Research and Learning Assessment
for the
Central Cascades Adaptive Management Area

Prepared for the

Central Cascades
Adaptive Management Area
Steering Team

by

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I. Introduction and Purpose

The recent plan for management of the "spotted owl forests" emphasizes technical and social learning within Adaptive Management Areas (USDA Forest Service and USDI Bureau of Land Management, 1994). For example:

> "Adaptive Management Areas are landscape units designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives" (page D-1);
>
> "Technical topics requiring demonstration or investigation are a priority for Adaptive Management Areas and cover a wide spectrum, from the welfare of organisms to ecosystems to landscapes" (page D-3); and,
>
> "The primary social objective of Adaptive Management Areas is the provision of flexible experimentation with policies and management" (page D-5).

Additionally, the first emphasis listed for the Central Cascades Adaptive Management Area is "Intensive research on ecosystem and landscape processes and its application to forest management in experiments and demonstrations at the stand and watershed level" (page D-12). Flexibility in management and in application of Standards and Guidelines within Adaptive Management Areas provides room for innovative and experimental approaches (pages D-9 through D-12).

Fortunately, programs to meet these objectives will not have to start from scratch. A large program of ecosystem research, development and education is well established within the Central Cascades Adaptive Management Area. Formal land designations to support this program include the H.J. Andrews Experimental Forest, two Research Natural Areas (Wildcat and Hagan Block), and an Integrated Research Site for the Long-Term Ecosystem Productivity (LTEP) program. The H.J. Andrews Experimental Forest and the nearby Three Sisters Wilderness are also designated Biosphere Reserves under the Man and the Biosphere program of the United Nations. Research in these areas and in other parts of the Adaptive Management Area has been underway for almost 50 years.

The Cascade Center for Ecosystem Management organizes and conducts a program of ecosystem research, development and education within the Adaptive Management Area . Although this program historically centered on the H.J. Andrews Experimental Forest and the Blue River Ranger District, Cascade Center projects occur within and surrounding the Adaptive Management Area. Many ongoing projects organized by other units and programs within the Adaptive Management Area also contribute directly to Adaptive Management Area learning objectives.

The purpose of this assessment is to provide organization, focus and context for understanding how existing and potential future research, development and education can contribute to the technical and social learning objectives of the Adaptive Management Area. More specifically, the purpose is:

- To identify ongoing studies within the Adaptive Management Area.
- To identify ecosystem management questions of relevance to the Adaptive Management Area that are in need of further study.

- To identify opportunities to match future studies with the geography of the Adaptive Management Area.
- To describe relationships and connections among the HJ Andrews Experimental Forest, the Cascade Center for Ecosystem Management, and the Central Cascades Adaptive Management Area.
- To describe potential future development of an adaptive management process for the Adaptive Management Area.
- To provide a sound starting point for development of Centrai Cascades Adaptive Management Area plans.
- To stimulate discussion of the role of science and scientists in the Adaptive Management Area.

This assessment is intended to illustrate some potential steps that capitalize on existing research and learning programs and the opportunities provided by the Adaptive Management Area. The assessment provides information to help focus Adaptive Management Area planning and citizen participation in Adaptive Management Area activities. An intent is to provide context for critical questions that need further discussion.

The Assessment is organized into six Chapters and four Appendices. The second Chapter provides an overview of the existing learning programs and infrastructure that currently function within the Adaptive Management Area. The third Chapter builds off of Chapter II by briefly describing over 100 ongoing research and learning projects within the Adaptive Management Area. Chapter IV identifies future learning needs, primarily by listing questions that have been identified for further study by managers, researchers, and citizens within the vicinity of the Adaptive Management Area. Chapter V describes general conditions within 13 subdividsions (termed "blocks") of the Adaptive Management Area and identifies potential research and learning themes and opportunities associated with each. Research and learning themes and opportunities applicable to larger-scales are also identified in Chapter V. The final Chapter highlights some questions related to research and learning within the Adaptive Management Area that require further discussion. The four Appendices include a list researchers working within the Adaptive Management Area, more detailed lists of questions in need of further study, a brief summary of adaptive management, and the Interagency Research Group list of research needs.

II. Existing Learning Programs and Infrastructure

H.J. Andrews Experimental Forest

The 15,700 acre Lookout Creek watershed was designated as the Blue River Experimental Forest in 1948. The name was later changed to the H.J. Andrews Experimental Forest in memory of Regional Forester H. J. Andrews, who was killed in an auto accident. The Andrews is managed for the purposes of research and education. Experimental watersheds, plots, monitoring stations and control areas cover virtually all of the Andrews. The vast majority of research conducted at the Andrews Forest are nonmanipulative, observational studies; however, studies requiring manipulation of experimental variables are essential to answer some questions and are part of the Andrews Forest research program. Physical facilities at the Forest have greatly expanded in the last 5 years. Currently there are three dormitories capable of housing approximately 60 individuals, a new office and laboratory building, and construction of a new conference room/classroom suitable for groups of up to 100 people is scheduled to begin in 1995.

The emphasis and scope of the research program on the Andrews has changed and grown markedly over the years. The initial emphasis of research at the Andrews in the 1950s was to learn how to convert old forests to new forests in an efficient manner. Attention shifted in the 1960s to look at the effects of forest cutting, particularly on soil and water. The 1970s ushered in a new era of ecosystem science, focused initially on old-growth forests. The emphasis on ecosystem science continues today. Studies have been undertaken on the structure and composition of forest communities, the vertebrates and invertebrates that inhabit the forest, aquatic ecology, decomposition, nutrient cycles, long-term ecosystem productivity, disturbance patterns, fungi, lichen, and the relationships among these features of the ecosystem. A long-term measurements and permanent plot program provides critical baseline data for vegetation, fish, hydrology, climate, and erosion.

The Andrews is administered under Memoranda of Understanding among the Pacific Northwest Research Station, Oregon State University, and the Willamette National Forest. These three institutions provide the personnel, organization, and resources to conduct the Andrews research program. A wide variety of cooperating organizations also contribute to the Andrews program. A Board of Directors composed of a member of each primary institution makes policy and administrative decisions for the Forest. Open meetings are held monthly where participants from all three institutions and cooperating organizations are invited to exchange information, review research proposals, and shape the direction of the program.

A number of interwoven programs provide the resources for the research program on the H.J. Andrews Experimental Forest. Major support comes from the LTER (Long Term Ecological Research) program of the National Science Foundation (NSF). The Andrews is a coniferous forest site in the LTER network of 18 sites located throughout the United States and Antarctica. The Pacific Northwest Research Station, Oregon State University, and the Willamette National Forest all provide baseline funding and salaries to support the Andrews program. Special programs, such as the Forest Service New Perspectives Program, support specific aspects of the overall program. Numerous project-specific grants come from a wide variety of agencies and organizations (e.g., NSF, NASA, EPA).

Research Natural Areas

Two Research Natural Areas (RNAs) are located within the Adaptive Management Area (Hagan Block, and Wildcat Research Natural Areas) and three are nearby (Three Creeks, Middle Santiam, and Ollalie Ridge Research Natural Areas). These areas represent particular ecosystems and are dedicated to long-term, nonmanipulative research. Three of the Research Natural Areas contain vegetation plots that are regularly measured as part of the Andrews permanent sample plot program.

Data Management

Data management is a crucial component of the overall research and learning program. Oregon State University and the Pacific Northwest Research Station jointly sponsor two data management programs housed in the Forestry Sciences Laboratory on the Oregon State University campus. The Quantitative Sciences Group manages the Forest Science Data Bank by providing protocols, expertise, and long-term storage media for Andrews datasets. Some of these datasets are now available through INTERNET. Spatial data are analyzed, displayed and stored at the GIS (Geographic Information Systems) Lab. Several GIS workstations are available at the Lab. Both of these programs require substantial resources and expertise.

Each of the administrative units within the Adaptive Management Area (Sweet Home, McKenzie and Blue River Ranger Districts, and McKenzie Resource Area) also maintain extensive databases, and support GIS workstations. In addition, the Cascade Center operates a GIS workstation at Blue River Ranger District dedicated to support of Cascade Center projects.

Cascade Center for Ecosystem Management

The Cascade Center for Ecosystem Management is a research and management partnership formed in 1991 as an evolutionary outgrowth of the Andrews program. The increasing importance of larger spatial scales, the expanded effort to rapidly incorporate research findings and concepts into management practices, and a growing communication and education program led to the recrafting of the Andrews program as the Cascade Center. Today the Cascade Center manages a program of ecosystem research, development, demonstration, and education throughout much of the Adaptive Management Area. Projects are aimed towards improving both our understanding of ecosystem function and our application of that knowledge through ecosystem management.

The production and dissemination of new information drives the Cascade Center program. The process begins with research, management or public questions. Projects are designed to answer questions, or to demonstrate results in an applied context. Depending upon the nature of the question and the resources available to address the question, projects take a variety of forms. **Research projects** are designed to answer science questions and produce scientifically credible results with a degree of statistical rigor. **Management studies and monitoring projects** use scientific methods to address questions concerning the effectiveness of management plans and actions. **Demonstration projects** incorporate new information and concepts into management practices. Demonstration projects test the operational feasibility of new practices, and serve a critical role as a forum to exchange information and promote dialogue. ***The primary product from Cascade Center projects is information.*** A variety of methods are used to exchange project results, including tours, workshops, presentations, publications, and interactions with the media. Information is used to adapt practices on a variety of scales and to produce a new generation of

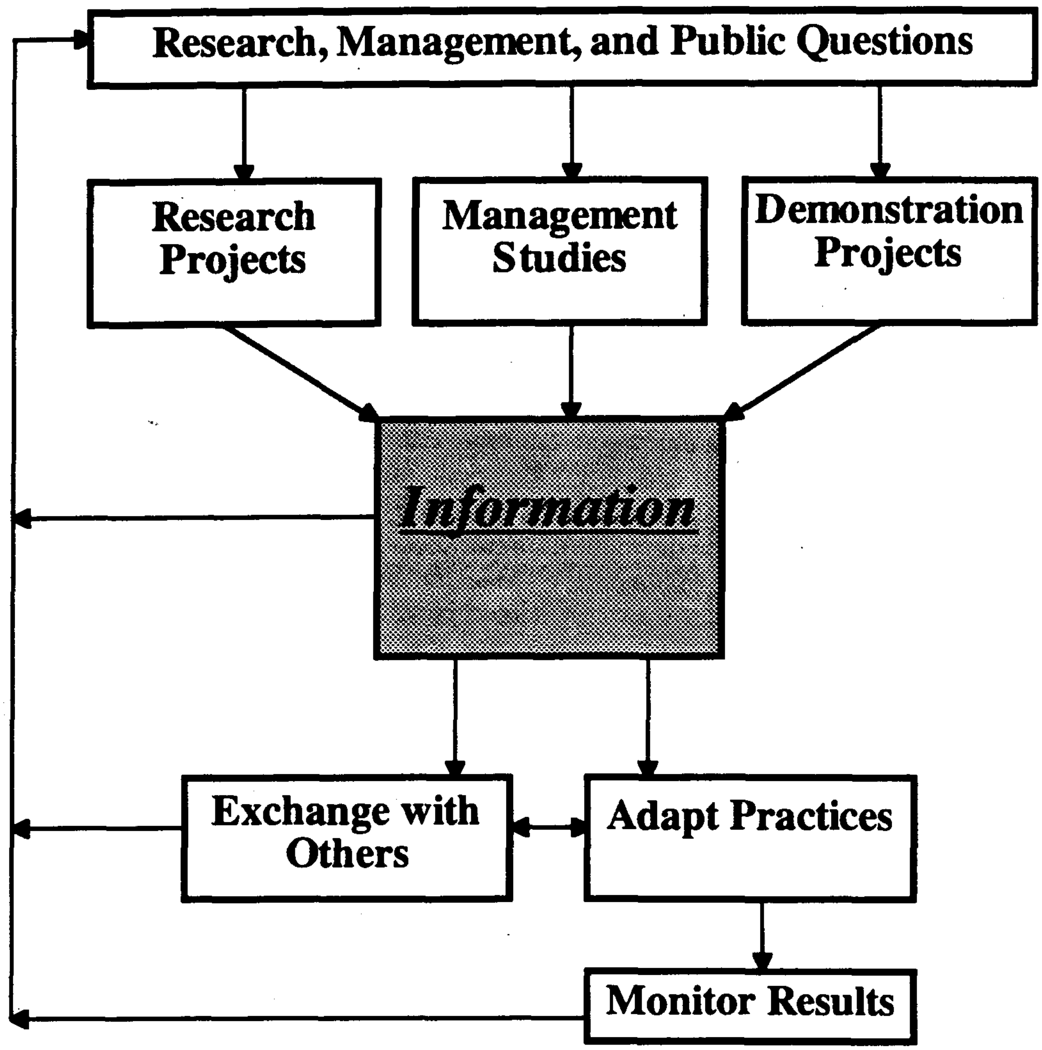

Figure 1. Cascade Center Approach to Adaptive Management

questions. New practices are monitored to judge their effectiveness (Figure 1).

The Cascade Center approach described above works in the spirit of adaptive management. The Cascade Center operates as an active, information-seeking arm of Forest Plan implementation. Underlying assumptions are tested, and alternative views are developed. Results are widely disseminated and applied, through largely informal and invisible processes. As an example, a rough tally of the Forest-wide Standards and Guidelines in the 1990 Willamette National Forest Plan showed that 58 were directly or indirectly derived from information developed through the Andrews and Cascade Center programs. Relatively little effort has been made to structure the cycle of information generation and application, nor has the public been well integrated into this process. The Adaptive Management Area provides opportunities to do both (see Chapter VI, Further Discussion).

Relationship of the Andrews and Cascade Center to the Central Cascades Adaptive Management Area

The Adaptive Management Area is in many ways analogous to the H.J. Andrews Experimental Forest. Both are land allocations with management objectives oriented towards learning and adaptive management. However the mandates of the Adaptive Management Area are much broader, and include development of innovative approaches to solving social and administrative problems. In addition, the Adaptive Management Area is an order of magnitude larger than the Andrews Experimental Forest. While the Cascade Center conducts projects throughout the Adaptive Management Area, historically the focus has been on the Andrews and the Blue River Ranger District. The Cascade Center and the Andrews Forest can go a long way towards meeting some of the objectives for the Adaptive Management Area. The social and administrative challenges of the Adaptive Management Area are substantially outside the scope of the Cascade Center. In addition, communication and coordination of projects focused on the technical learning objectives of the Adaptive Management Area that occur on the 50% of the Adaptive Management Area that is not in the Blue River Ranger District may need further refinement.

III. Current Studies

A large number of projects that contribute directly to the technical and social learning objectives of the Adaptive Management Area are currently underway. These projects are initiated, funded and supported through a wide variety of mechanisms. The following sections attempt to organize and describe these projects and programs. Studies are organized into three broad categories: **Basic Science, Management Studies**, and **Development and Demonstration Projects**. Numerous subcategories further organize the study descriptions. The labels and categories utilized are to some extent arbitrary, and the level of description is necessarily brief. The name of each study is followed by the abbreviations of the sponsoring organizations (Table 1) and a general descriptor of the status of the study. "**Startup**" means that the study is in the initial phases of planning, site selection or data collection; "**ongoing**" means that data collection or analyses are well underway; and "**reporting**" means that the study is mature enough that results are available. Each study is given a unique number that is used in the Ongoing Study Matrix at the end of the chapter. These numbers will also be used as identifiers in a Geographic Information System (GIS) database that will be developed to help track studies within the Adaptive Management Area.

Basic Science

Basic science projects seek to answer questions and test hypotheses so that a greater understanding of ecosystems and social systems can be obtained. While the distinction is somewhat arbitrary, projects labeled as "basic science" in this Assessment are generally motivated by a desire to know what makes the system tick, and not by any particular management question. These studies are generally funded through science organizations, such as the National Science Foundation (NSF), and evaluated based on their contribution to the body of scientific knowledge. That said, today's basic science questions and issues have a way of becoming tomorrow's management questions and issues. These studies are organized in this Assessment into three categories: the Long-term Environmental Measurements Program, which supports many other studies; the Long-term Ecological Research Program (LTER); and Other Basic Science. Studies from all three sections reinforce each other and involve many of the same scientists.

Long-term Environmental Measurements Program

The long-term environmental measurements program supports a wide variety of question-driven studies. Baseline data for several critical physical and biological components have been collected over the past 10-40 years. These data allow longer term trends to be detected and provide context for interpretations from other datasets. Resources for this program come from the Pacific Northwest Research Station, Oregon State University, and the National Science Foundation. Major projects are summarized in this section.

