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The History of DEMO: An Experiment in Regeneration Harvest of Northwestern Forest Ecosystems

Abstract

As management priorities for federal forest lands have shifted, it has become clear that different strategies for harvest and forest regeneration are needed. The DEMO experiment arose in response to this need, with leadership provided by a consortium of university and Forest Service scientists and federal forest managers. With specific congressional direction (included in federal appropriations for the Forest Service), the initial planning for an experiment in retention harvest strategies began in 1992. Initial planning efforts were hampered by competing research objectives and disagreements over experimental design, shifts in program leadership, difficulties in transferring funds to the appropriate entities, and conflicts related to the Federal Advisory Committee Act. In 1994, once these challenges were overcome, the experiment began.

DEMO is not only an experiment in retention harvesting, but also in collaboration between research and management, as well as federal and state governments and the university community. The scope and intensity of collaboration have been demanding, requiring effective communication and coordination across institutional lines. The early history of DEMO has taught us that experiments of this kind require: (1) a coordinated legislative package and multi-year budget commitment, (2) a well-developed management structure, (3) an efficient process for planning, (4) commitment of lead scientists to the coordination and planning of disciplinary and interdisciplinary research activities, (5) effective collaboration between research and management, and (6) a well-developed outreach program. Other large-scale silvicultural/ecological experiments with characteristics similar to DEMO are underway at several locations around the world. These will offer additional learning opportunities for large-scale, interdisciplinary research.

Introduction

A common perception of traditional resource management is that it is based on scientific experimentation. In this paradigmatic view, scientific findings in the fields of soil science, ecology, and plant physiology are used to formulate management approaches that are tested prior to widespread application.

Yet such a systematic approach to forest management has been rare—at least in North America during the 20th century. For example, there has never been a credible, large-scale, statistically designed experiment in regeneration harvest of Douglas-fir forests of the Pacific Northwest. Dispersed patch clearcutting adopted on national forests in the Pacific Northwest after World War II was consistent with the findings of Isaac (1943) and others; however, the concept was applied extensively without experimental testing. Alternative approaches, such as selection cutting, were rejected based on a few case studies. Other har-

vest experiments were done at a very small scale and generally lacked statistical rigor, especially statistically valid replication; Tappeiner et al. (1997) provide a more comprehensive review of the evolution of harvesting methods in the region.

New societal demands and increased scientific knowledge are driving major changes in forest management which require integration of ecological values (such as maintenance of biological diversity) with commodity production (Kohm and Franklin 1997). Under intense scrutiny from interested stakeholders, managers are faced with developing and applying new, unproven approaches to forest management. Although presumably based upon the best available science, the economic and ecological costs, benefits, and overall effectiveness of these new approaches are unknown. This is the case on federal, state, and private forest lands in the Pacific Northwest (e.g., Tuchmann et al. 1996).

The new paradigm for testing such approaches is called *adaptive management*—although in a less

formal form, the concept has existed for several decades. Adaptive management calls for the systematic and iterative collection of information to assess and, where necessary, modify policies and management strategies. Science is an important part of this process. Yet, experiments which involve large treatment areas and long periods of time are difficult to establish and maintain.

In this paper, we describe the evolution of a major experiment in retention harvesting, the Demonstration of Ecosystem Management Options (DEMO) study. We describe the origin of the experiment, the role of an institutional partnership (New Perspective Partners) in obtaining congressional support, and the development of the experimental design through several iterations. Our objective is to share lessons with others who become involved in such projects. Finally, we identify other large-scale, silvicultural experiments to illustrate the range of large-scale experimentation in modern resource management. These experiments (including DEMO) reflect an increasingly common blend of research and management that is essential to the implementation of ecosystem management.

Conception and Early History

The need to examine the effectiveness of alternatives to traditional silvicultural regimes, such as clearcutting, has been recognized among foresters and scientists for several decades (e.g., Hammond 1991). The northern spotted owl debate (see, e.g., Thomas et al. 1990) and other issues related to biological diversity and ecosystem functions, such as hydrologic regulation (see, e.g., Jones and Grant 1996), intensified interest in alternative silviculture during the 1980s. Concurrently, our understanding of ecosystem structure and function (e.g., Franklin 1992), natural disturbances (e.g., Franklin et al. 1995), and the consequences of large-scale manipulation of forest landscapes, such as fragmentation (e.g., Franklin and Forman 1987), expanded dramatically.

