very limited understanding of persistence issues for these taxa and, thereafter, to develop science-based management recommendations.

The surveys represented an adaptive management mitigation put in place to protect more than 400 species of apparently rare, old-growth-associated species. The challenge of accomplishing this was mind-bending, and the unwieldy "survey and manage" provision has been blamed subsequently for the stalling—critics would say failure—of the Northwest Forest Plan.

A PNW Research Station scientist worked on an interagency team tasked with developing a strategic survey framework to guide the effort. The team also designed a variety of survey approaches for immediate implementation prior to the signing of the 2001 supplemental environmental impact statement and record of decision for survey and manage. The final framework document now guides the $3.5 million strategic survey effort of the regional survey and manage program.

VIABILITY AND MITIGATION

The biodiversity objective that generated the survey and manage mandate was given to the Forest Ecosystem Management Assessment Team (FEMAT) by President Clinton. It sought the "maintenance and/or restoration of habitat conditions to support viable populations, well-distributed across their current ranges, of species known (or reasonably expected) to be associated with old-growth forest conditions." The ensuing rating process and evaluation relied on a mix of expert opinion, broad-scale maps of land allocations, general forest conditions, and standards and guidelines for management within different land allocations.

As teams of agency specialists drafted the final environmental impact statement (EIS) with this and other objectives in mind, a number of mitigation challenges became evident. First, many species of concern were rare or locally endemic, and the sites where they occurred did not overlap with an area managed as a reserve under the plan. This meant the plan's coarse-filter approach of relying on reserve land allocations was not considered adequate for several species, and additional sites might be needed in the managed "matrix" lands.

Second, some species rated poorly because of specific provisions of the standards and guidelines for the matrix lands, such as levels of down wood retention. Others could suffer because standards and guidelines for activities in reserves did not provide protection for their habitat or because microhabitats such as seeps and springs had no protection provisions. Finally, some species were so poorly known that there was great uncertainty about risks to their survival.

The survey and manage effort was at first lost in the details of implementation of the Northwest Forest Plan, Molina recalls, but by 1996, broad-scale surveys were supposed to have been implemented.

"By then we were starting to understand some of the problems," he says. "Take fungi, for example. They are highly temporal in their fruiting habits, both within and between years. Really you should return to a site every year for 5 years to properly survey most fungi, which renders single preproject surveys completely impractical."

The more logical solution appeared to be to take a regional perspective and use long timeframes to establish rarity properly, as well as to depend on broad-scale surveys—a strategic approach overall. Beginning in 1996, expert teams began the required extensive, regional surveys.

But by 1998, the survey and manage implementation was starting to miss deadlines. The lawsuits followed immediately.

KEY FINDINGS

- A guiding, scientifically based framework is key to successfully implementing a complex regionwide survey and inventory for rare forest species.
- Using a variety of coordinated survey approaches provides opportunities to address multiple species and management objectives.
- Probabilistic, random-point surveys at regionwide scales are feasible and allow for predicting species presence, distribution, and associations with habitat and reserve land allocation.
- Timely adaptive management decisions depend on efficient collection and analysis of relevant science information. The framework clearly lays out the process for incorporating new information into adaptive management decisions for maintaining species persistence.

Credit: W.P. Leonard

Del Norte salamander.

WHAT HAVE WE WROUGHT?

"Lawsuits accelerated the need for the agencies to tackle these issues head on," Molina notes. "It became completely obvious that Survey and Manage was much bigger than we thought, it needed more resources, a permanent structure, and better guidelines. New leadership was also needed for a program that was rapidly becoming a focal point of public attention."

Reorganizing became a priority, to make clearer the adaptive process that could address the challenge. Did all the listed species need mitigation? Did certain species need land allocated outside the reserves? What other measures were necessary? One obvious answer appeared to be strategic surveys.

The PNW Research Station sponsored the interagency strategic survey workgroup, assembled to improve scientific understanding of how to collect and analyze new information and combine it with existing databases. Subsequently, strategic surveys became the rallying principles for meeting the needs of survey and manage program, but also for the larger objectives of the Northwest Forest Plan, according to Molina.