Abbreviation	Organization
BLM	Bureau of Land Management
DNF	Deschutes National Forest
EPA	Environmental Protection Agency
MAB	Man and the Biosphere
NASA	National Aeronautics and Space Administration
NBS	National Biological Survey
NCASI	National Council for Air and Stream Improvement
NSF	National Science Foundation
ODA	Oregon Department of Agriculture
ODF&W	Oregon Department of Fish and Wildlife
OSU	Oregon State University
PGE	Portland General Electric
PNW	Pacific Northwest Research Station
SCERT	State Community Economic Revitalization Team
SHHS	Sweet Home High School
SHS	Springfield High School
UCB	University of California at Berkeley
UG	University of Georgia
UNESCO	United Nations Education Science and Cultural Organization
UO	University of Oregon
USDA	United States Department of Agriculture
USF&WS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UW	University of Washington
WMI	Wilflife Management Institute
WNF	Willamette National Forest

Table 1 - Abbreviations

Vegetation (NSF, OSU, PNW, UW -ongoing, reporting) (B1)

A network of over 100 permanent vegetation study areas are periodically measured to better understand natural processes of succession, tree mortality, biomass accumulation, timber growth, and herb and shrub dynamics. These areas range in size from a single plot to small watersheds, and are located in the H.J. Andrews Experimental Forest, nearby Research Natural Areas, and in other parts of the Pacific Northwest and other western states. Vegetative conditions range from post-clearcutting to old growth. Numerous studies depend upon data from this project.

Meteorology (PNW, OSU, NSF, - ongoing, reporting) (B2)

A permanent network of meteorological stations that span different environmental zones is established in and around the Andrews Forest. Precipitation, temperature, humidity, snow depth and duration, wind speed and direction are regularly measured and the resulting data stored in the Forest Science Data Bank. Acidic precipitation and atmospheric wet fall/dry fall are also monitored through participation in the National Atmospheric Deposition Program (NADP), which includes approximately 300 sites across the nation. These datasets are routinely used for climatic studies and as basic information for a wide variety of studies.

Hydrology (PNW, OSU, NSF - ongoing, reporting) (B3)

A network of gauged watersheds located in and around the Andrews Forest provides long-term data on stream discharge, water chemistry, water temperature and sediment. Three sets of watersheds span a range of sizes and elevations and provide comparisons of undisturbed, moderately disturbed, and heavily disturbed watershed conditions.

Erosion (PNW, OSU, NSF - ongoing, reporting) (B4)

Networks of sites are established to monitor several erosional processes. Sediment catch basins located at the base of some of the water gauging stations measure total sediment export from the watershed. Several large, slow-moving, deep-seated earthflows are instrumented and measured on a regular basis. Inventories of landslides and debris-flows are periodically conducted on the Andrews Forest. These projects provide data to estimate erosion rates and to correlate these rates with landscape characteristics and human uses.

Stream channels (PNW, OSU, NSF - ongoing, reporting) (B5)

Changes in stream channel morphology are measured through a variety of means. Permanent channel cross-sections are monitored along a gradient of small to large streams on the Andrews Forest and Hagan Block RNA. Time-lapse photographs provide visual records of channel changes. Surveys and maps document input rates, residence time, transport distance, and physical characteristics of large woody material in the stream.

Long-term Ecological Research Program (LTER)

The National Science Foundation-sponsored Long-Term Ecological Research program provides relatively stable (6 year funding cycle) support to the basic science program at the Andrews Forest, and a mechanism for integration across the larger Andrews research program. The Andrews Forest has been designated as an LTER site since 1980. The LTER program supports a long-term environmental measurements program that provides data for a wide variety of analysis and synthesis efforts. Many of the long-term measurements and studies on the Andrews Forest and surrounding landscape are supported through the LTER program. Short-term projects that contribute to understanding of longer-term ecological processes are also part of the LTER program. Over 50 scientists and 30 graduate students from Oregon State University, the Pacific Northwest Research Station and other cooperating institutions are involved in the Andrews Forest LTER program.

The central question of the Andrews Forest LTER program is : How do land use, climate change, and natural disturbance affect ecosystem characteristics such as primary productivity, biodiversity (includes both vascular and nonvascular plants, fungi, and both vertebrate and invertebrate animals), water yield, water quality, carbon stores, and disturbance patterns? Andrews Forest-related LTER research is organized into several thematically-based components. Many of these components are common among the eighteen LTER sites across the country and Antarctica. Common questions, methods and protocols promote intersite comparisons, a key concern for the National Science Foundation. The following description of LTER programs and projects is organized by the Andrews Forest LTER components. Many of the projects listed here are supported by funding sources in addition to LTER. Also, many of the studies listed in the Other Basic Science section, which immediately follows the LTER section, contribute directly to LTER studies and frequently involve the same scientists.

Component 1: Successional processes and higher trophic levels

Knowledge of the processes driving and controlling plant community succession, and the interactions of higher trophic levels that directly or indirectly depend upon plants for food, is fundamental to understanding ecosystem function. Studies in this component strive to understand how plant communities change in composition and structure over time, and the interactions of invertebrates and vertebrates with plant community dynamics. Because of the importance of invertebrates in our ecosystems as decomposers and herbivores, several studies are directed towards better understanding plant and invertebrate interactions.

<u>Vegetation succession (NSF, OSU - ongoing, reporting) (B6)</u>

A wide variety of studies are examining the changes in plant communities over time utilizing the permanent vegetation study areas network. The following projects are currently active:

- Successional processes in natural forests, and following logging
- Development of old growth structure and volume in maturing Douglas-fir stands
- Structure, productivity, and mortality rates of riparian forests
- Plant demographic patterns
- Comparison of factors controlling growth, yield and biomass accumulation rates

- Growth and yield of noble fir forests

Biodiversity of arthropods in coniferous forest ecosystems (OSU, PNW - ongoing, reporting) (B7)

Insects, spiders, mites and other arthropods are sampled seasonally at several locations on the Andrews Forest to develop a data base on abundance, distribution, habitat affiliations and overall biological diversity. The 3400 species collected to date are estimated to represent approximately half of the total species. This basic information is used in many studies. These small organisms play important roles in nutrient cycling, pollination, predation, parasitism, herbivory, and resiliency to disturbances.

Riparian zone arthropods (NSF, OSU - reporting) (B8)

Transects spanning upslope and riparian environments have been established to compare arthropod composition in riparian areas to upslope areas. This study is obtaining baseline information that will be useful in monitoring riparian conditions.

Canopy arthropod ecology (NSF, OSU - ongoing, reporting) (B9)

This study is looking at the influence of canopy architecture and spider species behavior on the composition of forest canopy arthropods. Spiders are important predators of insects in the forest canopy.

Role of arthropods in wood decomposition (NSF OSU - startup) (B10)

The role and interactions of arthropods in wood decomposition is being investigated through a new manipulative study on the H.J. Andrews Experimental Forest. Logs will be inoculated with various arthropod species at different depths under different moisture conditions and compared to each other in terms of decomposition processes.

Biodiversity and habitat affiliations of moths and butterflies (NSF, OSU - ongoing) (B11)

Moth and butterfly sampling, trapping and rearing studies are underway to determine host plants, parasites, and identity of larvae and adults. These projects are designed at a landscape scale to help develop a big picture understanding of insect diversity using the abundant species of moths and butterflies in the area.

Canopy invertebrates response to stand age and structure (OSU, PNW, WNF, NSF - reporting) (B12)

Canopy invertebrate response to forest development and disturbance intensity is being assessed through comparison of old growth and mature natural forest, old-growth shelterwoods, and 10-15 year old plantations. Samples of arthropod abundance have been collected in the canopies of six replicates of each treatment in 1986, 1992, and 1994.

Component 2: Terrestrial/aquatic interactions

Forest-stream interactions profoundly shape forest and stream ecosystems. Forests affect nutrient input and processing, stream temperature, channel form, fish habitat and disturbance processes affecting streams. These studies are focused on understanding these interactions at multiple scales, ranging from individual channel units up to entire watersheds.

Long-term woody debris dynamics (NSF, OSU ,PNW - ongoing, reporting) (B13)
Numbers, locations, dimensions, movement, and new inputs of woody debris have been inventoried annually since 1982 in the channel and floodplain of Mack Creek (H.J. Andrews Experimental Forest). The dataset has been used to develop and calibrate a wood dynamics model, and to provide management recommendations.

Long-term trout population study (OSU, NSF, PNW - ongoing, reporting) (B14)
In one of the longest running trout population studies in the west, cutthroat trout populations in clearcut and old-growth sections of Mack Creek have been inventoried annually since 1973.

Nutrient addition study (NSF, OSU - ongoing, reporting) (B15)
Nitrogen was added to Lookout Creek in a dilute solution from 1991 to 1993 to evaluate trophic level responses to changes in primary productivity. Algal community composition, algal biomass, primary production, macroinvertebrates, and vertebrate responses have been measured. Follow-up measurements are continuing.

Landscape pattern of riparian forests (OSU, NSF, PNW - ongoing) (B16)
The composition, structure and dynamics of riparian forests is being compared among several watersheds in the Willamette NF using satellite imagery.

Disturbance modeling (OSU, NSF, UG - ongoing) (B17)
In cooperation with the University of Georgia, a model of disturbance in stream ecosystems using trout populations as a biotic response variable is being developed.

Stream chemistry and temperature monitoring (OSU, NSF, PNW - ongoing, reporting) (B18)
Long-term stream chemistry (nutrients, sediments, cations, alkalinity, pH) and temperature measurements have been collected in harvested and undisturbed watersheds since the 1950s in the H.J. Andrews Experimental Forest.

Component 3: Effects of early successional nitrogen fixers
Productivity of western Cascade forests is generally limited by nitrogen due to the nature of the underlying parent material. Some early-successional plants are capable of fixing atmospheric nitrogen in a form usable by plants. This study is attempting to better understand the role of nitrogen-fixers in maintaining forest productivity.

Ceanothus ecology (OSU, NSF, PNW -reporting) (B19)
This project is examining limits on establishment, growth rates, and nitrogen fixation rates by *Ceanothus*, and the controls on nitrogen fixation by associated microrganisms.

Component 4: Competitive interactions in young forest stands

Forest structure and soil conditions are assumed to play a major role in the productivity of young forest stands. This study, as well as other related studies, is designed to experimentally test this assumption.

Young stand spacing and nutrient study (OSU, NSF, PNW - ongoing) (B20)

A series of young stands on the Andrews Forest were treated by thinning, pruning, and fertilization in the 1980s to establish a range of stocking levels and nutrient status. The role of stem density in regulating self-thinning and the effects of nutrient levels on competition and growth are the primary questions of the study. Periodic remeasurements are taken, but the study hypotheses require further stand growth and competition before conclusions can be drawn. A wood quality component was added to the study in 1995.

Component 5: Log/snag decomposition processes

Decomposition of wood plays a major role in forest soil conditions, nutrient cycling, carbon storage and release, and as habitat for plants and animals. A series of studies have been installed to better understand the factors controlling decomposition of fine and coarse wood at a variety of scales in differing environmental conditions.

Long-term log decomposition (OSU, NSF, PNW - ongoing, reporting) (B21)

Installed in 1985, this is a comprehensive, long-term (200-year design) study on the Andrews Forest looking at a variety of log decomposition processes. Sampling continues on a regular schedule for wood density, depth of decay, moisture content, nutrient and lignin content, leaching, respiration, nutrient export through mushrooms, and insect emergence. Data from this study are being used to construct a series of models that predict decomposition and nutrient release from woody detritus.

The study also includes an aquatic component. Ninety logs were placed into Lookout Creek at the same time; their movement and decay has been tracked since 1986.

Fine woody detritus decomposition (OSU, NSF, PNW - ongoing, reporting) (B22)

Decomposition of smaller diameter branch and bole pieces is also being studied in conjunction with the long-term log decomposition study.

Leaf litter decomposition (OSU, NSF, PNW - ongoing, reporting) (B23)

Leaf and fine litter decomposition is being analyzed as part of a 28-site, LTER study (LIDET) extending from the north slope of Alaska to Costa Rica. Litterbags containing fine material collected from participating sites are placed in the forest at the Andrews.

Root decomposition (USDA, OSU, NSF, PNW - startup) (B24)

A three-site study (Cascade Head, HJ Andrews, and Pringle Falls Experimental Forests) to examine the factors controlling the decomposition of fine and coarse roots in the Pacific Northwest was initiated in 1994. The study will test the effect of species, size, initial chemistry, moisture and temperature on decomposition and nutrient release. Data from the experiment will be used to construct a root decay model.

Component 6: Long-term site productivity

Most studies of forest productivity have been of short duration, yet our native ecosystems function at a time-scale of multiple centuries. Soil nitrogen and organic matter stores are generally agreed upon as principle factors affecting forest productivity, and are also affected by forest cutting practices. These studies attempt to understand the processes that are likely to affect nitrogen and organic matter over the long-term.

Long-Term Ecosystem Productivity (LTEP) (PNW, WNF, OSU, NSF - startup) (B25)

This large-scale, long-term (200-year design) experiment has been in the planning and pretreatment sampling stage since the mid-1980s. It is part of a five-site regional network, and includes both basic and applied programs of research. The study will examine the effects of species composition associated with different successional stages, and the effects of varying levels of forest floor organic matter on a wide variety of ecosystem productivity measures. Three replications of six treatments and a control are planned. Implementation is scheduled for 1995 through 1997 in the Isolation Block of the Blue River Ranger District.

Soil nitrogen dynamics (OSU, NSF, PNW - reporting) (B26)

Soil samples have been transferred across elevation zones to look at the potential effects of climate change on nitrogen transformations. Laboratory experiments have also been conducted on these samples.

Patterns of biological activity in forest soils (OSU, NSF, PNW - ongoing, reporting) (B27)

A series of studies in and around the Andrews Forest were designed to determine the spatial patterns of soil processes and the potential causes of spatial variation.

Component 7: Flux of trace gases

It is well established that the concentration of carbon dioxide, methane, and nitrous oxide are increasing in the earth's atmosphere, and may influence global climate. These studies are focused on better understanding the factors influencing the flux of these gases to and from forest soils. Forest cutting and silvicultural practices may alter gas exchange in the forest.

Soil processes and properties (OSU, NSF, PNW - ongoing) (B28)

Monthly measurements are taken at 20 permanent gas exchange sites located on the Andrews Forest. Variables measured include field and laboratory soil respiration estimates, soil and air temperatures, pH, soil moisture, soil organic matter, soil dissolved organic carbon, mineralizable nitrogen, denitrification potential, bulk density, and litter mass.

Landscape-level soil respiration (OSU, NSF, PNW - ongoing) (B29)

Periodic measurements are made of a wide range of variables influencing soil respiration across a network of 180 sites on the Andrews Forest. These data are being used to describe landscape level controls over soil respiration and other soil processes. In addition, detailed studies of soil respiration variability at different temporal and spatial scales are underway.

Forest soil wet-up experiment (OSU, NSF, PNW - ongoing, reporting) (B30)

The influence of moisture content on gas fluxes is being investigated through a series of soil wetting experiments. Measurements are made of soil moisture, respiration, dissolved organic carbon, soil microbial activity and chemistry.

Effects of forest thinning on microbial processes (OSU, NSF, PNW - startup) (B31)

A retrospective study has been initiated comparing old growth, even-aged stands, and thinned stands in terms of mycorrhizal and invertebrate biodiversity. Variables affecting soil respiration are also being measured.

Component 8 : Disturbance

Forest and stream ecosystems undergo constant, slow changes on a daily basis. Rapid changes are also induced by disturbances such as fire, flood, wind, landslides, timber cutting, or road-building. These disturbances play a major role in shaping ecosystems. The frequency, severity, duration, and spatial extent of a disturbance all affect the starting conditions for a new generation of plants and animals. Starting conditions, in turn, strongly influence the future pathway of ecosystem development. These studies attempt to better understand disturbance regimes and effects.

Central Cascades fire regimes (PNW, OSU, NSF - startup) (B32)

Building upon the fire history studies previously completed for the Andrews, Deer Creek Upper Blue River, and Augusta Creek areas, a new project aims to develop and apply new techniques to interpret the influences of topographic, climatic, and vegetative type on fire regimes within a large Central Cascades study area.

Patterns of exotic plant invasion (PNW, OSU, NSF - ongoing) (B33)

Patterns of exotic plant invasion are being examined in relation to plant dispersal mechanisms and forest road, trail and timber cutting patterns on the Andrews Forest.

Debris flow recovery (OSU, NSF, PNW - ongoing, reporting) (B34)

Fish populations, macroinvertebrates, water chemistry, and channel structure were measured prior to a large debris flow in N. Fork Quartz Creek that occurred in 1986, and have been remeasured each year since then.

Modeling of land use and climate change effects on hydrology (PNW, OSU, NSF, WNF, USGS - startup) (B35)

A model that portrays interactions of forest conditions and hydrologic processes is being used to assess the effects of land management and climate change. Scenarios that simulate potential future landscape changes in the Andrews Forest and in Augusta Creek provide the input for the hydrologic model.

Component 9: Synthesis and modeling

Many of the studies in this Assessment in some way divide and isolate some portion of the ecosystem in order to gain insight into a particular process or question. Studies in this section attempt to put the pieces back together by integrating across spatial or temporal scales, or across ecosystem functions. Much of this work is done using computer models as a means to integrate data and concepts, and evaluate potential future conditions.

Climatic variability (UO, OSU, PNW - ongoing, reporting) (B36)
The long-term metereological dataset has been extended back in time through correlation with regional metereological data. Change in climate over time is being assessed and compared with El Niño events, ocean salmon catch, and with other meterological stations throughout the LTER network. Records from the meterological stations on the Andrews are also being analyzed to determine patterns in the spatial variablility of climatic variables.