In 1991, there was an opportunity to establish a major harvest experiment that would integrate ecological and commodity objectives on the Olympic Peninsula of Washington State. In 1989, the Commission on Old Growth Alternatives for Washington's Forest Trust Lands recommended creation of a new research facility, the Olympic Natural Resources Center (ONRC), as well as an

Olympic State Experimental Forest (OSEF) to be created from a large block of trust lands managed by the Washington Department of Natural Resources (WDNR). Development and testing of silvicultural approaches that integrate wildlife (including the spotted owl) and fish values with commodity production were a high priority objective of the experimental forest.

A major forest harvest experiment was proposed as a potential "flagship" activity for the newly established ONRC. This experiment would not only address a major research need, but also serve as a focal point for creating an interdisciplinary, inter-institutional environment for research on the Olympic Peninsula. Design work was initiated in December 1991 by Dean R. Berg, then a staff member of ONRC, and Jerry F. Franklin. WDNR staff in Forks and Olympia were included in discussions from the onset.

A detailed plan was completed in May 1992 after review of preliminary designs by scientists and staff from the ONRC, WDNR, and USDA Forest Service Pacific Northwest Research Station in Olympia, Washington. The plan called for a split-plot design involving eight structural treatments and two logging systems (readers unfamiliar with the concept of retention harvest methods and related concepts, such as aggregates, are referred to Franklin et al. 1997). The treatments initially were: (1) 0% retention (clearcut); (2) 12% retention in dispersed and aggregated fashion, respectively; (3) 24% retention in dispersed and aggregated fashion, respectively; (4) 60 and 80% retention, with harvest in the form of group selection; and (5) untreated control. Response variables included tree growth and yield, understory composition, tree regeneration, animal communities, fungal communities, and the sources and dynamics of coarse woody debris. A simplified plan involving only six treatments eventually emerged from this scoping effort (Olympic Natural Resources Center 1992).

Extensive discussions between ONRC and WDNR staff continued with regard to location, particularly whether plots should be placed in second-growth forests of the Clallam River drainage or in old-growth forests elsewhere in the proposed OSEF. Differences in opinion reflected both scientific issues (e.g., homogeneity or levels of comparability among treatment areas) and policy. One manager opined, for example, that "Much

research is being conducted on mangling [sic?] second growth forests. Some should occur on the OSEF. . . [however] the Department's prime interest in research is in finding ways to produce commodities from these old growth forest [sic] while at the same time protecting the ecological values."¹ No consensus was reached, and WDNR chose not to proceed with the experiment at that time.

Enter the New Perspectives Partners

Early in the 1990s, it became apparent that implementation of ecosystem management was hampered by lack of research—especially research integrated with management. While strong research programs existed in the region, they were poorly coordinated and disjointed with management—in some cases, researchers and managers worked at cross-purposes. In an effort to minimize such problems, the Ecosystem Management Partnership was formed (the name was changed later to New Perspectives Partners). New partners were added, but the originating institutions and individuals remained active, providing the leadership and continuity.

Initially the partnership included scientists from University of Washington, Oregon State University, the USDA Forest Service Pacific Northwest Research Station, innovators from the Aerial Forest Management Foundation, and resource managers from the USDA Forest Service Pacific Northwest Region. The group proposed a coordinated effort in ecosystem management research and development, as well as a mechanism for funding. Based on their work, specific federal appropriations were made to support ecosystem management research and development at the three research institutions and the Aerial Forest Management Foundation.

Working with members of Congress, the partners emphasized the need for experiments on alternative approaches to forest harvesting and suggested how such studies might be implemented on federal and state lands in the Pacific Northwest. At the same time, the Douglas Project Coalition (a local group of interested businessmen and citizens from Douglas County, Oregon) was also seeking funding for a large-scale study and demonstration on the biological, social, and economic consequences of diverse forest management strategies.

The 102nd Congress quickly responded. On June 29, 1992, the House Committee on Appropriations reported the "Department of Interior and Related Agencies Appropriation Bill, 1993," which provided for establishment of silvicultural experiments on National Forest land (U.S. House of Representatives 1992). Language in this bill (under the timber sales section of the National Forest Systems appropriation) called for ". . . An increase of \$1,000,000 in silvicultural examination. These funds, along with \$1,000,000 in base funds to be redirected for this purpose, are to be provided for the Pacific NW New Perspective Partners demonstration program. These funds will be used, under the joint control of the scientists directing the program under the Forest research program and the NFS managers involved, to support scientific costs associated with the establishment of one major silvicultural experiment each in Washington and Oregon, using new forestry and landscape management techniques."