"It rapidly got to the stage that a few species could let Survey and Manage become the 'plan buster' for the Northwest Forest Plan. We needed a way to quickly and logically acquire new information that would allow us to deal with those species that were actually stopping harvests, as well as focusing on truly rare species of high persistence concern."

The concept of strategic surveys reorganized the survey and manage program, he recalls. It provided an iterative adaptive framework to assess information needs for all species,

Science Findings is online at:

http://www.fs.fed.us/pnw

The site includes our new **Science Update**—scientific knowledge for pressing decisions about controversial natural resource and environmental issues.

design and implement strategic surveys, and analyze that information for relevance to species and habitat management. Two key questions drive the analysis: What are primary persistence concerns, and how do we manage species and habitats to assure persistence?

"Acquiring information through surveys and management of known sites provided the basis for dealing with the high levels of risk and uncertainty surrounding these poorly known species and also provided the foundation for adaptive management decisions," Molina says.

LAND MANAGEMENT IMPLICATIONS

- Scientifically valid survey and inventory techniques were compared for effectiveness in meeting different management objectives for conserving rare, poorly known species. This allowed agencies to prioritize efforts and resources based on species and management needs.
- Probabilistic survey designs allow extrapolation to a regional scale of results on species presence, distribution, and association with key landscape features.
- Strategically selecting survey approaches based on specific species information needs and management priorities allows for efficient use of agency personnel and funds to meet multiple objectives.
- New information from well-designed strategic surveys can result in removal of species from the survey and manage list and thereby free up protected sites to meet other management needs such as timber harvest.

MULTIPLE MODES OF STUDY

Once analyses of species information needs and program priorities are completed, an assessment is made of available approaches, taking into account efficiency and effectiveness. Information could come from field surveys, research studies, herbaria and museums, literature, and other sources such as habitat models.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208
(503) 808-2137

Sherri Richardson Dodge, Editor
srichardsondodge@fs.fed.us

Send new subscriptions and change of address information to pnw_pnwpubs@fs.fed.us

Keith Routman, layout
kroutman@fs.fed.us

USDA United States Department of Agriculture

Forest Service

Field surveys range from broad-scale statistically based sampling approaches that cover the entire plan area, to small-scale focused site surveys designed to gather species presence, abundance, and site habitat data.

"These various approaches come with strengths and weaknesses in addressing different information needs, so typically a combination of approaches are evaluated for effectiveness in gathering the information as well as costs and resource availability, particularly expert personnel," Molina explains.

A jump-start came from the Forest Inventory and Analysis (FIA) and current vegetation survey plots, which occur throughout the plan area. Several habitat features are repeatedly inventoried at each point on a 5.5-kilometer grid. From this system of plots, a stratified random grid design was developed with input from a team of statisticians. The design stratified approximately 660 random grid points into late-successional old-growth (LSOG) and non-LSOG associations, and reserve versus nonreserve allocations.

The resulting comprehensive databases would be used to address such species-specific questions as, What is the age class of the forest the species is found in? How rare is it? Is it associated with LSOG? How well-distributed is it in the reserves?

"This basis allows us to create a scientifically valid survey design to pick up as many species as possible," Molina notes, "although we have to recognize that it's not so good for the rarest of species. For example, more than half the species on the survey and manage list are known from fewer than ten sites."

"This approach is already starting to do its job, in that a number of species have been taken off the list based on the results. It is a statistically valid design, with a reasonable level of uncertainty and significant predictive value," Molina explains. The stratification allows this survey design to address specific questions, and thus can be refined, so long as the plot selection within strata remains random to keep the design valid. The importance of habitat, for example, could be examined in more detail under this design, to ascertain how specific habitat features like large woody debris contribute to species presence and persistence.

Credit: Dan Powell

Cauliflower mushroom.

USING THE ADAPTIVE LOOP

A supplemental EIS in 2001 incorporated species reviews that placed all species into one of six categories, based on species rarity, preproject survey practicality, and sufficiency of information to determine whether the species warranted protection by the survey and manage program. Analyses within the supplemental EIS also enabled managers to remove 80 species from the list because they were not found to be rare, associated with LSOG forests, or of persistence concern.