Changes in regional carbon storage (PNW, OSU, NASA, NSF - ongoing, reporting) (B37)
A linked series of three models is being developed to assess changes in terrestrial carbon stores and exchange with the atmosphere. Data are being assembled and integrated at stand, landscape, and regional scales. The HARVEST model estimates the amount of carbon removed from a site during timber harvest. A preliminary version of PRODCARB, which tracks the fate of harvested carbon in forest products manufacturing and use, has been completed. Satellite imagery is being analyzed to determine changes in carbon storage and atmospheric fluctuation since 1972 at a regional scale.

Other Basic Science

Studies listed in this section are not part of a formal program, such as the LTER program, but are generally funded on a project by project basis. The LTER program, and the larger Cascade Center program, provide context and integration for many of these studies. Some are directly linked to ongoing research listed above in the LTER component descriptions, and involve the same scientists. Studies in this section are organized by Watershed Processes, Spotted Owl, Carbon Storage and Release, Soil Processes, Biodiversity, Landscape Patterns, and Plant Ecology.

Watershed Processes

Water Quality and Quantity Monitoring (WNF, USGS - ongoing) (B38)
In addition to the network of watersheds monitored through the Andrews LTER program, several other streams in the Adaptive Management Area are being monitored. Baseline water quality data have been collected in Moose Creek over the last 8 years for turbidity and pH. Bear Creek and Marten Creek both have stream discharge, sediment and temperature monitoring stations and approximately 10 years of data. Budworm Creek has been monitored off and on over the last 12 years for turbidity, depth, and summer temperature. Upper Blue River and Lookout Creek are part of the US Geological Survey network of streams gauged for discharge and water quality.

Experimental studies of debris flows (USGS, PNW, OSU, WNF - ongoing) (B39)

A 90 meter-long experimental debris-flow flume is located near the Andrews Forest Headquarters site to allow geologists to make key measurements not otherwise possible. Debris flows are released from the top of the flume allowing scientists to measure all phases of the debris-flow process, from initiation to deposition. The primary purposes are to test and further develop mathematical models for interpreting and forecasting debris-flow behavior, and to develop improved technologies for mitigating the destructive effects of debris flows.

Groundwater and nutrient cycling in riparian zones (OSU, PNW - reporting) (B40)

The movement of nutrients and organisms in wetted areas beneath the surface in riparian areas (hyporheic zone) is a new area of research interest. A series of small test wells and probes have been installed along McRae Creek to begin collecting this kind of data on the Andrews.

Historical changes in the Upper McKenzie River (OSU, PNW, WNF - reporting) (B41)

Changes in channel form and riparian vegetation from the late 1940s to 1986 were analyzed on the upper 70 kilometers of the McKenzie River. Channel area, tributaries, side channels, large woody debris, exposed gravel bars, roads, and dominant riparian vegetation were tabulated and compared. Channel straightening, reduction in side channels, and loss of pool-forming agents (e.g., large wood) have significantly reduced fish habitat heterogeneity and off-channel refugia.

Parasite dynamics in low elevation streams (UCB, NASA, OSU, PNW - startup) (B42)

This study addresses the effects of logging-induced changes in streams on the parasite-host interactions of a parasite (*Plagioporous silicula*) that infects Cutthroat trout. The intent is to gain insight on potential effects of global climate change on aquatic systems.

Spotted Owl

Prey species of the spotted owl (OSU, USF&WS, WNF, PNW - ongoing, reporting) (B43)

A variety of studies have been undertaken to better understand the population dynamics, community ecology and habitat affiliations of common prey species of the spotted owl. The abundance, habitat relationships, movements, and home range size of northern flying squirrels have been analyzed. The abundance of northern flying squirrels and Townsend's chipmunks in old-growth forests and 30-40 year old plantations were compared. Early results indicate that northern flying squirrels, the primary prey species at certain times of the year, are equally abundant in both types of stands. Other prey species, such as deer mice, are now being investigated. Analysis is currently underway to determine the relationship between prey densities and spotted owl reproductive rates.

Spotted owl demography study (OSU, USF&WS, WNF, PNW - ongoing, reporting) (B44)

Spotted owl birth, survival, and death rates are being analyzed in this large-scale study; most of the Adaptive Management Area is included. Several dozen pairs of owls have been banded and tracked annually since 1987. These data are used in spotted owl models that project future owl populations. Current results show that spotted owl populations are decreasing. This study is part of a regional network of similar studies throughout the range of the northern spotted owl. A subset of the demography study, called the density study, attempts to accurately determine the total numbers of spotted owls by conducting an intense search to find every owl in the study area.

Spotted owl habitat preferences study (OSU, USF&WS, WNF, PNW - ongoing, reporting) (B45)

In a companion study to the owl demography study, spotted owl home range composition and habitat use are being analyzed throughout much of the Adaptive Management Area. The purpose is to better understand what kinds of habitat the spotted owl uses and avoids for different life history stages. Using radio telemetry, owls are tracked within two study areas: one is highly fragmented and the other is relatively contiguous mature and old forests.

Landscape pattern and predators of the spotted owl (OSU, WMI, USF&WS, ODF&W, WNF, PNW - reporting) (B46)

Relative abundance of the great horned owl, the primary predator of the northern spotted owl, and the spotted owl were analyzed in relation to landscape pattern. Results showed that great horned owls frequent edges between old forests and plantations, while spotted owls avoid edges.

Relations of spotted owls and landscape structure (OSU, USF&WS, AID - startup) (B47)

Remote sensing data on forest conditions in the central Cascades and field data on spotted owl site usage are being analyzed to determine the relationship between spotted owl nest-site selection, reproductive success and forest fragmentation.

Spotted owl demography study (NCASI/BLM - ongoing, reporting) (B48)

Data on spotted owl birth, survival, and death rates and habitat use are being collected in a large study area encompassing much of the northern tributaries of the Lower McKenzie River, including the westernmost portions of the Adaptive Management Area.

Carbon Storage and Release

Seedling Growth and Litter Decomposition Study (EPA, WNF - ongoing) (B49)

The purpose is to better understand how tree growth and decomposition will change in response to increasing atmospheric carbon dioxide and temperature. This study is designed as a reference point for detailed tree growth and decomposition studies in growth chambers established at the EPA Environmental Research Laboratory in Corvallis (TERA Project). Alternative climate change scenarios are being simulated in these chambers. Three small plantations of seedlings are established along an elevational gradient in the South Santiam basin, including one site in the Adaptive Management Area.

Modeling the effects of land use on regional carbon stores (OSU, NASA, PNW - ongoing) (B50)

Forest practices are one potential factor affecting the amount of carbon in the atmosphere and potential climate change. The objective of this study is to better understand the role of timber harvesting and forest regrowth on the Pacific Northwest regional carbon budget. A series of satellite images across the region depicts changes in vegetative condition over time. These data are being linked to carbon storage and release models to describe net changes in atmospheric carbon due to forest practices.

Soil Processes

Mycorrhizal mat communities (OSU, PNW, NSF - ongoing) (B51)

Mycorrhizal mat communities are an extensive feature of our forest soils. Concentrations of mycorrhizal fungi form mats which can dominate soil characteristics in the immediate vicinity. These mats increase nutrients available to trees, increase biological diversity, facilitate growth of conifers on stressed sites, and may reduce root pathogen development. Studies are underway to better understand the precise role of these mats in nutrient cycles, the dynamics of mat development, and the mechanisms that allow these mats to act as conifer seedling nurseries. Factors at the stand level that influence mat distribution are also being studied.

Factors influencing carbon and nitrogen cycling (OSU, PNW, NSF - ongoing) (B52)

A series of studies are being conducted to determine the most important factors influencing nitrogen and carbon cycling at spatial scales ranging from small plots to the region. The resulting data will be used to generate models that can estimate the effects of climate change and disturbances on carbon and nitrogen cycling at multiple scales.

Biodiversity

Mycorrhizal fungus communities (PNW, OSU, WNF- ongoing, reporting) (B53)

Young, middle-aged, and old forests are being compared to determine the composition and abundance of mycorrhyizal fungi, particularly for certain species collected for people's use. The purpose is to better understand the habitat preferences and association of fungi with forest succession following disturbance.

Forest canopy epiphytes (OSU, PNW - ongoing, reporting) (B54)

Lichens, mosses and related plants reside in forest canopies. Previous work has shown that species composition differs quite markedly across a forest. Current work is aimed at better understanding the microsite habitat affiliations of these canopy epiphytes. Using ropes and an upper canopy platform, changes in species composition across forest age, within the crowns of individual trees, from forest edge to forest interior, and from streamside to upper slopes are being assessed.

Riparian moss communities (OSU, PNW - reporting) (B55)

Field surveys were conducted in riparian areas in the Andrews Forest to characterize moss communities. The species present and the abundance of species was correlated with elevation and the size of the stream. At a finer scale, moss species composition and abundance was associated with the levels of coarse wood and the distance from the stream. The highest diversity of mosses occurred in areas of intermediate disturbance frequency. Several new moss species were identified.

Bird and mammal communities in riparian areas (OSU, PNW, USF&WS, WNF - reporting) (B56)

The species composition, abundance and structure of songbird and small mammal communities has been assessed in riparian areas of young, mature, and old-growth forests.

Harlequin ducks (OSU, ODF&W, USF&WS, BLM, WNF, PNW - startup) (B57)

Investigators are locating nesting and brooding Harlequin ducks using radio telemetry, and describing habitat features at site and landscape scales. Harlequin ducks are identified as a sensitive species with small and declining populations. Protection of nest sites is likely important for conservation of the species.

Forest dwelling bats (WNF, OSU, SHS, PNW - ongoing) (B58)

Ten species of bats likely occur within the Adaptive Management Area, yet relatively little is known of their basic ecology and habitat needs. Two projects are underway analyzing bat roost characteristics and locations, and bat foraging habitat. These data should help assess the adequacy of existing management guidelines.

Taxonomy and ecology of soil arthropods (OSU, PNW - ongoing, reporting) (B59)

Extensive samples of litter and soil organisms have been taken in forested habitats to characterize these invertebrates. Commonly, 250 species of insects and other arthropods are found in a single square meter of forest floor. These organisms play important roles in nutrient cycling, but are poorly understood taxonomically.

Taxonomy and ecology of Hemiptera (OSU, PNW - ongoing, reporting) (B60)

The habitats, distribution, and identity of true bugs are being assessed in this study. These species play roles in the ecosystem by feeding on plants and preying on other invertebrates. There are over 200 true bug species found in our forests.

Arthropods of Pacific yew (OSU, PNW - reporting) (B61)

A review of the insects and other arthropods found on Pacific yew and other species of yew was just completed. Yew appears to have fewer insects and mites on it than any other tree. Specialized chemicals in the foliage may be the reason.

Neotropical songbird monitoring (WNF, Institute for Bird Populations, Pt. Reyes Bird Observatory - ongoing) (B75)

Neotropical migratory songbirds are monitored annually at six stations on the Willamette NF, including one within the Adaptive Management Area and one nearby. The purpose is to assess population trends, survivorship, and breeding successs of these speicies. Birds are caught with mistnets and banded. These sites are part of the national Monitoring Avian Productivity and Survivorship (MAPS) program.

Landscape Patterns

Landscape pattern dynamics (OSU, PNW, WNF - ongoing) (B62)

Existing landscape composition and pattern is being compared to historic and potential future conditions in the Andrews and Augusta Creek areas. Fire history studies accomplished in both areas provide a basis for reconstructing landscapes from approximately the year 1500 to the present. A simple simulated timber cutting model projects potential future landscapes under alternative rotation ages and spatial rule sets. Preliminary results show that current conditions at both sites are well outside the range of pre-settlement conditions. Continuation of short rotation, dispersed cutting will push these sites further outside the range of pre-settlement conditions, while long rotation cutting with an aggregated cutting strategy may restore presettlement landscape patterns.

Forest fire patterns (OSU, PNW, WNF - ongoing) (B63)

Variation in fire severity has historically had a major influence on forest structure and composition. Existing data from fire history studies are being analyzed to improve our understanding of topographic controls on fire severity. This analysis is drawing upon fire history data from the Andrews Forest, upper Blue River, Deer Creek, Augusta Creek and from the recent Warner Creek fire.

Landscape pattern inertia (OSU, PNW, WNF - reporting) (B64)

A simple timber cutting simulation model was used to generate alternative future landscapes in the Cook-Quentin study area. The purpose was to determine how long it takes to achieve alternative landscape pattern objectives under various timber cutting rules given current landscape conditions. The study shows that changes in landscape pattern can lag substantially behind changes in the timber cutting rules. The legacy of dispersed-cutting generated landscapes will be difficult to erase without substantial reductions in harvest rates.

Forest distribution and change in western Oregon (OSU, NASA, PNW -reporting) (B65)

Satellite imagery from 1972 and 1992 was classified into broad vegetation categories for a large western central Cascades study area. Landscape pattern was analyzed and compared with these datasets. Results showed dramatic change in some areas, and the distinctive imprint of various ownership's and land-use categories.

Regional landscape pattern and biological diversity (OSU, NASA, PNW -ongoing) (B66)

A series of statistical models are being developed that use satellite data to map potential habitat for selected species. Models have been developed for 24 species of birds and additional models are planned for selected small mammals, amphibians and bats. Satellite imagery provides relatively low cost and consistent information across time and ownership's. The goal is to correlate the occurrence and abundance of species and species groups with measures of forest structure detectable from space.

The archive of satellite data are being used to quantify changes in potential habitat over the last 20 years.

Comparison of road networks across land ownership classes (OSU, PNW - ongoing) (B67)

Road density and placement as a function of topography are being compared across ownership and broad land-use categories in central western Oregon.

Comparison of riparian vegetation across land ownership classes (OSU, PNW - ongoing) (B68)

Forest age class distribution within several riparian zone widths is being compared across ownership and broad land-use categories in central western Oregon.

Pre-logging landscape patterns (WNF, OSU, PNW - ongoing) (B69)

A 1933 forest cover type map is being analyzed to determine pre-logging landscape pattern in three western Oregon study areas, including one that covers most of the Adaptive Management Area. Environmental factors such as slope, aspect, elevation, precipitation, distance to streams, and fire regimes will be compared to the landscape pattern to assess potential explanatory factors.

Comparison of land-use patterns across large drainage basins (UNESCO/MAB, OSU, Northwest Area Foundation - ongoing) (B70)

Objectives are to study interactions among social and ecological processes that affected land-use and vegetative patterns between two contrasting large basins (McKenzie River and the Middle Fork of the Willamette River). Forest cutting and road development patterns are being compared across the two basins to determine the causes and consequences of forest development and use decisions.

Plant Ecology

Forest canopy gaps (PNW, OSU, NSF, UW - reporting) (B71)

Experimental gaps ranging from one eigth to half an acre in size were created on the Andrews to better understand the effects of gaps in the forest canopy. Tree, shrub, and herb regeneration, seed rain, microclimate, and soil characteristics are being analyzed in relation to gap size and position. This study is part of a two-site experiment; additional replications were installed on the Wind River Experimental Forest.

Forest stand dynamics modeling (OSU, PNW, WNF, Duke - ongoing, reporting) (B72)

A computer simulation model, called ZELIG-PNW, is being used to assess a wide variety of alternative timber cutting regimes. Plots of trees are grown, harvested, regenerated and tended according to a silvicultural prescription, and the model reports on the resulting future stand composition and structure. Since many silvicultural approaches being considered today have never been implemented, early indications of potential results will be through stand growth models. Outputs from ZELIG can be linked to wildlife habitat or other assessment modules that depend upon knowing detailed information about stand conditions.

Douglas-fir and alder interactions (OSU, USDA, WNF, PNW - ongoing) (B73)

Interactions among nitrogen-fixing red alder and Douglas-fir have long been of interest to managers and scientists since growth of Douglas-fir is commonly nitrogen-limited. Multiple replications of Douglas-fir and alder plots are established on two sites in the Andrews. The proportion of each species and the spacing between trees is varied so that scientists can evaluate the potential influence of red alder on Douglas-fir growth. Additional replications of this study are located in the Coast Range.

Plant populations during early, post-logging succession (OSU, PNW, WNF - ongoing, reporting) (B74)

Changes in plant populations in the Pacific silver fir zone during early succession following logging are being investigated in a study on the Andrews Forest (Cornell).

Management Studies

Management studies apply scientific methods to management questions. Experimental design and measurement protocols are utilized to produce reliable information that will help managers make better decisions. Frequently scientists also have a high interest in these studies because they shed light on underlying science issues, and provide another means of testing hypotheses about how the system works. Many of these projects also help answer monitoring questions and could be labeled as monitoring projects. Management studies are organized into Stand Management, Watershed Restoration, and Social and Economic categories.

Stand Management

Young stand thinning and diversity study (WNF, OSU, PNW - ongoing) (M1)

Millions of acres of even-aged, predominantly Douglas-fir plantations in western Oregon and Washington have historically been managed with a primary goal of future timber production. This study is evaluating the effectiveness of alternative treatments in 30-40 year old plantations in terms of biological diversity, nutrient cycling, special forest products, economics, and conifer production. Treatments include light thinning, heavy thinning with underplanting, gap creation with planting and thinning, and a control where no treatments will occur. A major goal of the treatments is to more rapidly produce large trees while fostering understory establishment and growth. Four replications of the four-treatment set are established, two within the Adaptive Management Area. Thinning treatments are being installed in 1995.