In the final version of the Appropriations Act for Fiscal Year 1993, Congress combined funding requests from the Olympic Natural Resources Center and Douglas Project Coalition into a \$1.5 million earmark, directing the Forest Service to conduct demonstrations in consultation with the Partners and Douglas Project Coalition. Key congressional members behind this provision included: Sid Yates (IL) (then chair of the appropriation subcommittee which handled Forest Service budgets), Norm Dicks (WA), Les Aucoin (OR), Sid Morrison (WA), and Peter DeFazio (OR), and in the Senate, Mark Hatfield (OR).

Developing the Experimental Design

With direction and financial support from Congress, planning for the experiment began in earnest. In December 1992, the New Perspectives Partners' Scientific Coordination Team produced a consensus document on the form of the experiment. Their design emphasized a broad range of levels of green-tree retention with the pattern of retention (i.e., dispersed vs. aggregated) secondary. The design was similar to that developed earlier by ONRC, but it contained seven treatments. Levels of retention were increased in several of the treatments (e.g., from 12 to 20% and 24 to 40%) reflecting federal forest land managers' interests in higher levels of retention. Twenty hectares (50 acres) was suggested as the minimum treatment

area. Numerous response variables were identified including physical, biological, and economic parameters.

Subsequent analysis indicated that, due to limited availability of field sites, only six treatments were possible. Finding even the 180 ha needed for a single replication of six treatments of comparable forest stands and site conditions proved difficult. No suitable sites were found on the Olympic National Forest, originally planned as the locale for DEMO in the state of Washington; hence the experiment was shifted to the Gifford Pinchot National Forest where sites for three replications were ultimately found (Aubry et al. 1999, Halpern et al. 1999). An additional Washington replicate was sited on Department of Natural Resources Land, largely through the efforts of Washington Commissioner of Public Lands Jennifer Belcher and Gifford Pinchot National Forest Supervisor Ted Stubblefield. Sites suitable for four replications of the experiment were identified on the Umpqua National Forest in Oregon, partially due to the interests of the Douglas Project Coalition; Forest Supervisor Don Ostby was critical in this successful siting effort.

Next, research foresters at the USDA Forest Service Pacific Northwest Research Station in Olympia, Washington conducted much of the detailed design work on DEMO through 1993. A new design emerged that incorporated a full range of retention levels but substantially modified the treatments previously proposed:

<i>Treatment</i>	<i>Description</i>
0%	clearcut
20%	retention in small patches or aggregates (= clearcut with undisturbed patches)
40%	20% as aggregates and 20% as dispersed retention over the remaining 80% of the harvest unit (= shelterwood with undisturbed patches)
60%	created by cutting small patches occupying 20% of the area and thinning the remainder of the stand (= group selection with thinning)
80%	created by cutting small patches occupying 20% of the area (= group selection)
100%	uncut control

Although this design was clearly tied to traditional regeneration harvest practices, it was confounded experimentally in that levels and patterns of green-tree retention varied simultaneously, precluding the possibility of ascribing treatment-level differences to the amount or spatial pattern-

ing of retention. This was viewed as a serious issue by participants who wished to systematically examine responses to individual treatment variables. Indeed, a great deal of silvicultural experimentation can be criticized for its focus on comparisons of generalized silvicultural systems, such as shelterwood and selection, rather than on systematic manipulation of a single variable, such as tree density or spatial pattern of harvest. Such comparisons, which typically involve simultaneous manipulation of several variables, strongly limit the forester's ability to draw general inferences about the effects of manipulating forest structure.

Resolution of alternative experimental approaches occupied much of the spring of 1994. Two conceptually distinct approaches were proposed and debated: a comparison of specific silvicultural prescriptions in which several aspects of retention varied simultaneously (the design described above), or a systematic comparison of variation in levels and patterns of retention. Input from biometricians and quantitative scientists was critical in these discussions. The debate culminated in a meeting on May 2, 1994. Participants in DEMO made the decision to proceed with a design that allowed for clear statistical inferences regarding the effects of level and pattern of green-tree retention (see Aubry et al. 1999). The treatments included: 15% retention, dispersed; 15% retention, aggregated; 40% retention, dispersed; 40% retention, aggregated; 75% retention, aggregated; and 100% retention (control).