An annual species review process expedites status evaluation and assignment of suitable mitigation measures for each species. The review follows three steps. First is application of a systematic filter to identify species for which we have significant new information. Second is review of all information by species. And third is development of recommendations for appropriate management actions for each species.

"The results of this process may lead to recommendations for changing species assignments to survey and manage categories, to changes in the management recommendations and survey protocols, or to changes in information needed about a species," Molina says. "Additional information needs flow into the species information needs analysis and provide further guidance for the development of strategic surveys."

Credit: W.P. Leonard

Van Dyke salamander.

Surveying for more than 300 species over tens of millions of acres is no mean undertaking, especially when you're sampling for rare events, he points out.

"The great majority of species shared two important unknowns: Were they associated with late-successional old-growth forests, and how well did the reserve land allocations provide for their persistence? Because preproject surveys focused on matrix lands and were causing problems with implementation of the Northwest Forest Plan, survey effort was specifically needed in reserves to better understand how they might provide for species persistence."

Several other strategic approaches provided needed information on selected species. Some surveys targeted known sites to assess whether species were still present and to gather poorly understood habitat attributes. Such surveys were integrated with a variety of habitat models (potential natural vegetation models, predictive habitat models, and Bayesian belief models to determine microscale habitat features), most of which can still only target one species at a time.

In addition, taxa experts helped to target surveys in likely habitats, particularly in reserves where data were scarce. It is difficult to extrapolate from expert searches, and extrapolation is an important element in an undertaking on such a large land base. But Molina notes it is important to take advantage of the brain trust of species experts. For truly rare species, or those difficult to detect, expert searches offer a good option, particularly as statistically designed landscape surveys are considerably more expensive.

ACCUMULATING USABLE DATA

"Timely adaptive management decisions depend on efficient collection and analysis of relevant science information," Molina notes. "The framework we developed clearly lays out the process for incorporating new information into adaptive management decisions for maintaining species persistence. For example, data gathered from strategic surveys were immediately used in the annual species review process, allowing each species to be evaluated for management status and needs."

Number of species among taxa groups analyzed in the original FEMAT report, listed in the original survey and manage guidelines, revised guidelines, and currently

	Number of species			
Taxon	FEMAT analysis	Original guidelines	Revised guidelines	Current*
Fungi	572	234	208	189
Lichens	157	81	48	43
Mollusks	102	43	43	39
Bryophytes	106	23	17	15
Vascular plants	124	17	12	12
Vertebrate	82	6	6	5
Arthropod guilds	15	4	4	4

*Annual species reviews conducted since 2001 have resulted in additional species removal from the list.

As the data were assembled, two trends began to emerge. First, most species on the original lists were indeed rare, and remained rare as data accumulated. Nearly one-third of all species were found at 5 or fewer sites, according to Molina, and over half at 20 or fewer sites.

Second, and most important in terms of impact, the number of less rare, uncommon species found on 300 sites went from 17 to 29 species. Albeit a small percentage increase in the total number of species, it represents an order of magnitude in the number of sites they occupied compared to the majority of rarer species.

"In essence, fewer than 10 percent of the total species created the greatest impact on the ability of the agencies to meet other plan objectives," Molina says. "This is critical. On the one hand, we have been able to identify and protect truly rare species. On the other, the program was caught by surprise when it turned out a small minority of species—not as rare as originally believed—were not dealt with expeditiously through

WRITER'S PROFILE

Sally Duncan is a science communications specialist and writer focusing on forest resource issues. She is also a candidate for a Ph.D. in Environmental Sciences at Oregon State University in Corvallis, Oregon, where she lives.

adaptive decisions, and ended up having a large overall impact on the plan."

Adaptive approaches to the accumulating information had a number of highly productive outcomes. The first was development of management recommendations, summarizing what was known about a species, how to manage for their persistence, and what was needed to improve management in the future.

Second, the annual review process found a sizable number of species to be more common than thought and removed them from the list. Some of these changes were highly significant from a management perspective. Molina gives the example of delisting the Del Norte salamander and the blue-gray tail- dropper mollusk, which released approximately 2,000 matrix-land sites for other management activities. In addition, the placement of some species into a category where preproject surveys were no longer practical or needed also notably reduced the level of these expensive surveys.

Credit: Dan Powell

Red coral fungus.