Monitoring of green tree retention cutting (WNF, PNW, OSU, UW - ongoing, reporting) (M2)

Several monitoring efforts are underway to evaluate the effectiveness of green-tree retention within timber harvest units. Many retention cutting units have been established on the Willamette NF, and elsewhere, in the last 10 years. Studies are evaluating blowdown rates, overstory and understory growth and mortality, diversity and abundance of mycorrhizal fungi, diversity and abundance of soil microarthropods, economics, and birds. Many of these projects are nearing completion. However, much longer term studies will be needed to assess the consequences of green tree retention cutting since many effects may not be apparent for decades.

Retrospective studies of overstory retention (WNF, PNW, OSU - reporting) (M3)

Retrospective studies are one means of obtaining a preview of the long-term effects of green tree retention cutting. This set of retrospective studies assesses conditions in fire-created, two-storied stands as a surrogate for 40-80 year-old green tree retention units. Stand composition and structure may be very similar to future stands initiated with green tree retention cutting. Diversity of vascular plants, biomass and diversity of epiphytes, abundance and diversity of mycorrhizal fungi, and conifer growth and mortality are being examined in this study. A final report is due in the spring of 1995.

Retrospective study of young-growth Douglas-fir (OSU, NBS, BLM - ongoing) (M4)

Commercially thinned and unthinned young-growth Douglas-fir stands throughout western Oregon BLM lands have been selected for a retrospective study. One site is in the Marten Creek block of the Adaptive Management Area. The purpose of the study is to determine how treatments performed in the past on young Douglas-fir stands have affected stand and habitat characteristics such as large tree and understory development, vegetative diversity, stand growth, and the response of wildlife populations.

Tall bugbane (*Cimicifuga elata*) monitoring (WNF, BLM, ODA - ongoing) (M5)

Cimicifuga elata is a sensitive plant species found in low-elevation forested habitats in the western Cascades, including several populations within the Adaptive Management Area. A cooperative monitoring project was initiated in 1991 with the BLM and Oregon Department of Agriculture to determine population size and reproductive status. Annual monitoring has continued by Willamette National Forest botanists on three populations within the Adaptive Management Area.

Fire regimes and stand structure (WNF, PNW, OSU - reporting) (M6)

A project in the Andrews Forest and in the Augusta Creek area is designed to correlate levels of coarse woody debris with fire regimes. Stand structure data, such as down wood and snags, and environmental variables are being compared to fire regime mapping to determine if approximate predictions of coarse woody debris amounts can be made from apparent fire regimes.

Wildlife use of created snags (WNF - ongoing) (M7)

A variety of methods have been used to create snags, including tree topping, girdling, burning, and inoculation with fungi. Monitoring efforts are underway to compare cavity development and snag use.

Watershed Restoration

Pool complexity study (OSU, WNF, Flyfishers Assoc., Portland Flyfishers Club, NSF - ongoing) (M8)

An experimental manipulation of woody debris loadings was installed in three streams (Lookout Creek, Tidbits Creek, and N. Fork Quartz Creek) in 1994 to test for improved habitat quality for aquatic vertebrates. Three blocks, each consisting of four treatments, are replicated in each of the three streams. The treatments are low complexity (2 large logs), moderate complexity (3 large logs and 1-2 tops), high complexity (5 large logs and 3 tops) and a control (no wood added). Vertebrate populations, wood dynamics, and leaf retention are being assessed.

Small basin roading and cutting effects on peak streamflows (PNW, OSU, NSF - ongoing, reporting) (M9)

Discharge records from the last 40 years for three small, low-elevation paired watersheds on the Andrews (WS1, WS2, and WS3) have recently been reanalyzed to determine the effects of roads, clearcuts, and roads and clearcuts combined on peak flows. Results show that roads tend to shorten the time to peak flows and increase the peak, but not increase the total volume of storm discharge. Clearcuts tended to increase the total volume of storm discharge, at least under some conditions.

Large basin roading and cutting effects on peakflows (PNW, OSU, ,WNF, NSF - reporting) (M10)

Discharge records and forest cutting and road building data from the last 40 years have recently been reanalyzed for three pairs of large watersheds (Blue River and Lookout Creek., North and South Forks of the Breitenbush River, and Salmon Creek. and the North Fork of the Middle Fork of the Willamette River.). The intent was to estimate the effects of roads and clearcuts on peak flows. Rain-on-snow events were isolated and analyzed. Results showed that increases in peak flows have occurred as forest cutting and road development progressed. However, the mechanism(s) remain unclear since clearcutting, road building, and stream cleanout activities all occurred simultaneous with increased peak flows.

Road effects on hydrology (PNW, OSU, NSF - ongoing, reporting) (M11)

A recently completed field project measured the extent to which the road system functions as an extension of the intermittent stream network through road ditches connected to the natural stream network. Follow-up work is underway to determine the significance of road networks in terms of altered hydrologic processes.

Effects of barrier removal on cutthroat trout (OSU, WNF, PNW - ongoing) (M12)

A culvert that blocked movement of cutthroat trout along Mack Creek was removed in 1994; an additional blockage at the Mack Creek water gauging station is scheduled to be remedied in 1995. Follow-up monitoring based on the genetic makeup of the cutthroat trout population is designed to asses rates of population intermixing and genetic drift. This information should help assess the significance of barriers to trout populations.

Moose Creek rehabilitation monitoring (WNF, SHHS - ongoing) (M13)

This project is evaluating the effectiveness of anchored versus unanchored stream restoration structures in terms of winter refugia for wild steelhead, dissipation of high flow energy, summer hiding cover, and nutrient retention. Approximately 85 structures have been placed into Moose Creek since the autumn of 1993 utilizing a variety of placement strategies. Through a Partnership in Business program at Sweet Home High School, senior biology students are collecting much of the field data.

Blue River Reservoir revegetation (WNF, OSU - ongoing, reporting) (M14)

Revegetation trials in the Blue River Reservoir drawdown zone have been underway for several years. Various species of grasses, sedges, shrubs, and trees have been planted and monitored for survival and growth in this harsh zone of alternating periods of inundation and exposure. Successful revegetation efforts can reduce erosion, provide winter forage, and decrease the ugliness of the drawdown zone.

Social and Economic

Social acceptability of forestry practices (OSU, PNW, WNF - reporting) (M15)

People's reactions to alternative forestry practices were catalogued on a series of tours to the H.J. Andrews Experimental Forest and nearby lands, and to McDonald Forest (OSU College of Forestry School Forest). Surveys were administered to participants and questions raised during discussions were tabulated. Results from analysis of this data showed that individual's acceptance of forestry practices was dependent upon information received about the purpose of the practice, alternatives considered, levels of canopy retention, and a variety of personal characteristics.

Survey of public attitudes on forestry issues in Lane and Linn Counties (OSU - reporting) (M16)

Surveys were administered to a large number of Lane and Linn County residents in 1994 to determine people's attitudes on a wide range of forestry issues. Results showed high levels of frustration with the current forestry policy quagmire. Significant differences between urban and rural areas were also apparent. Data were further analyzed in 1995 to show results for communities within the Adaptive Management Area.

Upper McKenzie economic development (UO, McKenzie Chamber of Commerce - startup) (M17)

A study of economic trends and strengths of the upper McKenzie River valley has been initiated to provide a basis for development of a strategic plan and economic development projects. Tourism attractions will be inventoried and regulations affecting community development reviewed. Information will be gathered through detailed surveys and numerous meetings with community groups.

Special forest products processing plant (WNF, Mater Eng., OSU - reporting) (M18)

This study, completed in 1992, evaluated the economic feasibility of establishing a special forest products processing plant in Sweet Home. The study includes an inventory of targeted species, product market evaluations, recommended harvest methods designed to conserve the species and protect the environment, an evaluation of administrative policies, and an economic analysis of a potential processing plant sited in Sweet Home.

Development and Demonstration Projects

Development and demonstration projects are designed to take new findings and concepts and apply them in an operational setting. Development and demonstration projects test the operational feasibility of new practices, and serve a critical role as a forum to exchange information and promote dialogue. Demonstration projects provide on-the-ground examples of new practices and thinking.

Delta Showcase public participation (WNF, UO - reporting) (D1)

The Delta Showcase project was designed to develop a collaborative public decision-building process to help make decisions in the Delta area. The decision-building process was organized along a Delphi model and run by the University of Oregon's Planning and Policymaking program, although final decision-making authority resided with the Forest Service. A follow-up project evaluated the effectiveness of the public involvement process. Results showed that the process held considerable promise, but that the process was not fully tested since no timber sales were proposed.

Landscape case-studies (WNF, PNW, OSU - ongoing, reporting) (D2)

Managers and researchers have collaborated on a series of landscape-scale case studies within and nearby the Adaptive Management Area. The Cook-Quentin project evaluated aggregated timber harvest settings (minimize fragmentation) as compared to the traditional dispersed timber harvest settings approach, and concluded that larger old-growth blocks could be protected in the near term with an aggregated settings approach. The Upper Fall Creek project further developed the aggregated settings approach by setting priorities for protection of old-forest blocks within the context of an overall landscape design. Both of these projects assumed Forest Plan timber production levels and attempted to mitigate environmetal effects through landscape design. The Augusta project established specific landscape objectives based on the range of "natural" variability, and integrated both terrestrial and aquatic objectives into a spatially and temporally explicit management design for the long term.

Slim Scout structural retention (WNF, OSU, PNW, UW - ongoing) (D3)

The Slim Scout timber sale, planned in 1990 and cut in 1991, has been the site of over a hundred tours. The sale demonstrates green tree and snag retention, down wood retention, and landscape approaches to unit location and fuels treatments. There is a trail through one of the units, and good views of the Andrews and upper Blue River areas. Sale units are also marked with permanent plots to monitor mortality of overstory trees and growth of the stands.

South Fork pilot watershed analysis (WNF, USF&WS, PNW, OSU - reporting) (D4)

A portion of the Adaptive Management Area lies within the South Fork of the McKenzie watershed where a pilot watershed analysis was conducted in 1994. The pilot team tested watershed analysis procedures under the new Northwest Forest Plan and analyzed watershed conditions, trends, and key processes. Results included recommendations fro watershed restoration projects, descriptions and maps of disturbance processes and regimes, and alternative concepts for designing riparian reserves and landscapes to meet the ecosystem objectives in the Northwest Forest Plan. Recommendations for improving watershed analysis procedures were given to the Regional Ecosystem Office.

Ecosystem workforce pilot project (WNF, SCERT, OSU - reporting) (D5)

Organized as an interagency partnership under the State Community Economic Revitalization Team (SCERT), the pilot demonstrated that a targeted program of employing dislocated workers to perform ecosystem restoration projects could be successful. Ten workers were selected, trained and employed implementing restoration projects in 1994.

Falls Creek hydroelectric project (WNF, PGE - reporting) (D6)

The Falls Creek hydroelectric project delivers four megawatts of electricity during high flow season (typically November through July) through high-head turbines. The project demonstrates that hydroelectric power can be produced without adversely affecting fisheries along some stream segments. High stream gradients and barrier falls severely limit fish populations in this stream.

Precommercial thinning for wildlife trees (WNF - startup) (D7)

A project is being planned on the west side of Cougar Reservoir to demonstrate precommercial thinning strategies in young plantations in order to promote development of large, open-grown "wolf trees" for wildlife use.

Precommercial thinning and pruning for firewood (WNF - startup) (D8)

Demand for firewood greatly exceeds supply. A project near Blue River Reservoir is designed to demonstrate precommercial thinning and pruning strategies in a stand of densely stocked 20-25 year old Douglas-fir, where the contractor will have salvage rights to the cut material for firewood.

Gate Creek restoration (WNF, BLM, ODF&W, Giustina - startup) (D9)

This is a partnership project designed to restore fish habitat in Gate Creek, formerly a major anadromous fish stream tributary to the McKenzie River. The project is demonstrating stream restoration strategies in a watershed with a mixed and intermingled ownership pattern.

Nearby related studies

A number of studies and related projects are occurring on lands close by, but not in the Adaptive Management Area. In most cases the primary participants in the projects play major roles in projects within the Adaptive Management Area, and the projects themselves are closely connected to other projects within the Adaptive Management Area. These studies are described here to provide further context and understanding of ongoing studies within the Adaptive Management Area. Most of these projects are focused on understanding and interpreting disturbance regimes, and using that information to help design management practices.

Crest fire history (WNF, DNF, PNW, OSU - ongoing) (N1)

A fire history study is underway in the High Cascades province to the east of the Adaptive Management Area. The purpose is to characterize fire frequency, severity and spatial pattern in the little-studied higher elevation zone. This study is part of a larger collective effort among the Cascade Center and the Forest Service Ecology Program to describe disturbance regimes across major environmental gradients in the western Cascades.

Warner fire analysis (WNF, OSU, PNW - startup) (N2)

Plots have been established within the Warner Creek fire area to describe immediate post-fire conditions and to monitor recovery. Plots have been established in different plant communities, and where fires burned at different intensities. An analysis is currently underway to determine if fire intensity was related to topographic and other environmental factors.

Paleoecological transects (UO, PNW, Ecotrust, OSU, WNF - ongoing) (N3)

Pollen, plant material and charcoal from sediment cores taken from several lakes and bogs in the western central Oregon Cascades are being analyzed to determine changes in plant composition and relative abundance over the last 10,000 years. These studies are part of a west-to-east transect from the coast to the Cascade crest, and a north-to-south transect along the western Cascades. These studies provide a long time frame context for interpreting the shorter term fire history work.

Augusta Creek landscape restoration(WNF, PNW, OSU - ongoing, reporting) (N4)

The Augusta Creek project was initiated to develop and demonstrate landscape composition and pattern objectives based upon a range of "natural" variability. Additional purposes were to integrate aquatic and terrestrial conditions and processes into the landscape objectives, and to connect landscape analysis to site-level planning. A potential future ecosystem management design has been developed and projected into the future and is now being analyzed and compared to pre-watershed analysis prescriptions.

Santiam Pass forest health demonstration (WNF - ongoing) (N5)

The Santiam Pass forest health project is designed to improve the vigor of stands in the Santiam Pass area, and to reduce the risk of extreme fire. High levels of mortality have occurred in the area over the last seven years due to drought, fire exclusion, spruce budworm outbreaks, and high levels of other pathogens. A variety of actions designed to mimic the "natural pattern" of disturbances in the area are planned, including commercial thinning, understory removal, regeneration harvests, and prescribed fire.

Starrbright secondary succession (OSU, WNF, USDA, UW - ongoing, reporting) (N6)

A small-scale manipulative study is evaluating the interactions among early successional species and soils in the Starr Creek area. In a portion of a stand clearcut and burned according to the study design in 1991, species composition of early-successional species was manipulated to evaluate competitive interactions. Soil characteristics are also being evaluated to determine potential effects on plant interactions.

Quartz Creek stream restoration (WNF, OSU, PNW - ongoing, reporting) (N7)

Large wood structures were installed in Quartz Creek in 1988 to evaluate the effectiveness of this form of stream restoration. Approximately one third of the structures were anchored at both ends, one third were anchored at one end only, and the rest were unanchored. Results show that the structures that moved in high flows were from each group in roughly equal proportion, although the less anchored structures moved farther. The large wood structures have trapped smaller wood quite effectively so that the size distribution of instream wood now matches reference streams unaffected by management. Results from fish monitoring have been inconclusive to date. This study is also part of the LTER Terrestrial/Aquatic Interactions component.

Ongoing study matrix

The matrix listed below (Table 2) summarizes ongoing studies by ecosystem component, scale, and study type. Cells within the matrix contain study numbers. These numbers are identical to the numbers in the preceding section. The purpose of the matrix is to allow easy visualization of areas of relative strength and weakness in the current research and learning program of the Adaptive Management Area. Many studies occupy several cells in the matrix because the study evaluates multiple aspects of the ecosystem or social system, or includes multiple scales.

Components	Scale Stand or Site	Small watershed	Large Watershed	Province or Sub-region
Trees	B1,6,20,25,49,71, 72,73,74. M1,2,3,4,6,14. D3,7,8. N6.	B1,6,16. N2.	B16. D4.	
Shrubs & herbs	B1,6,19,25,71,74. M1,3,4,5,14. N6.	B1,6,33.	B33. D4.	
Lichens & mosses	B54,55. M3.	B54,55.	D4.	
Fungi	B51,53. M1,2,3.		D4.	
Invertebrates	B7,8,9,10,12,34, 59,60,61. M2.	B7,8,11.	B7,11.	
Amphibians	M1.		D4.	
Fish	B14,34. M8,12,13. D9. N7.	B14. D6,9.	D4.	
Birds	B43,56,57. M1,2,4,7. D7.	B44,45,46,47,48. D6.	B44,45,46,47, 48. D4.	B75.
Mammals	B43,56,58. M1.		D4.	B66.
Soil & nutrient cycles	B19,20,21,22,23, 25,26,27,40,51,52, 73. M1. N6.	B21,22,23,26,52.	B52. D4.	B52.
Fire	M6.	B63. N2.	B32,63. D4. N5.	B32. N1,3.
Atmosphere	B2,28,30,31,49.	B2,28,29	B2,29,36.	B36,50.