The first four treatments provide for a simple factorial comparison of two levels and two patterns of retention, and the last represents an untreated control. The nature of the fifth treatment generated significant debate. Some suggested 0% retention (a clearcut), whereas others preferred a treatment that represented a high level of retention. This issue was discussed at length, with National Forest System managers providing the deciding vote for 75% retention. At issue was whether a clearcut treatment could or should be applied on National Forest lands (since this prescription was no longer used), as well as a desire to experiment with higher levels of retention. The discomfort of many National Forest personnel was accentuated by the knowledge that they had no control over where the 0% retention treatment would be placed since it was to be randomly assigned. Of course, scientists often have used experimental treatments outside the bounds of

standard operational practices to provide tests of treatment variables that are sufficiently extreme to define the limits of the responses—i.e., to define the response surface. However, it was jointly decided by the managers and scientists involved in DEMO not to do so in this case.

Even though the original design work for DEMO preceded the work of the Forest Ecosystem Management Assessment Team (1993), the final DEMO plan considered the needs of, and was an appropriate response to, the Northwest Forest Plan, providing a rigorous evaluation of the individual effects of various levels and patterns of green-tree retention. As described in the final study plan for DEMO, "The DEMO design is expected to provide reliable and broadly applicable information on the effects of green-tree retention in harvest units, as well as information on disturbance responses and resource interrelationships in managed forest stands" (Anon. 1996). Of course, to ensure the "cleanest" test possible of the main variables of interest (level and pattern of green-tree retention), some other provisions of the Northwest Forest Plan (e.g., requirements for riparian buffers) were not implemented on the harvest units. The Plan allows for such deviations when necessary for a scientific experiment of this sort.

Lessons for the Future

DEMO has provided valuable insights into the initiation, development, and implementation of large-scale, multidisciplinary research—particularly research that stems from problems in natural resource policy and intimately involves those charged with its implementation. We have learned many lessons, although we have only just completed pre-treatment sampling, with harvesting underway at some locations. These lessons are most relevant to public sector projects (such as DEMO), but the principles are broadly applicable:

1. *A coordinated legislative package.* Typically, research is conducted independent of resource management (although clearly intended to address its needs). Efforts like DEMO that require explicit interaction between research and management and are long-term in nature will require effective empowerment to succeed. Specific legislative direction is a common vehicle for this purpose. Efforts such as DEMO should have: (1) firm legislative or executive authority, (2) financial

- authorization, (3) a policy framework that allows research and management to collaborate effectively (e.g., that allows transfer of funds), and (4) clearly articulated objectives covering the entire duration of the program (to ensure stability). DEMO has evolved through a piecemeal approach in its legislative authorization. It has received funding on an annual basis, but only through negotiation, and with no assistance in bridging some of the policy elements that make collaboration between research and management difficult. Some of these needs have been partially met through the administrative adoption of a new Memorandum of Understanding by Regional Forester Robert Williams and Pacific Northwest Research Station Director Tom Mills.

2. *A well-developed, clearly articulated management structure.* Management models with a clear charter and an effective decision-making process will be most successful. DEMO has been challenged by rather dramatic changes in its management structure, in part due to conflicts involving the Federal Advisory Committee Act (FACA) or, at least the agency's interpretation of FACA. FACA resulted in the removal of key university faculty from direct involvement in decisions about the design or implementation of the study, including some of the people who were responsible for the original congressional direction and funding. Fortunately this did not happen until after the debates about the experimental design had concluded; however, it did mean that subsequent planning and implementation took place without the direct involvement of the instigators. Creation of a Scientific Oversight Committee and a DEMO Coordinating Group were useful contributions to the management structure. The DEMO Coordinating Group has been critical to resolution of issues associated with implementation of the experiment and allocation of resources. Among various possible approaches would be: (1) early development of a more formal structure for decision making and implementation with defined responsibilities, (2) modification of FACA (or its application) to allow continued involvement of key non-agency personnel in design and implementation of the project, and (3) continuity in personnel administering the project.

3. *An efficient research planning process.* Large-group science is extremely difficult to conduct. It requires strong centralized leadership.

Leadership in the early planning stages of DEMO was diffuse and uneven, resulting in far too many fundamental design changes. The level of "democracy" involved was nearly fatal. Large-scale, interdisciplinary experiments that address research-management issues will be fraught with many problems—some conceptual, others operational. During the evolution of the DEMO design, conceptual problems included fundamental disagreements about the inclusion of a clearcut treatment, the underlying analytical approach (ANOVA vs. regression), and the nature and extent of post-harvest silvicultural treatments (e.g., weed control, thinning, or other common stand management strategies). Operationally, design and implementation have been challenged by relatively high levels of variation in pre-treatment conditions within study blocks and large differences in stand structure and environment among blocks (Aubry et al. 1999, Halpern et al. 1999); difficulties in meeting all of the requirements of NEPA; and other logistical problems that in many cases reflect the differences in culture between research and resource management entities. We have learned that a clearly designed planning and decision process that identifies and addresses potential conflicts can be used to efficiently work through these types of problems.