STRATEGIC ACHIEVEMENTS

"Regardless of the often poor perception and acceptance of Survey and Manage from inside and outside the agencies, we now have a much greater understanding of diverse, rare, poorly known species," Molina says. "Conservation of fungi, lichens, bryophytes, mollusks, and arthropods was a major step toward 'protecting all the pieces' in ecosystem management."

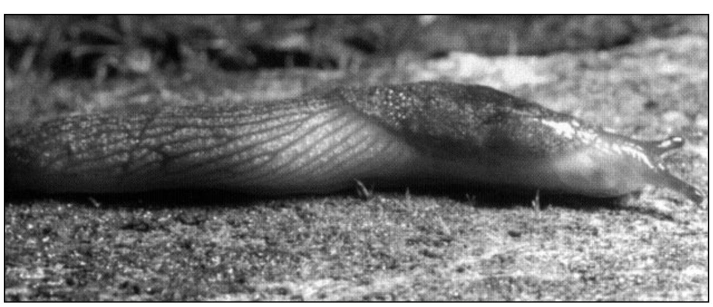
Synthesis of this information into management recommendations, survey protocols, and field guides provides a strong knowledge base to guide species management in the future. As well, significant new survey strategies and information-gathering approaches were designed and tested at unprecedented scales.

The adaptive management approach itself, an elusive goal in ecosystem management, has been proved in the survey and manage program with an ongoing series of better informed management decisions. Molina emphasizes that the ability to work in an integrated fashion among six federal agencies was possibly one of the most difficult challenges successfully navigated by the program. He notes that survey and manage remains an unfinished program of work, subject to the large shifts of land management philosophy of different political administrations.

"In conclusion, whether perceived as a visionary conservation program or simply an experiment of unbridled management complexity, survey and manage has plowed new ground in conservation science and management," Molina says. "It has accrued enormous gains in knowledge about these species, addressed considerable uncertainty, and developed new methods of species inventory that will prove valuable in future management plans."

"The life-sustaining matrix is built of green plants with legions of microorganisms and mostly small, obscure animals, in other words, weeds and bugs... They run the world precisely as we would wish it to be run..."

—E.O. Wilson, *The Diversity of Life*



Credit: John Applegarth

Blue-gray tail-dropper.

FOR FURTHER READING

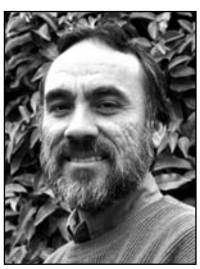
Molina, R. [and others]. 2003. *Strategic survey framework for the Northwest Forest Plan Survey and Manage program*. Gen. Tech. Rep. PNW-GTR-573. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Molina, R.; Lesher, R.. 2003. *Protecting rare, old-growth forest associated species under the survey and manage guidelines of the Northwest Forest Plan*. [Unpublished document.]

Science
FINDINGS

U.S. Department of Agriculture
Pacific Northwest Research Station
333 SW First Avenue
P.O. Box 3890
Portland, OR 97208-3890

SCIENTIST PROFILE



Randy Molina has been with the PNW Research Station since 1994, first as a botanist and then a research botanist. He became team leader of forest mycology in 1996. He is an expert on the ecology and management of forest fungi and has published extensively on the diverse degrees of specialization seen among symbiotic fungi and forest trees. He currently is developing a rare species research and management program for the Station.

Molina can be reached at:

Pacific Northwest Research Station/
USDA Forest Service
Forestry Sciences Laboratory
3200 SW Jefferson Way
Corvallis, OR 97331
Phone: (541) 750-7391
E-mail: rmolina@fs.fed.us

COLLABORATORS

Robin Lesher, Mount Baker/Snoqualmie National Forest, WA

Dan McKenzie, EPA, Corvallis, OR

Neal Middlebrook, BLM, Coos Bay, OR

Jim Alegria, BLM, Portland, OR

Jan Ford, Klamath National Forest, Yreka, CA

Tom Edwards, USGS, Logan, UT

Richard Cutler, Utah State University, Logan, UT

Terry Brumley, PNW Region, USFS, Portland, OR

Bruce Rittenhouse, BLM, Portland, OR