Components	Scale			
	Stand or Site	Small watershed	Large Watershed	Province or Sub-region
People	B25. M15. D1,3.		B70. D4,5.	M16.
Economics	M1,2. D8.	D6.	M17,18. D4,5.	
Land ownership			B67,68,70. D4.	B67,68.
Roads	B4.	B3,4,33. M9,11.	B3,4,33,35,67, 70. M10,11. D4.	B67.
Landscape pattern		B1,6,62,64. M9. D2. N4.	B62,69,70. M10. D4. N5.	B65,66.
Watershed processes	B4,5,15,34,39.	B3,4,5,18,38. M9,11. N4.	B3,4,18,35,38, 41. M10,11. D4.	
Riparian interactions	B4,5,6,8,13,15,17, 25,34,40,56. M8.	B3,4,5,6,8,16,42. N4.	B3,4,8,16,41, 68. D4.	B68.
Stream restoration	M8,12,13,14. D9. N7.	D9.	D4.	
Stand dynamics	B1,6,20,25,71,72. M1,3,4. D3.		D4.	
Dead wood	B1,6,10,21,22,24, 25. M6. D3.	B1,6,21,22,24.	D4.	
Carbon storage	B1,6,10,21,22,23, 24,25,37,49.	B1,6,21,22,23,24, 37.	B37.	B37,50.

Table 2 - Matrix of Ongoing Studies

IV. Research, Management, and Public Questions and Potential Studies

Source Material

Appendix B contains several lists of questions or needs for studies. These lists are the product of group efforts by individuals in the local area. Most have been recently compiled, although a couple date back several years. Some groups identifed priorities while others produced unprioritized lists. While these lists contain much information, they are an incomplete sample and contain the biases of those who participated. Due to the length of these lists only "high priority" questions are identified in this section. Appendix B contains all of the questions. The following groups contributed lists of questions and needs:

- Oregon Cooperative Wildlife Research Unit - March 3, 1995
- Blue River Ranger District Group - January 11, 1995
- Eugene District/McKenzie Resource Area Group - December 19, 1994
- McKenzie Ranger District Group - December 15, 1994
- Wildlife Biologists - December 9, 1994
- Willamette National Forest Ecology Group - November 28, 1994
- Willamette National Forest Fire Group - November 21, 1994
- Fisheries Biologists and Aquatic Ecologists - October 17, 1994
- Adaptive Management Area Public Meetings -April and May, 1994
- Willamette National Forest Botantists - December 16, 1993
- Cascade Center - Corvallis Session - December 3, 1993
- Cascade Center - Eugene Session November 30, 1993
- Blue River Ranger District Group - Winter 1991
- Willamette Forest Plan Information Needs - 1990

These lists are printed in their entirety in Appendix B.

Criteria for "High Priority" Questions

Higher priority questions and potential projects are identified in the next section based upon criteria described in this section. Although the lists of questions in Appendix B are an incomplete and biased sample of needs, they do contain a lot of information. In an attempt to focus attention on some of the higher priority needs and opportunities, I evaluated these lists against the following criteria to produce a subset of "high priority" questions:

1. Does the question appear on multiple lists?

2. Did the question surface within a multi-disciplinary group?

3. Was the question identified as a high priority question through a ranking process?

4. Does the question build on the existing knowledge base?

5. Does the question fill a hole in the Matrix of Ongoing Studies (Table 2)?

6. Does the question appear answerable?

7. Does the question fit a "High Emphasis" need (22 are listed in the report) or "Critical FEMAT Research Element" (10 are listed in the report) as identified in the Interagency Research Work Group Report (January 31, 1994)? These needs are listed in Appendix C.

8. Is there local public support for the question?

9. Will answering the question meet needs of other Adaptive Management Areas?

10. Will answering the question require a project that local communities can see as a short-term benefit?

The questions that follow meet these criteria to varying degrees. Some are general questions that would require whole programs to fully answer, while others are very specific. Some need long-term studies to answer, while others could be addressed in the short term. Further sorting, classifying and filtering could be done to provide a stronger basis for decision-making. However, given the purposes of this Assessment, I decided to leave these questions in a fairly raw and unfiltered form. These questions should be viewed as a starting point for a more broad-based process that directly involves citizens in helping to identify high priority needs. Appendix B provides a more complete listing of questions perceived by particpants as needing to be addressed.

"High Priority" Questions

The results listed below are necessarily subjective and represent a rough-cut first approximation of high priority questions. I attempted to be fairly inclusive at this time owing to the varied nature of the source material, and the qualitative and limited analysis performed. With a few exceptions, questions are transcribed verbatim as received from its originator. No attempt was made to rank the questions. When similar questions appeared on multiple lists I used the most focused and clearest version. Questions were somewhat arbitrarily placed into categories to provide some organization to the list. Many questions could easily be placed into several categories.

Social Interactions, Human Uses and Community Goals

What kinds of public involvement techniques will help ensure that all interested voices are heard up front and throughout the process?

What form of collective decision-making process will help ensure that decisions made can be implemented? How can common ground be found? Can consensus be reached? Will an advisory group be formed, and if so, what is the best way for it to function?

What is the linkage among the Adaptive Management Area and community goals? What are the communities and how are they linked?

What is a meaningful and useful definition of sustainability that includes both social and ecological objectives, and where in the Adaptive Management Area can it be implemented?

What is the role of the McKenzie River in the upper valley economy and culture?

What are the common interests among the gradient of human communities along the McKenzie River valley?

What is public understanding and acceptance of managing within the range of natural variability?

Fire as an ecosystem process and concerns over smoke:

- What level of smoke resulting from prescribed natural fire is socially acceptable?
- Are people willing to accept relatively frequent occurrences of small amounts of smoke to avoid the larger amounts of smoke resulting from less frequent catastrophic fires?
- What is an acceptable balance between allowing fire to play a more "natural" role in the ecosystem and smoke?

What is the role of the public in establishing measurable ecosystem management objectives?

Is there any overlap between public desire for maintaining the aesthetics of the forest and maintaining the functions of the forest? (e.g., can wildlife trees be aesthetically pleasing?)

Many opportunities to better understand the implications and importance of people's use of this area, and of Federal agency efforts to manage this use, could be pursued. For example:

What is the level of satisfaction of McKenzie River users with current management practices?

What are appropriate and acceptable standards for river use within the McKenzie River Wild and Scenic River corridor?

What are the effects of dam-altered stream flows on McKenzie River users directly and indirectly (e.g., effects on fish habitat)?

What is the value of Terwilliger Hot Springs to the community (local and more broadly)?

What are the impacts of Forest Service regulation of Terwilliger Hot Springs use on community economics and culture?

What are sustainable levels of Terwilliger Hot Springs use in terms of water quality, vegetation and social interactions?

Who are the customers of the Terwilliger Hot Springs?

What is the contribution of the Terwilliger Hot Springs to the local economy?

What are the trends in vegetation, soil, water quality, crime, user satisfaction at the Terwilliger Hot Springs?

American Indian Relations

What are effective ways of learning about and enhancing American Indian values?

How can American Indian knowledge and values be integrated into research projects?

How can American Indian interest in historic use sites, such as the Cougar Rock area, be integrated into Adaptive Management Area objectives and activities?

Special Forest Products

What are the impacts of immigrant special forest product collectors on local communities?

What is the abundance of plants producing special forest products? How can they be sustained?

What are the impacts of disturbance and harvest of special forest products (wildlife habitat and food base, soil, plant populations)?

What ecological functions do plants producing special forest products perform?

Economics

How can we encourage local processing and value-added products from resources harvested from the forest?

How can dollars earned from harvest of public resources be retained locally for reinvestment in the Adaptive Management Area?

What types of Federal forest activities put money into local communities? How much and where does it go?

What are the economic effects on local communities from Federal forest activities?

What is the role of the McKenzie River in the upper valley economy and culture?

Compare energy intensive, highly mechanized, large contract approach to forest operations to labor intensive, smaller operations in terms of economics (operator, administrative, community) and energy requirements.

What development objectives of local communities should be incorporated into projects testing sustainable development?

Landscape Pattern

What mechanisms can make ecosystem management more effective in areas of multiple ownership's?

What type, size, and location of corridors meet wildlife objectives? Are corridors effective?

How do landscape patterns affect the quality of wildlife habitat? (e.g., corridors, fragmentation, etc.)

What output levels are linked with alternative management strategies?

What are measurable objectives of ecosystem management?

How do we establish and link objectives at different spatial and temporal scales?

What is the effectiveness of the default riparian reserves for dispersal/migration?

Disturbance Processes and Ecosystem Management

What is the range of natural variability?

What kinds of management practices are consistent with the range of natural variability?

What are the risks of being outside of the range of natural variability?

What are the consequences of fire suppression on future fire frequency and severity?

What are the implications of altered fire regimes on vegetation, habitats, or other ecosystem processes?

What kinds of disturbance patterns, especially fire, historically occurred in riparian areas?

What is the relationship of fire regimes to landforms, plant communities or other environmental gradients?

What are the consequences of fire suppression on special habitats, and how do we sustain these areas?

How do we integrate fire protection measures with ecosystem management? (fuel loading, road closures, prescribed burn policies, use of fire retardant, etc.)

What was the historic role of low-severity underburns on snag recruitment?

What are efficient approaches to protecting Late Successional Reserves? What mix of fuel reduction and fire suppression meets Late Successional Reserve objectives in an efficient manner?

How should we manage following catastrophic disturbance?

Biodiversity

What are the keystone species for the ecosystem we manage, and what are survey and management strategies for them?

What is vertebrate response to disturbance during operations; e.g., tree cutting, planting, road building? e.g., bird nesting.

What are the minimum viable populations of keystone and indicator species?

What is the role of large woody debris in nutrient/water cycling; providing dispersal/connectivity for small mammals, fungi, bryophytes, etc? (question relates to salvaging in Late Successional Reserves)

What are the consequences of eliminating the shrub/herb stage during plantation management?

What stand features are keystone species dependent upon?

What affect does underburning stands of varying ages and structure have on wildlife?

Spotted Owls

What is the influence of forest management on spotted owl movements and home range, survival and reproductive rates, population demography, and seasonal diets?

What is the influence of forest management on the abundance and species diversity of small mammals in different forest types?

What is the influence of forest management on the movement and home range size of northern flying squirrels (a primary spotted owl prey species), and on the abundance and habitat associations of northern flying squirrels and Townsend's chipmunks?

How do changes in forest structure affect the abundance of fungi, small mammals, and spotted owl prey?

Riparian Management

How are wildlife species that are dependent upon fish influenced by various riparian area management strategies?

What kind of silvicultural practices are appropriate in riparian areas and riparian reserves? What are the physical and biological effects of riparian silviculture?

What is the effectiveness of designated riparian area widths (edge effects, microclimates, wildlife, plant populations, etc.)?

What are the effects of the conversion of hardwoods to conifers in riparian systems (ie nutrient input, etc) and upslope (retention in harvest areas)?

What is the effectiveness of the default riparian reserves, and how can/ should their boundaries be adjusted to increase their effectiveness? What criteria should guide riparian reserve boundaries?

What is the effectiveness of stream restoration practices on resident trout and on wild spring chinook? Need to look at a whole stream system for treatments.

What is the effect of reintroducing adult spring chinook in Blue River and the South Santiam River above the dams? Monitoring can include nutrient cycling and a comparison with the current practice of releasing juveniles above the dam.

What is the response of wild spring chinook populations to habitat manipulation?

What is the effect of road building and road obliteration in the riparian management zone on aquatic species and processes?

What would be the effect of additional over-wintering habitat upon trout populations

What is the influence of forest management on the abundance and diversity of bird and small mammal communities in riparian areas?

Stand Management

Are selective harvesting and thinning practices sustainable?

How can we imitate natural stand dynamics?

What silvicultural practices accelerate/enhance the development of late-successional characteristics?

Is fire an effective tool to promote development of late-successional forest characteristics? Best opportunities may be found in mature (100-150 year old) stands.

How can we manipulate young stands to create features keystone species are dependent upon?

What are the benefits/detriments of scattered and/or aggregated green trees vs. intact patches?

What is the effectiveness of underplanting/density control versus natural recovery after thinning, burning, salvaging of blowdown, etc. on stand development?

What are the effects of the conversion of hardwoods to conifers in riparian systems (ie nutrient input, etc) and upslope (retention in harvest areas)?

Additional sources

Other sources of questions in need of further study include:

1. A long list of questions related to mushroom harvesting is included in "Commercial Harvest of Edible Ectomycorrhizal Fungus Sporocarps from Pacific Northwestern Forest: Ecological and Management Implications" by R. Molina, M. Amaranthus, D. Pilz, and C. Fischer (1994).

2. A 24 page list of stand-level information needs was produced as a New Perspectives initiative in August 1990 by a Pacific Northwest Research Station Team (D. DeBell, C. Harrington, and M.Raphael).

3. The Research Working Group of the Interim Interagency Implementation Team produced a broad strategic plan for research in the region, dated January 31, 1994. Appendix 4 contains a review of research needs identified through analysis of the FEMAT report.

These reports are available for review from the author.

Current Proposals

The following proposals are currently circulating in search of financial sponsors:

1. **"Ecosystem management thinning of very young plantations in the Central Oregon Cascades"**. Gabe Tucker and John Tappeiner, OSU. This proposal is a spin-off and first cousin to the Young Stand Thinning and Diversity Study currently being implemented in the Adaptive Management Area and elsewhere on the Willamette National Forest. Stands of age 10-25 years old would be thinned to varying specifications and compared to controls in terms of vegetation and habitat development, conifer production, economics, and chantrelle mushrooms. The principal investigators propose to select stands from within the Adaptive Management Area

and potentially on nearby private lands, and to include some stands as Case Studies to be implemented immediately.

2. **"The dynamics and use of artificially created snags in western Oregon forests".** Matt Hunter and Bill McComb, OSU. The principal investigators propose to sample standing/falling rates and apparent use of a large number of artificially created snags in western Oregon, and to subsample actual nesting use of these snags by cavity-nesting birds. The purpose is to monitor the effectiveness of a common practice prescribed to meet Forest Plan Standards and Guidelines, and to develop more refined prescriptions for snag creation.

V. Opportunities

Overview

The purpose of this section is to identify how ongoing and potential research and learning opportunities match with the geography of the Adaptive Management Area. The intent is to relate the questions identified in the last Chapter to conditions within the Adaptive Management Area by suggesting potential opportunities for research and learning activities. These opportunities are suggested for specific portions of the Adaptive Management Area (termed blocks), or for larger aggregations of blocks. These opportunities are intended to be suggestive, not exhaustive, and to be considered as a starting point for further discussions among citizens, scientists and managers.

In many respects the Adaptive Management Area is an aggregation of several disparate landscapes glued together around the Blue River watershed. Depending upon how watersheds are defined, the Adaptive Management Area contains 10-12 different watersheds within three main basins tributary to the Willamette River (South Santiam, Calapooia, and McKenzie Rivers). Several of these watersheds are only partially located within the Adaptive Management Area; other portions either lie within other allocations or nonfederal ownership's. The two main basins (South Santiam and McKenzie Rivers) define and divide transportation systems and human communities as well. Land management history and objectives also vary widely across the Adaptive Management Area.

For purposes of describing reseaarch and learning opportunities within the Adaptive Management Area, I've subdivided the area into 13 blocks (Figure 2., Central Cascades Adaptive Management Area.). The next section describes general conditions within each block, and suggests general themes and potential studies that emerge at the scale of the block. A subsequent section considers opportunities associated with larger portions of the Adaptive Management Area. More site-specific opportunities, such as stand or stream-reach scale projects, are not generally addressed in this chapter. In most cases opportunities could be found in multiple blocks to address these questions. A more detailed question-specific and site-specific analysis would need to be undertaken to locate suitable sites for individual projects.