4. Commitment of lead researchers to the coordination and planning required for success. One of the more difficult problems with DEMO has been that key participants have been involved in many activities in addition to DEMO. While most have attended to their disciplinary responsibilities effectively, some have been unable or unwilling to invest the necessary time and effort to ensure clear interdisciplinary communication. On the participant side, involved scientists and managers must make adequate commitments of time, especially to coordination and communication processes. On the agency or contractor side, there needs to be a commitment of adequate multi-year resources. In addition, one or more program coordinators need to be committed exclusively to management of the project.

5. Effective collaboration between research and management and among scientists. Effective collaboration requires a high level of understanding by researchers of the constraints of management and vice versa (see Abbott et al. 1999). However, basic vocabulary and operating styles

differ between research and management, and between federal and academic institutions. Early planning efforts where significant time is devoted to institutional and cultural orientation before any substantive research planning begins will pay dividends. For instance, short-term exchanges of research and management personnel might be possible, or collaboration might be encouraged during short, intensive research sessions or workshops. Recently, the DEMO Coordinating Group has found bi-weekly conference calls and periodic group meetings useful to resolve issues of experimental design and treatment implementation, as well as to facilitate interactions and share philosophies and operational styles. Even with substantial efforts at mutual understanding and communication, it is clear that the goals and constraints of managers and scientists are going to be different and that many decisions will represent compromises.

6. A communication program. Given the magnitude of the investment and the importance of the issues inherent in large-scale interdisciplinary studies, it is essential that there are mechanisms to share basic information with different constituencies, including Congress, resource managers, and the public. The importance of outreach in obtaining initial as well as continuing support for the project cannot be overemphasized. Possible media include: information brochures, annual (or at least periodic) reporting procedures with publications, symposia, workshops, and special presentations for managers and decision makers. Such efforts must be strongly supported by agency administrators at local, regional, and national levels, however.

The problems posed by large-scale experimentation underscore the need for a strong statistical design and for treatments that offer major, rather than subtle, contrasts. Researchers and managers must recognize the advantages and disadvantages of heterogeneous versus smaller, homogenous treatment areas. Traditional plant science and silviculture emphasize small homogenous plots. While this approach is valuable in many respects, it is inadequate for the study of large-scale ecosystem responses (e.g., responses of wide-ranging vertebrates).

7. Sufficient support for data management. Identification of critical data management needs, identification of the institutions and individuals

responsible for data management, quality control and archiving, and allocation of financial resources to achieve adequate data management are critical in large-scale ecosystem research. The scale of the task is rarely appreciated and decisions as to the institutions who will undertake the responsibility are generally not an early consideration in the design of such experiments. Furthermore, participants (especially scientists, we think) are traditionally loath to allocate large percentages of a program budget to the data management activity, preferring to spend as much as possible in research—i.e., new data acquisition. In large-scale projects of this type, our experience is that about 20% of the project budget needs to be devoted to the broad category of data management: documentation, metadata preparation, quality control (QA/QC), on-line data provision, long-term archiving, and facilitation of data exchange among collaborating scientists.

Despite the difficulties, large-scale experimentation is necessary to address large-scale problems and challenges in management. There are an increasing number of such enterprises underway. Examples include: (1) the Methods of Alternative Silvicultural Systems (MASS) project on Vancouver Island (Arnott et al. 1995); (2) ecosystem management studies in the Ouachita Mountains, Arkansas (Baker 1994); (3) the Silvicultural Systems Project (SSP) in the State of Victoria, Australia (Squire 1992); and (4) studies on the Black Mountain Experimental Forest, California². Indeed, there is sufficient interest in such projects in Canada that a network—the Forest Ecosystem Research Network of Sites (FERNS)³—has been established to facilitate exchange of information among various long-term silvicultural experiments, including organization of a workshop in 1998 on “Long-Term Silvicultural Research Sites: Promoting the Concept—Protecting the Investment.”

The MASS project is focused on regeneration, wildlife habitat, and aesthetic concerns in montane forests on the eastern side of Vancouver Island (Arnott et al. 1995). The cost and feasibility of using small patch cuts, green-tree retention, and shelterwood systems are being compared. Harvests were performed in 1993. Each approach has been replicated three times within a single large experimental area; a nearby clearcut and uncut old-growth block provide additional comparisons. The importance of both sufficient funding and committed scientists who are willing to collabo-

rate have been identified in reports about MASS as key factors in making such projects successful. MASS has had substantial financial support from industry and government and has incorporated scientists and students from many different organizations, including several universities.