Blocks	Acres
Moose Creek	9,209
Canyon Creek	17,845
Calapooia River	5,815
Blue River	28,550
H.J. Andrews	15,738
Lower Blue River	10,042
Deer Creek	17,423
McKenzie Valley	34,996
Lower South Fork	8,154
Isolation Block	2,228
Marten Creek	3,717
Bear Creek	3,073
Hagan LSR	9,144
Total Acres	**165,934**

Table 3 - AMA Block Sizes

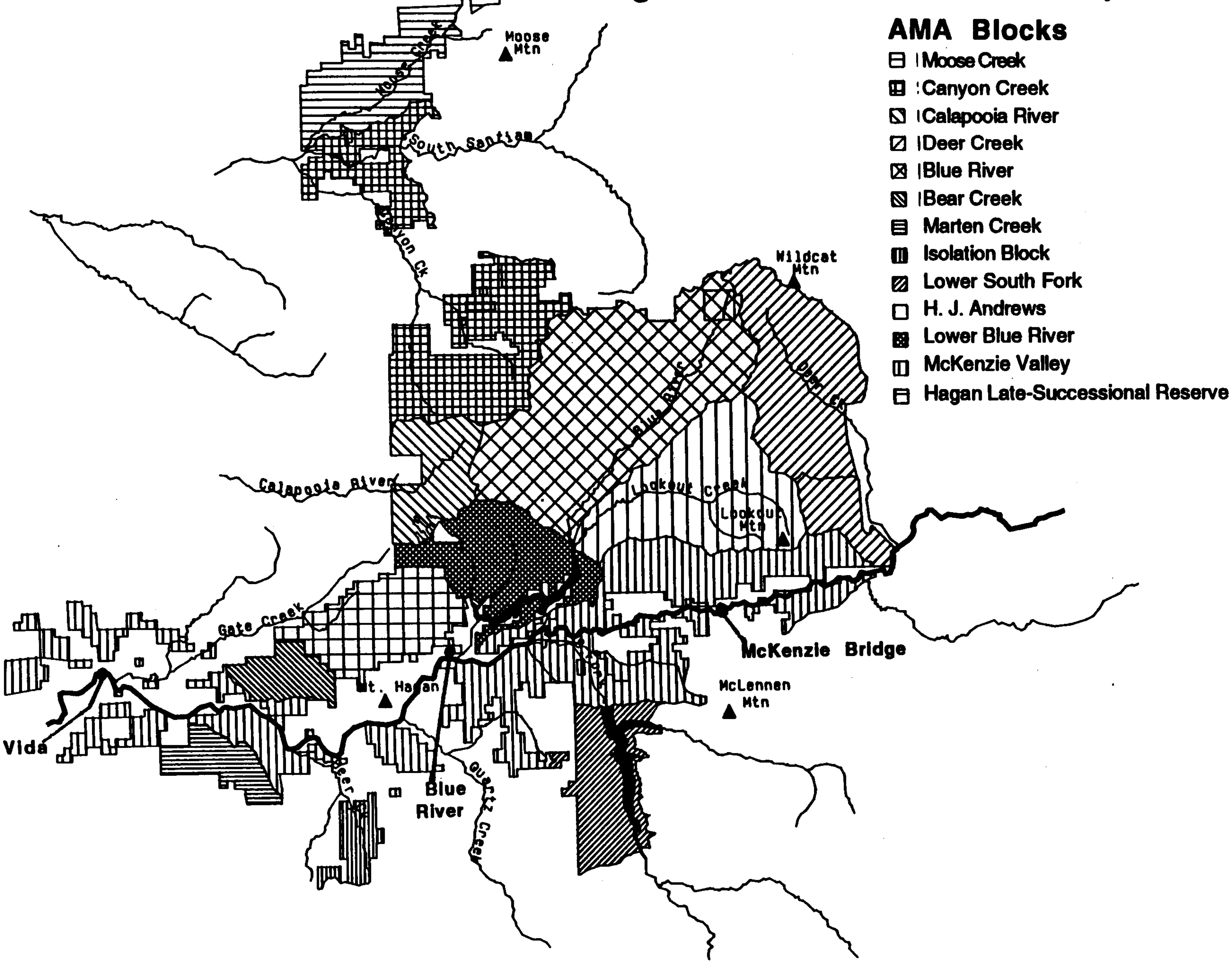

Figure 1. Central Cascades Adaptive Management Area

Many of these blocks are defined by watersheds. In several cases small adjacent blocks were included with a watershed, or several small watersheds were lumped together for ease of analysis and reporting. Distinct objectives also served to define some of the block boundaries. Each of the 13 blocks are described below. Table 3 lists the total federally-owned acres within each block.

Blocks

Moose Creek (9,209 acres)

Description

The Moose Creek Block lies in the northwestern corner of the Adaptive Management Area. With the exception of the privately-owned, upper eastern slopes, the block is managed by the Willamette NF. Most of the block falls within the Moose Creek watershed, and all of the Federally-owned portions of the Moose Creek watershed are in this block.

The majority of the watershed contains relatively uniform, relatively even-aged stands of post-fire, mature Douglas-fir forests (approximately 90-110 years old). Roads have been built into the lower portion of the block to provide access for cutting and stand-tending operations. Young, even-aged plantations are dispersed through portions of the lower watershed. Most of the Federally-owned part of the upper watershed is still roadless. Moose Creek provides key habitat for winter steelhead and spring chinook salmon, and is closed to angling. Stream restoration projects are underway in the lower stream reaches. Cougar Rock (4,692'), located at the far northern tip of the block, is of interest to American Indians for berry-picking and cultural values. Moose Lake is in the roadless portion of the area and is the largest natural lake within the Adaptive Management Area.

Research and Learning Opportunities

Several opportunities are suggested by the conditions and history of this block. Large stands of relatively even-aged mature Douglas-fir forests lend themselves to questions around the use of cutting practices and/or fire to accelerate <u>development of late-successional forest conditions</u>. In fact, the Northwest Forest Plan identifies that need for this area. There may also be the potential to better understand the <u>effects of alternative cutting practices and riparian reserve designs on 1st to 3rd order streams</u> in this block. Within this watershed there is a range of small watershed-scale conditions due to different cutting practices in the roadless portion, the heavily cutover private lands, and the partially cut lower reaches under Federal management. Cougar Rock may provide opportunities to establish a demonstration project highlighting management to <u>sustain usual and accustomed American Indian uses</u>. Additionally, the Moose Creek block is close to Sweet Home and may offer opportunities to address <u>public involvement, decision-making, and local processing questions</u>.

Canyon Creek (17,845 acres)

Description

This portion of the Adaptive Management Area consists of the Canyon Creek and Falls Creek watersheds, both tributary to the South Santiam River, and other minor streams also tributary to the South Santiam. Almost all of the Falls Creek basin is managed by the Willamette NF, while most of the lower and middle portion of Canyon Creek basin is privately owned. The Falls Creek Hydroelectric Project demonstrates that hydropower can be produced without adversely affecting fisheries in some stream segments. High stream gradients and barrier falls severely limit fish populations in this stream. Canyon Creek and the South Santiam River provide key habitat for winter steelhead and spring chinook salmon.

The area has been extensively roaded and harvested for timber. Only small areas remain unroaded and remaining patches of natural forest are fragmented. There are over 2,000 acres of plantations greater than 30 years old in the upper portion of Canyon Creek. Lower portions of the block border the South Santiam corridor and are managed for scenic values.

Research and Learning Opportunities

The relatively large area of older plantations in this area, and in the nearby Calapooia block, provides opportunities to test or demonstrate alternative approaches to managing for differing mixes of objectives, and to promote late-successional characteristics in plantations. Work in these plantations could build on the Young Stand Thinning and Diversity Study underway in other portions of the Adaptive Management Area by adding replications, or by combining or extending treatments. Also, Canyon Creek may be a large enough area to evaluate approaches to more effective management in intermingled ownership's. Canyon Creek may offer an opportunity to demonstrate a coordinated approach to stream restoration at a small-watershed scale in an area of mixed ownership. Work here could be linked to similar opportunities in the Gate Creek and Deer Creek areas in the McKenzie Valley block. The Canyon Creek block is close to Sweet Home and may offer opportunities to address public involvement, decision-making, and local processing questions. Extensive root rot pockets within the South Santiam River highway and recreation corridor provide an opportunity to explore the integration of public concerns over scenery and forest health.

Calapooia River (5,815 acres)

Description

The Federally-owned headwaters of the Calapooia watershed lie within the Adaptive Management Area and are managed by the Willamette NF. The vast majority of the watershed's lands are privately owned, downstream from the Adaptive Management Area, and in young plantations. The Federal acres are roaded and fragmented due to the traditional practice of dispersing patch clearcuts across the landscape. This basin also has a high proportion of older, even-aged plantations due to past management practices. The Gold Hill mining district and Tidbits Mountain straddle the watershed boundary with the Blue River watershed.

Research and Learning Opportunities

The relatively large area of older plantations in this area, and in the nearby Canyon Creek watershed, provides opportunities to explore alternative approaches for managing older plantations to meet ecosystem management objectives. Work in these plantations could also build on the Young Stand Thinning and Diversity Study underway in other portions of the Adaptive Management Area by adding replications, or by combining or extending treatments. Watershed analyses planned for both the privately-owned and federally-owned portions of the watershed could be integrated to demonstrate planning and implementation approaches for restoration of watershed conditions at a watershed scale in an area of mixed ownership.

Blue River (28,550 acres)

Description

This block contains the lands in the Blue River watershed above Blue River Reservoir. The entire Blue River watershed consists of this block plus the Lower Blue River and HJ Andrews blocks. With the exception of two small inclusions of private land, the entire block is managed by the Willamette NF. Wolf Rock is a dominant feature of the upper watershed.

Even-aged plantations and roads are dispersed throughout the block. Uncut forests are quite mixed, ranging from young, fire-regenerated Douglas-fir to mature and old forests.

Because of its proximity to the Andrews, the area has long been used for research. Numerous datasets have been developed through these studies (e.g., stream discharge, fire history, spotted owl occurrence). Research activities in this area have increased in recent years as interest in larger scales has increased and the research program has grown. The area also receives a lot of exposure, particularly in the Mona Creek basin, through the 50-70 tours the Cascade Center hosts each year.

Research and Learning Opportunities

The best opportunity to conduct landscape and watershed scale projects in the Adaptive Management Area is likely to be in this area. When combined with the Lower Blue River and HJ Andrews blocks, the watershed contains 54,330 acres. Deer Creek is the next largest watershed in the Adaptive Management Area (17,423 acres) and is adjacent to the Blue River basin. Landscape and watershed-scale projects could be developed at the scale of this block, or for the entire Blue River watershed, or could include adjacent lands in the Adaptive Management Area, such as Deer Creek.

One possibility is to use the conceptual model developed for the Augusta Creek Project to develop an ecosystem management approach at the landscape-scale for this area. The approach used in Augusta Creek develops landscape composition and pattern objectives for managed landscapes and links those to stand-level prescriptions. Numerous assumptions underlie this approach and the effects of managing under this approach are largely unknown. Key assumptions and variables could be identified and used as a basis for a comprehensive, long-term monitoring program. This scale project may offer opportunities to develop collaborative learning processes with interested citizens, or to work with community members to translate sustainability concepts into ecosystem management designs.

Blue River basin could be paired with Lookout Creek watershed (i.e., the Andrews Experimental Forest) for a watershed-scale comparison of stream recovery. Blue River could be actively treated with stream restoration projects and Lookout Creek could be left to recover on its own. At a smaller scale, there are four side-by-side small watersheds within the Blue River watershed that could have different stream restoration approaches taken for comparison. Placement of in-stream structures, riparian silviculture, road restoration, and hands-off approaches could be tried and monitored.

Prior to designation as a spotted owl Habitat Conservation Area, there was a research proposal to conduct a manipulative landscape experiment in this area. The basic concept was to create through timber cutting over time different landscape patterns in several adjacent small basins (4,000 - 7,000 acres each) so that the effects could be monitored. These treatments would be designed to maximize differences in landscape pattern.

Because of it closeness to the Andrews Experimental Forest, the wide range of conditions in the area, and the active management history, the area is also frequently used for plot, stand, and stream reach level studies.

H.J. Andrews (15,738 acres)

Description

This block coincides with the H.J. Andrews Experimental Forest and the Lookout Creek watershed. The H.J. Andrews Experimental Forest is administered through a three-way partnership among Oregon State University, Pacific Northwest Research Station and the Willamette NF (See Chapter II). The Andrews has been the location of hundreds of studies since its designation in 1948, and is a site in the National Science Foundation-sponsored Long-Term Ecological Research (LTER) program (See Chapter III). Although nearly a third of the Andrews has been converted to plantations of one form or another, very little cutting has occurred in the last twenty years. The remaining 2/3 of the experimental forest is evenly split among mature and old forests. Several dozen studies are currently active, the vast majority of which are focused on ecosystem processes.

Research and Learning Opportunities

The Andrews is one of the most studied forests in the world; a wealth of data concerning the functioning of forest and stream ecosystems have been collected and stored. Opportunities to utilize existing datasets to add context and integrative power to new studies are abundant. The Andrews will continue as the primary place for basic ecosystem research in the area for the foreseeable future. A constant stream of new and revived studies are implemented on the Andrews Forest. Many of the 74

Basic Science projects listed in Chapter III take place on the Andrews Forest or rely upon Andrews-generated datasets.

Lower Blue River (10,042 acres)

Description

This block contains the Willamette NF administered lands that drain into Blue River below the head of Blue River Reservoir. The area could easily have been included with the Blue River block, but is presented separately because of the influence of the dam and reservoir. Managed by the Army Corps of Engineers, Blue River Dam and Reservoir are major features attracting recreationists and blocking fish passage. The Army Corps of Engineers is currently in the midst of a planning process for a proposal to install temperature control devices in the intake tower at Blue River Dam.

Access to the area varies from the unroaded portion in the northwestern corner to the heavily traveled areas near the Reservoir. Uncut forests are generally 110-140 year old mature Douglas-fir; plantations are scattered across the lower slopes. The Gold Hill mining district straddles the ridge demarcating the northwestern boundary of the block.

Research and Learning Opportunities

Several promising studies underway in the area may have potential for further extensions. Revegetation trials in the reservoir drawdown zone are attempting to determine which species will best survive and provide stabilization, forage, and aesthetic benefits. One replication of the Pool Complexity Study is located in the North Fork of Quartz Creek; additional stream restoration studies may be feasible in this area. The area may also fit well as part of a larger landscape study within the entire Blue River watershed. If the temperature control project at Blue River Dam is implemented, there are opportunities to work with the Army Corps of Engineers and the US Geological Survey to analyze sediment accumulation rates within the Reservoir.

Deer Creek (17,423 acres)

Description

Most of the Deer Creek watershed and several adjacent smaller patches that lie within the Adaptive Management Area are included in this block. All of this area drains into the McKenzie River and is managed by the Willamette NF. The area has been extensively roaded and harvested for wood products using clearcut and shelterwood systems. Bunchgrass Mountain bounds the upper, northeastern portion of Deer Creek. Higher elevation meadows, currently undergoing invasion by conifers, cap portions of the mountain. Directly to the north and northwest of Bunchgrass Mountain, the Wildcat Mountain Research Natural Area drapes across the Adaptive Management Area boundary. Numerous studies have occurred and are ongoing in the Research Natural Area. (Streams -fish - Trailbridge in the AMA?)

Research and Learning Opportunities

Ecosystem restoration may be a good theme for research and learning in this block. Numerous opportunities exist to design stand, road, meadow, riparian, and in-stream restoration activities for maximum learning. Landscape-scale projects in the adjacent Blue_River watershed might better address some questions, such as those associated with some of the larger-home range wildlife species, if this block were also included. This area might also be large enough to design a management approach with the concept of sustaining ecosystems and a local economy. A community-based approach designed to support retention of income derived from the forest in the local community for the long-term could be coupled with practices designed to sustain the forest for a small-scale demonstration of sustainable development.

McKenzie Valley (34,996 acres)

Description

The common elements uniting the diverse lands in this block are the McKenzie River, Highway 126, and high levels of human use. Lands in this block lie within the McKenzie Valley in close proximity to the river. Human use of these elements heavily flavors the conditions, concerns and opportunities associated with this block. Much of the McKenzie River in this block is designated or proposed for study as a Federal Wild and Scenic River (Recreational status) or State Scenic Waterway, and is much prized for its recreational, fishery, domestic water source, power generation, and homesite values. Numerous campgrounds, trails, roads, boat-launching sites, and fishing-access sites are located close to the river. Features of particular note include the McKenzie River Trail (National Recreational Trail status), the Delta Campground area (includes old-growth trail and amphitheater), Castle Rock, and Eagle Rock. The McKenzie supports a prized chinook salmon and native rainbow trout fishery, and a hatchery run by the State. Isolated subpopulations of bull trout are found in some of the upper reaches. A partnership effort is underway to restore the old McKenie Fish Hatchery as a visitor center.

Privately-owned lands are intermingled throughout the block, particularly towards the western end. Most of the lands managed for wood fiber production have been clearcut once, and some areas are now being harvested a second time. The Federally-owned, upper valley lands towards the eastern end are managed by the Willamette NF and are in a range of conditions from young plantations to old growth. One replication of the Young Stand Thinning and Diversity Study is located in plantations in the Mill Creek area. The BLM - Eugene District manages the Federally-owned lands in the westernmost portions where uncut areas are generally even-aged (90-1120 years of age) mature Douglas-fir forests.

The towns of Vida, Blue River and McKenzie Bridge are found within the block, and numerous privately-operated resorts are located on the valley floor. Blue River and McKenzie Bridge Ranger District offices of the USDA-Forest Service are located by their namesake towns. Private residences are found throughout the area, frequently adjacent to the McKenzie River.

Research and Learning Opportunities

Many opportunities to better understand the implications and importance of people's use of this area, and of Federal agency efforts to manage this use, could be pursued. For example:

- What is the level of satisfaction of river users with current management practices?
- What is the role of the river in the upper valley economy and culture?
- What are appropriate and acceptable standards for river use within the Wild and Scenic River corridor?
- What are the effects of dam-altered stream flows on river users directly and indirectly (e.g., effects on fish habitat)?
- What are the common interests among the gradient of human communities along the valley?

Opportunities also exist to evaluate, develop and demonstrate better approaches to managing ecosystems in areas of fragmented ownership's. Cooperative stream restoration projects, such as that planned for Gate Creek, could be a good starting point, and could be pursued jointly with similar opportunities in Deer Creek and Canyon Creek. Integration of watershed analyses from the Forest Service, BLM and Weyerhaeuser is another arena ripe for cooperation. All three organizations have recently finished or are currently working on watershed analyses including lands in this block.

Given the number of people living in this area, opportunities to address public involvement, participatory decision-making, and community sustainability questions might logically be developed. Community-based decision-building involving adjacent home and business owners could be demonstrated in this block at a variety of scales. The Delta amphitheater could prove to be a valuable place for shared education efforts, and cooperative education projects with the McKenzie High School have already been initiated.

Lower South Fork (8,154 acres)

Description

The southernmost portion of the Adaptive Management Area extends southward along the west side of Cougar Reservoir and the South Fork of the McKenzie River. The block encompasses the area of several small tributaries that drain directly in to the reservoir, and is managed by the Willamette NF. Small amounts of private land occur in the upper reaches of these streams. The Army Corps of Engineers is currently in the midst of a planning process for a proposal to install temperature control devices in the intake tower at Cougar Dam.

Heavy use of Terwilliger Hot Springs is a dominant feature of the area. At times, hundreds of people a day enjoy the hot springs and nearby reservoir. User conflicts, crime and resource degradation are problems associated with the area.

A stand of old-growth forest occurs in the rugged slopes of the northern portion of the block. Heavy timber cutting has occurred over the last 40 years in the remainder of the block. Commercial thinning has been initiated the last 5 years as these plantations reach commercial thinning ages. One replication of the Young Stand Thinning and Diversity Study is located in this block. Additional exploratory commercial thinning prescriptions, such as very wide spacing and variable spacing prescriptions, are being tried in this area.

Research and Learning Opportunities

Young stand management is a theme currently being developed in this area. Because of the abundance of stands of commercial thinning age in the area, and the abundance of questions concerning future management activities in these types of stands, and current activities already underway, opportunity exists to develop a Young Stand Management Demonstration Area in this block. Similar opportunities exist elsewhere in the Adaptive Management Area (e.g., Canyon Creek, Calapooia Creek, Mill Creek); an overall program of young stand management trials and demonstration prescriptions could be developed for the Adaptive Management Area.

A variety of social, economic, and resource studies and collaborative projects could be undertaken to provide options to more effectively manage the Hot Springs. Innovative processes for development of an acceptable management scheme could be tested here. If the temperature control project at Blue River Dam is implemented, there are opportunities to work with the Army Corps of Engineers and the US Geological Survey to analyze sediment accumulation rates within the Reservoir. The Cougar Creek watershed may be an appropriate area to evaluate alternative approaches for riparian and aquatic reserves to meet aquatic ecosystem objectives.

Isolation Block (2,228 acres)

Description

The Isolation Block, managed by the Willamette NF, occupies most of the East Fork of Deer Creek watershed on the south side of the McKenzie River. Portions of the East Fork watershed and most of the surrounding landscape are in private ownership. The BLM - Eugene District manages some lands in the lower part of Deer Creek. Fire-regenerated Douglas-fir forests 70-85 years old cover most of the Isolation Block. A few clearcuts were dispersed through the block in the last 5 years. The vast majority of the surrounding, privately-owned forests have been clearcut and are now in 5-30 year old plantations.

The Isolation Block was designated as an Integrated Research Site for the Long-Term Ecosystem Productivity (LTEP) program. An amendment to the Willamette NF Forest Plan changed the land allocation to support research objectives in 1992. The LTEP program is a five-site regional network of applied and basic science studies focused on questions related to long-term ecosystem productivity. Treatments are planned for installation in the next 2 years. Units containing different mixes of species associated with differing successional stages, and varying levels of forest floor organic matter will be established in three replications. Planning and pretreatment data collection have been underway since 1990.

Research and Learning Opportunities

Given the size of the area, the surrounding landscape and past practices, the installation of the Long-Term Ecosystem Productivity treatments will dominate this block for the foreseeable future. Opportunities for additional work that tie in to the LTEP treatments abound. For example, questions related to animal use of down wood, the effects of cutting on riparian area species, animal use of hardwoods versus conifers, and the potential for acceleration of late-successional forest characteristics can be addressed with the treatments being planned for the LTEP study. There may be opportunity to address landscape questions related to the potential role of the native forest in the block to function as a refugia and dispersal center in a highly manipulated landscape. The Bear Creek and Marten Creek blocks provide similar opportunities and could be combined into a larger study with this block to evaluate these questions.

Marten Creek (3,717 acres)

Description

All of this block lies within the Marten Creek watershed managed by the BLM - Eugene District. Fire-regenerated stands (90 -110 years old) dominate the lower, Federally owned portions of the watershed. Occasional pockets of remnant older forest are scattered throughout this section. Upper portions of the basin are now in young plantation forests owned by Weyerhaeuser.

The Marten Creek watershed is a low-elevation basin (1200-2800 feet) with portions relatively undisturbed and intact. It was designated a Key Watershed in the Northwest Forest Plan and has been proposed as an Area of Critical Environmental Concern (ACEC) through BLM channels. The lower portion has largely unfragmented, mature riparian vegetation with occasional older remnants, an excellent steelhead fishery in the lower three miles, and potential for bull trout and chinook salmon. The watershed was also proposed for monitoring in the EPA EMAP program.

Research and Learning Opportunities

Several things point to an emphasis on studies focused on the aquatic system for this block. First, this is a low-elevation watershed that still has significant portions relatively intact and riparian systems in good condition. Second, there is approximately 10 years worth of stream discharge, sediment and temperature monitoring data, and a good physical stream inventory. Amphibian monitoring in mainstem Marten Creek has also been initiated. And third, the Key Watershed and proposed ACEC designations recognize the unique aquatic attributes of this basin, and given its relative scarceness will likely restrict many potential activities. Marten Creek offers opportunities to investigate the effectiveness of undisturbed small watersheds as refugia when intermingled with disturbed subbasins. Baseline habitat relationship data for sensitive species and species of concern found in low-elevation watersheds could be pursued in this area.

Bear Creek (3073 acres)

Description

All of this block lies within the Bear Creek watershed managed by the BLM - Eugene District. The Bear Creek watershed is a low-elevation basin (1200-2800 feet) with portions relatively undisturbed and intact. It was designated a Key Watershed in the Northwest Forest Plan and has been proposed as an Area of Critical Environmental Concern (ACEC) through BLM channels. Fire-regenerated stands (90 -110 years old) dominate the watershed; however, occasional pockets of remnant older forest are scattered throughout the area. The lower portion has largely unfragmented, mature riparian vegetation with occasional older remnants, and an excellent steelhead fishery below the falls The watershed was also proposed for monitoring in the EPA EMAP program.

Research and Learning Opportunities

Several things point to an emphasis on studies focused on low-elevation, aquatic systems for this block. First, this is a low-elevation watershed that still has significant portions relatively intact and riparian systems in good condition. Second, there is approximately 10 years worth of stream discharge, sediment and temperature monitoring data, and a good physical stream inventory. And third, the Key Watershed and proposed ACEC designations recognize the unique attributes of this basin, and given its relative scarceness will likely restrict many potential activities. Baseline habitat relationship data for sensitive species and species of concern found in low-elevation watersheds could be pursued in this area. A one-year pilot effort to census pine marten was begun in this area. There is also potential for genetic studies of cutthroat trout and aquatic macroinvertebrates in Bear Creek. Populations above and below the falls appear to be somewhat differentiated. There may be opportunity to address landscape questions related to the potential role of the native forest in the block to function as a refugia and dispersal center in a highly manipulated landscape. The Isolation Block and Marten Creek blocks provide similar opportunities and could be combined into a larger study with this block to evaluate these questions.

Hagan Late-Successional Reserve (9,144 acres)

Description

The Hagan block was designated as a Late-Successional Reserve in the recent Northwest Forest Plan. The area is managed by the Willamette NF and is covered by mature (100-140 years old) Douglas-fir forest. Most of the area drains into the South Fork Gate Creek and on to the McKenzie River. The Hagan Block Research Natural Area (RNA) occupies most of the North Fork of Hagan Creek watershed. The entire Research Natural Area is part of the permanent vegetation measurements program described in Chapter III, and the lower part of the main creek is part of the permanent stream channel measurements program, also described in Chapter III. Other studies have occurred in the area in the past.

Research and Learning Opportunities

Nonmanipulative research in mature Douglas-fir forests is the primary purpose of the Hagan Block Research Natural Area. The extensive vegetation dataset provides valuable information on forest development for potential projects evaluating animal use, land-water interactions, etc. The Late-Successional Reserve designation reinforces the nonmanipulative objective of the Research Natural Area and generally extends it to adjacent lands. The larger block could serve as a landscape-scale control for landscape studies. It may also make sense to add a stream to the permanent stream channel measurements program in a nearby highly manipulated watershed.

Larger-scale opportunities

This section takes a broader view than the previous section by looking at potential aggregations of the Adaptive Management Area blocks. The purpose is to identify potential opportunities to address questions that require larger scales. It is important that larger-scale opportunities be considered and evaluated in the early stages of Adaptive Management Area implementation. Landscape or watershed scale projects have a significantly greater potential to foreclose other opportunities, especially other landscape or watershed projects, than do smaller-scale projects. Suitable locations for landscape or watershed scale projects are also much more difficult to find and should not be compromised without consideration of larger-scale needs. Several potential larger-scale projects are briefly discussed below.

1. Spotted owl studies

Spotted owl demography and habitat-use studies are currently underway across most of the Adaptive Management Area. These studies have produced relatively long-term datasets critical for understanding population trends of the owl. There are few such datasets in the region. There may be opportunities to better understand owl responses to management actions by imposing a landscape design to future management treatments. Early coordination with the scientists involved in these studies is important; not only is there the potential to expand the information gained through these studies, but there is also the potential to inadvertently compromise ongoing studies.

2. Landscape experiment

A research proposal to conduct a manipulative landscape experiment in upper Blue River was advanced several years ago. The basic concept was to create contrasting landscape patterns in several adjacent small basins (4,000 - 7,000 acres each) through a long-term timber harvest design. Effects could then be monitored to evaluate the role of landscape pattern. If this proposal, or an updated version of it, is considered to be of high importance, the location and basic design needs to be settled early on as it may very well conflict with other proposed projects. These concepts evolved into the landscape design developed in the Augusta Creek project (see number 3 below) and may not be as high a priority as when originally proposed.

3. Landscape design

One possibility is to develop and demonstrate an overall landscape approach to ecosystem management that can be used as a basis for a comprehensive, long-term monitoring program. An example is the conceptual model developed for the Augusta

Creek project where landscape composition and pattern objectives for managed landscapes were integrated with aquatic ecosystem conservation goals, and linked to stand-level prescriptions. Objectives were set to match the range of "natural" variability, as viewed through an understanding of disturbance regimes, to the degree current conditions and goals allow. Numerous assumptions underlie this approach and the effects of managing under this approach are largely unknown. Key assumptions and variables could be identified and used to guide a monitoring program that would help evaluate how well this approach meets ecosystem management objectives. Species such as cougar and marten need a landscape-level project to effectively track population conditions and trends. Nearby landscapes managed under the Standards and Guidelines for Matrix lands, and lands managed as Late-Successional Reserves, could be monitored for the same variables as a comparison to a landscape design in the Adaptive Management Area.

4. Comparison of watershed restoration strategies

Opportunities exist to compare the effectiveness of alternative approaches to watershed restoration at both small and large watershed scales. For example, Blue River watershed could be paired with Lookout Creek watershed. Blue River could be actively treated with stream restoration projects and Lookout Creek could be left to recover on its own. Small watersheds across the Adaptive Management Area could also have different stream restoration approaches taken for comparison. Placement of in-stream structures, riparian silviculture, road restoration, and hands-off approaches could be tried and monitored.

Another example would be for each administrative unit to choose two similar creeks with low amounts of large instream wood for treatment. One gets treated with large wood and the other does not (control). The intent would be for the treated streams to receive a "maximum" restoration effort in one year. Effectiveness monitoring would compare the treated creek with the untreated similar creek on the same unit, and compare treatments between administrative units in the Adaptive Management Area.

Restoration strategies could also be compared between streams in the Adaptive Management Area that are closed to fishing with those that are open for fishing.

5. Comparison of alternative public and inter-governmental participation models

A variety of approaches for involving citizens in land management decision- making processes have been attempted on the Willamette NF and elsewhere (e.g., Consensus Groups, Fruitful Discussion Group, 318 Advisory Boards, Delta Showcase, Forest Plan, etc.). In addition, other models have been described and used in other parts of the region and country. One possibility might be to describe 2-4 alternative conceptual models for public and inter-governmental participation, and then test them out in different parts of the Adaptive Management Area. The effectiveness of these approaches could then be monitored. Citizens and representatives from other governmental bodies could help design alternative models. Projects such as potential road closures might be good candiates for public and inter-governmental participation.

6. Sustaining ecosystems and communities

The goal of designing and managing sustainable ecosystems to support sustainable communities at a local level is of widespread interest. Getting beyond the concept though is tough work. However, that is one thing Adaptive Management Areas are supposed to do. It may be possible to work directly with communities to understand and describe what managing sustainable ecosystems to support sustainable communities means, and to develop, implement and monitor appropriate strategies. The appropriate scale to address this goal is a critical question. Scales could range from the size of the Deer Creek block up to the entire McKenzie watershed lands. This project could be integrated with #3 and/or #5 above.

7. Citizen monitoring

Monitoring environmental conditions and the effectiveness of management actions utilizing local workers is one of the goals of Adaptive Management Areas. Monitoring projects could be initiated at a variety of scales. An education and training program might be necessary for certain kinds of monitoring projects. Monitoring activities are a critical part of many projects and opportunities in this Assessment and could be pursued on a project-by-project basis, or given more emphasis through a targeted program focused on employing local individuals.

8. Indian use patterns

Evidence of Indian use of the landscape has been accumulated on a site-by-site basis over the last several decades, usually as a result of some ground-disturbing activity. In combination with Indian knowledge, recovered artifacts indicate long-standing patterns of human use of the landscape. An opportunity exists to paint the broad picture of Indian use patterns across the entire Adaptive Management Area, or possibly the larger central Oregon Cascades, by integrating information from a broad set of sites.

9. Adaptive management process

In some ways adaptive management is nothing new; in other ways adaptive management is very new. Certainly people have been formally and informally experimenting for a long time, and new information has been incorporated into management practices. But adaptive management regards the entire management program as an experiment, and explicitly acknowledges that almost all of our actions rest on unproven assumptions. Adaptive management designs the testing of these assumptions into the management program itself and surfaces these assumptions so that interested parties recognize the degree of uncertainty underlying estimates and projections. Much testing and learning of the adaptive management process itself needs to occur, and the Adaptive Management Area ought to provide raw material and energy for further development of adaptive management. In the best spirit of adaptive management, we should learn while doing.

General Themes

A number of general research and learning themes emerge from the Adaptive Management Area. These themes represent strengths of the Adaptive Management Area and commonalties of interest. The intent of listing these here is to call attention to some high-priority subjects where the Adaptive Management Area appears to be positioned for success in terms of technical and social learning objectives. It is not meant to exclude other worthy subjects. The following list should be regarded as preliminary and highly biased.

1. Ecosystem Science

The ecosystem science program centered on the H.J. Andrews Experimental Forest is world-class, and offers abundant opportunities to address many of the questions identified in this report. This program is unique among the 10 Adaptive Management Areas and provides the Central Cascades Adaptive Management Area with many opportunities not available to other areas. Many expect us to continue to be leaders in this area.

2. Stream restoration

An active research and management program, and high levels of interest in this topic make it a clear candidate for continued emphasis in the Adaptive Management Area. Numerous streams in need of restoration can be found in the Adaptive Management Area. Notable projects currently underway include the Pool Complexity Study (which builds off the nearby Quartz Creek Restoration Study), the Gate Creek Cooperative Project, and the Moose Creek Restoration and Monitoring Project. Additional work is needed to address riparian silviculture issues.

3. Plantation management

An active research and management program, and high levels of interest in this topic also make this area a clear candidate for continued emphasis in the Adaptive Management Area. The Young Stand Thinning and Diversity Study, currently being implemented in the Mill Creek and South Fork areas, provides strong momentum in this area. Other innovative prescriptions are currently being prepared, and opportunities are high throughout many blocks in the Adaptive Management Area. In particular, Canyon Creek and Calapooia Creeks have abundant stands suitable for commercial thinning of one form or another. A proposal to evaluate alternative thinning strategies at the precommercial thinning stage is currently being circulated, and, if implemented, would add to the strengths in this area (see Very Young Stand Thinning Proposal, Chapter IV).

4. Landscape composition and pattern

Many of the most urgent questions clamoring for attention require the larger-scale view of a landscape or watershed. Fortunately, there is a history of scientists and managers working together on these issues in this area (Cook-Quentin Minimum Fragmentation Study, Upper Fall Creek Old Growth Evaluation, and Augusta Creek). Recent efforts are focused on integrating terrestrial and aquatic thinking into a unified management design. A wide variety of supporting studies are underway at this scale. Managers throughout the Adaptive Management Area have been working with landscape issues and watershed analysis and can contribute new concepts to this topic.