Several silvicultural experiments are underway in the central region of the United States. One of the most comprehensive of these is a study of alternative harvest cutting practices in mature short-leaf pine (*Pinus echinata*)-hardwood forests on the Ouachita and Ozark National Forests (Baker 1994). This study involves 13 harvesting treatments (11 partial-cutting methods plus unmanaged and clearcut controls) replicated four times, each treatment applied to a 14- to 16-ha stand. Variables under study include microclimate, tree demography, plant community composition, wildlife communities, arthropod and microbial communities, waters and soils, logging and management economics, and scenic quality. Initial harvesting occurred in 1993; thus, to date only preliminary results have been published (Baker 1994). Nevertheless, the interdisciplinary nature of the research team is apparent as is a broad range of participating organizations.

Two related large-scale silvicultural experiments are underway in the Northern Sierra Nevada of California. At the Goosenest Adaptive Management Area, an experiment is directed toward testing alternative techniques to accelerate the development of late-successional forest vegetation in forests which previously had been subject to intensive selection harvest⁴. The harvest treatments involve contrasting emphases on retention of pine or of large trees and, for the latter, an additional comparison with and without use of prescribed fire. The 20 treatment areas (including five untreated controls) are 40 ha in size. A second experiment in northern California at the nearby Black Mountain Experimental Forest is designed to test techniques to maintain and enhance the late-successional characteristics of eastside pine forests that exhibit high levels of natural structural variability. The two harvest treatments involve retention of high and low levels of structural diversity; each treatment is replicated six times with each 100-ha replicate further subdivided into equal areas with and without prescribed burning treatments. True control areas are not a part of the experimental design, although some adjacent ecological reserves provide “qualitative” controls.

One of the earliest of the new generation of silvicultural experiments was the Silvicultural Systems Project (SSP) initiated in 1986 in the Australian State of Victoria (Squire 1992). As originally planned, the SSP and the associated Value Added Utilization System (VAUS) trial were very ambitious in allowing the examination of ecological and economic alternatives across a broad range of forest types. Implementation was much more limited with experimental harvesting confined to three treatments replicated within a single forest type. Funding constraints were the major factor limiting implementation and adequate study of many important topical areas. The deficiencies were sufficient to lead independent reviewers of the project to question whether "... the VAUS Program can meet the ... Government's [informational] needs. ..." (Squire 1992). Eventually the silvicultural experiment was abandoned because of insufficient funding, despite a substantial initial investment.

Experiments such as these reflect the growing interest in projects that address large-scale interdisciplinary issues in forest ecosystems; they also demonstrate common approaches and difficulties. True statistical replication is difficult to obtain and, when achieved, typically involves significant tradeoffs in site heterogeneity within treated plots and among replicate sites. Large, multidisciplinary teams with members from a wide array of organizations are typical and substantial communication among individuals must occur if projects are to succeed. Achieving adequate and dependable funding is a very serious challenge in sustaining such studies. Even when they address critical information needs and policy issues, sub-

stantial investments may be lost, as in the Australian SSP example.

Conclusion

DEMO was born because of the need to evaluate the scientific basis for some of the newer strategies for forest management in the Pacific Northwest, especially on federal lands. It has brought researchers and managers together in an effort of unprecedented proportion. Through DEMO, both the research and the management community are gaining experience with new approaches to silviculture and resource management. Equally important, DEMO is paving the way to more effective collaboration between research and management. This collaboration lies at the heart of adaptive management, and is essential to the success of ecosystem management.

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Endnotes

¹Memo from John Calhoun, Regional Manager, Olympic Region, WDNR to Larry Mason, Executive Director, Washington Commercial Forest Action Committee, dated June 12, 1992.

²For more information on the Black Mountain Experimental Forest, contact the Pacific Southwest Research Station, 2400 Washington Ave., Redding, CA 96001, 916/246-5455.

³For more information on FERNS, contact Jim Wood, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia, 205/363-0600. Web site: <http://www.pfc.cfs.nrcan.gc.ca/practices/fern.htm>.

⁴For more information on the Gooseneck experiment, contact Kathy Harcken, Pacific Southwest Research Station, 2400 Washington Ave., Redding CA 96001, 916/246-5455.