5. Accelerating late-successional forest characteristics

The need to evaluate the potential to accelerate development of late-successional forest conditions is a high priority. Management of Late-Successional Reserves and Riparian Reserves requires better knowledge of the opportunities and risks associated with silviculture designed for this purpose. Candidate young and mature stands are widespread in the Adaptive Management Area. Prescribed fire and silviculture both need further evaluation.

6. Public and intergovernmental participation

There is a strong history of public and intergovernmental interactions within the Adaptive Management Area. A variety of approaches have been attempted in the past with varying levels of success. The initial Adaptive Management Area public meetings indicated further interest in developing meaningful approaches for citizen involvement, and it is a continuing theme of managers and scientists as well. Adaptive management and collaborative learning models may offer direction for further development in this area.

7. Intermingled ownership's

Problems and opportunities associated with intermingled ownership's are a recurring theme throughout the region as well as the Adaptive Management Area. Questions concerning how best to manage in areas of intermingled ownership continue to surface as a high priority. Several areas of the Adaptive Management Area have extensive intermingled ownership's and may offer opportunities to develop and evaluate more effective approaches to ecosystem management.

VI. Further Discussion

This chapter contains a variety of topics in need of further discussion and action to expedite achievement of Adaptive Management Area objectives. The organization of topics is somewhat arbitrary; several topics have facets in more than one section. Frequently, actions can address multiple needs simultaneously.

Next Steps with the Assessment

This Assessment paints a picture of existing research and learning programs and projects, and identifies needs and opportunities for future research, monitoring and learning activities. Although the Assessment contains an abundance of information, it represents a point-in-time and has been compiled without significant public participation or broad review. It should be viewed as the beginning of a process, not an end result. Potential uses of this Assessment include:

- to describe the extent of ongoing projects that are contributing to the technical and social learning objectives of the Adaptive Management Area to managers, citizens, policy-makers, scientists and others.
- to help identify opportunities and priorities for new projects contributing to Adaptive Management Area objectives.
- to help individuals and teams planning projects identify questions that their projects can help answer and contribute to Adaptive Management Area technical and social learning objectives.
- to help mangers, citizens and scientists decide how to best make use of the wealth of ongoing projects focused on learning.
- to help focus on some key choices that must be made early in Adaptive Management Area implementation so focused efforts can proceed.
- to provide a sound starting point for development of Central Cascades Adaptive Management Area plans.
- to help communicate to the broader regional Adaptive Management Area network, and to the Regional Research and Monitoring Committee, the work and role of the Central Cascades Adaptive Management Area.

A limited, short-term use of the Assessment could be to use it as a starting point in working with citizens and other government representatives to identify and design research or monitoring projects that meet high priority needs. A more ambitious use would be to identify critical choices that need to be made early in Adaptive Management Area implementation and use the Assessment as context and starting point for a broader decision-building process. For example, some of the landscape-scale opportunities have big implications and may conflict with other opportunities in some respects.

A limitation to broader public and manager engagement with this Assessment is the absence of a clear strategy over how Adaptive Management Area decisions will get made. If choices need to be made for focused implementation, what is the process by which they will be made? At what scale will these choices be made? What are the roles for citizens and scientists? A next step for use of this Assessment may be to clearly identify the choices that need to be made for focused and effective implementation. An additional step might then be to describe the process by which these choices will be made.

Clearly, there are choices to be made. Given limited financial and human resources, Adaptive Management Area implementation needs to be focused on the highest priorities. For example, some of the highest priority research or monitoring questions could be pursued in many different areas (e.g., stream restoration or young stand management). Should we optimize site selection on a project by project basis, or should there be some geographic distribution across the Adaptive Management Area? Landscape-level projects may offer greater returns, but have multiple implications in terms of compatibility with other projects and agency programs. Some form of land allocation to learning emphases or themes could help provide focus to implementation.

A larger question relates to the integration of projects that meet social objectives with projects oriented more towards meeting technical and social learning objectives. To what degree will projects that are not focused primarily on technical and social learning be implemented in the Adaptive Management Area? And how will they be integrated and prioritized with projects focused more on learning? The Adaptive Management Area is large (approximately 160,000 acres) and the human and financial resources for learning are limited. In addition, there are definite expectations that Adaptive Management Areas will contribute to broader social objectives. Direction contained in the Record of Decision is ambiguous on this point, but certainly implies that Adaptive Management Areas will contribute to social objectives, including timber harvest. These questions will not be limited to timber harvest however; many types of projects will be proposed. A clear set of priorities for research, monitoring, and learning projects within the Adaptive Management Area, and some form of land allocation to learning emphases or themes could help ensure that opportunities are not foregone as projects to meet social objectives are proposed and evaluated.

Timber harvest is perhaps where this question receives the most intense interest. There are requirements in the Record of Decision that short and long-term projections of timber harvest be developed for each Adaptive Management Area. Projections of the Willamette National Forest and BLM Probable Sale Quantities in the Record of Decision include specific assumptions about the level of timber that will be harvested in the Adaptive Management Area. Those assumptions are currently being reanalyzed by the Willamette NF planning team so that timber output targets can be more accurately distributed; it is highly desirable that these assumptions reflect realistic expectations of activities within the Adaptive Management Area that integrate learning objectives with social objectives. A clear set of priorities for research, monitoring, and learning projects within the Adaptive Management Area, and some form of land allocation to learning emphases or themes could be used as a basis for general estimates of short and long-term timber harvests.

The best approach to integrating social objectives with learning objectives may be to integrate learning with projects that meet social objectives. In fact numerous ongoing projects within the Adaptive Management Area do exactly that. For example, The Young Stand Thinning and Diversity Study and the Pool Complexity Study are being implemented through regular agency programs to meet annual targets. Additional opportunities undoubtedly exist within the Adaptive Management Area.

Due to the size of the Adaptive Management Area integration at the individual project level may not be sufficient. Integration at the landscape scale may provide more opportunities to meet multiple objectives. A landscape-level demonstration of our collective best shot at ecosystem management may meet some social objectives while simultaneously providing a basis for a comprehensive monitoring program. The process of designing the approach to ecosystem management can surface key underlying assumptions for monitoring. A large-scale project of this sort could also provide a vehicle for applying a more structured and visible adaptive management process. Because of the magnitude of a project of this sort and the potential for integration or conflict with other projects, a decision to proceed or not should be made early in Adaptive Management Area implementation.

Education

Learning involves both acquiring knowledge of the social and ecological world, and sharing and exchanging that knowledge throughout the interested community. This Assessment focused on learning in the sense of scientists and managers learning more about how our physical, biological and social systems function. Educational programs and opportunities have not been included. There are several active education programs and numerous education projects focused on sharing knowledge with a much broader constituency. For example, the Cascade Center organizes dozens of tours and workshops each year and produces publications for multiple audiences. And Natural Resource Conservation Education programs organize school-age or general public programs and presentations. A logical addition to this Assessment would be the inclusion of a chapter on education. Sections could cover existing programs and potential opportunities to better integrate programs or expand educational offerings. Infrastructure to support educational programs already exists in several places within the Adaptive Management Area. A chapter on education would make this Research and Learning Assessment more complete, and provide a basis for evaluating the strengths and weaknesses of current education efforts.

Adaptive Management

Adaptive management occurs within the Willamette NF and BLM at present in a more-or-less informal and unstructured manner. The adaptive management process used by the Cascade Center (described in Chapter II, shown in Figure 1) is structured, explicit and implemented with a strong experimental design, but not directly linked to agency decision-making. Moreover, adaptive management as practiced by the Cascade Center has not been tightly linked with citizens and is missing key elements of the adaptive management process (see Appendix D for a summary). For example, there has been no explicit description of a particular ecosystem, or comprehensive identification and sorting of key hypotheses. Forest Plan monitoring and adjustment processes are explicit, structured and directly linked to agency decision-making, but also lack key elements of an adaptive management process. For example, there has not been any serious coordinated effort to investigate key hypotheses, monitor the effectiveness of management actions, or treat management actions as experiments.

Adaptive management attracted attention in the FEMAT report and in the East-Side Forest Health Assessment. Adaptive Management Areas are places to develop and test adaptive management processes.. Yet adaptive management will have to function at a larger scale than the Adaptive Management Area to be fully successful. Numerous opportunities exist to develop and improve adaptive management processes. Potential linkages of the Adaptive Management Area to a broader adaptive management process are displayed in Figure 3.

A major first step could be to integrate Cascade Center adaptive management approaches with agency plan evaluation and adjustment processes. One approach would be to view the Adaptive Management Area as the geographical focal point for the testing and development of ecosystem management hypotheses. The basic Cascade Center adaptive management model might work well in this context. The Adaptive Management Area would be an active, information-seeking arm of Forest Plan implementation. Results from Adaptive Management Area projects would be evaluated and synthesized with other sources of new information on a regular basis. Management practices could then be adjusted through both informal processes within the discretion of the Forest Plan, and through more formal processes that modify the Forest Plan (Figure 3).

A second step could be to more actively engage the public in the adaptive management process. This could be done in the context of a regular cycle of prioritizing needs for new information, helping pursue new information, evaluating new information, and assessing the need to change ecosystem management practices. A broader adaptive management process linked to agency plan adjustments could be a more structured and visible approach (Figure 3). More informal and easier approaches could also be pursued. For example, adaptive management field trips could be organized for citizens, managers and scientists. Results could then be shared widely. Other approaches might be to identify an area where new information has recently surfaced and host a variety of information sharing forums to gain others views and incorporate that into a report for agency plan adjustment processes. Another option could be to involve citizens on the front end of the information producing process by helping prioritize key questions in need of further study.

Additional steps could be undertaken to develop a more rigorous adaptive management process. For example, some prototype adaptive management applications (e.g., the Everglades) have used fairly simple comprehensive models that portray major interactions among ecological and social components to help develop hypotheses and evaluate potential implications of management actions. A specific landscape-scale project may provide the best means to implement such an approach.. This may be of more interest to researchers than managers or citizens.

Many questions are involved with each of these approaches. Who will make it happen? How can the rest of the Forest and BLM District participate? How can new information produced in places other than the Adaptive Management Area be folded into the adaptive management process? How will these processes actually work?

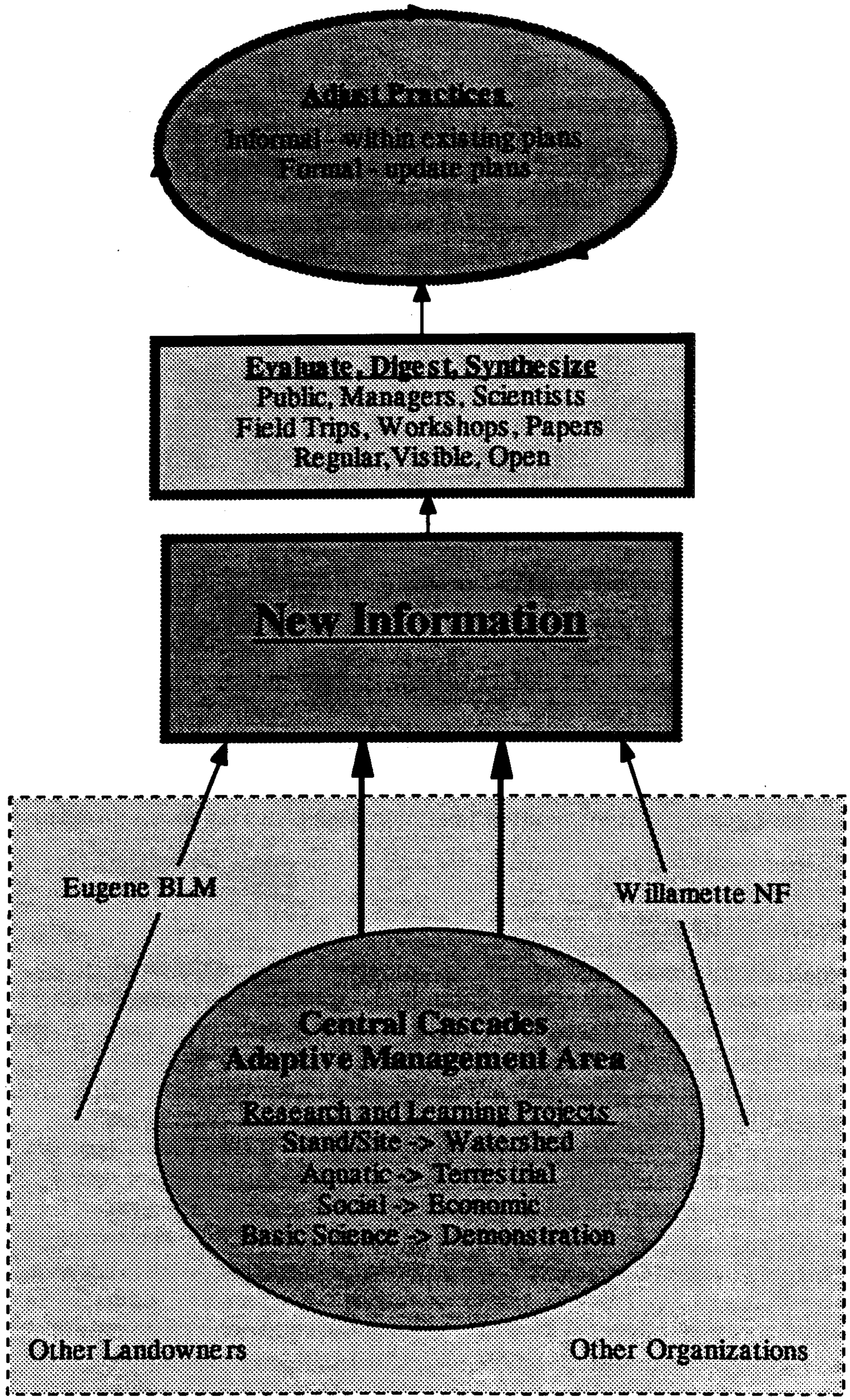

Figure 3. Potential Adaptive Management Area Linkages

Role of Scientists

Designation of the Central Cascades Adaptive Management Area expands the geographic extent of lands managed with a major emphasis on research, monitoring and learning activities, and may bring more visibility to the role of science and scientists in ecosystem management. The role of science and scientists remains to be fully developed, and the Adaptive Management Area will in fact provide the testing grounds for an ongoing refinement of those relationships. A more visible and perhaps more structured adaptive management process could be fertile ground for exercising new relationships among scientists, citizens and managers. The role of scientists in the adaptive management process needs further elaboration. Some potential roles include:

- synthesis of existing knowledge
- development of measurement and analysis protocols
- hypothesis development and testing
- introducing concepts from new directions in science
- gatekeeper of scientific process
- projections of potential consequences of ecosystem management choices

Other roles undoubtedly exist, these are merely meant to help kickstart the discussion. Appropriate forums and participants need to be identified in order for this discussion to move forward. It may be best for this discussion to unfold in the context of doing adaptive management activities, rather than holding a specific meeting for the purpose.

Role of Cascade Center

The Cascade Center administers a large and diverse program of research, monitoring, and development and demonstration projects, and a closely related communication and education program, that contribute directly to Adaptive Management Area goals. However, at present there is no mandate for the Cascade Center to organize, coordinate or even be informed of all research, monitoring, and development and demonstration projects that occur within the Adaptive Management Area. Many projects contributing to learning objectives within the Adaptive Management Area are implemented without involvement of the Cascade Center. Projects arise from many directions and no concerted effort is made to ensure that information is efficiently shared. Project needs are dealt with on a case-by-case basis. For the most part this seems to work effectively; over 100 projects are listed in the Ongoing Studies section of this Assessment (Chapter III). It is not at all clear that any change is necessary or desirable. However, it can be confusing to some. Information flow and responsibility for coordination of research, monitoring, and development and demonstration projects is dispersed. The most appropriate means of communication may not be apparent to individuals new to the scene or interacting from the distance. It may be desirable at some point to clarify roles, responsibilities and information flow for research, monitoring, and development and demonstration projects across the Adaptive Management Area.

Project Tracking

Tracking the location and status of the great number of research, monitoring, and development and demonstration projects underway in the Adaptive Management Area (see Chapter III) is a large and never-ending task. Projects are underway at all scales ranging from small plots to the entire Adaptive Management Area. At present there is no map or database that shows where these projects are located. Approximately half the project locations are displayed either on the Cascade Center Project Map or the H.J. Andrews Experimental Forest study site GIS layer. However, the Cascade Center Project Map is already out-of-date and incomplete, is a non-updatable paper map, and does not cover the entire Adaptive Management Area. The Andrews study site data is also incomplete, limited to the Andrews property, and somewhat outdated.

Several problems are involved with tracking projects. The first challenge is simply the large number of projects. In addition projects are constantly arising, dying off, and occasionally reborn. The wide variety of scales makes finding a suitable format for display difficult. Many projects extend beyond the Adaptive Management Area. And since projects arise from so many sources, personnel change rapidly, and at present there is no defined tracking protocol, information concerning project location and status is widely dispersed and incomplete.

As with clarifying the role of the Cascade Center, there may not be a pressing need to take any action. However, questions around project location and status frequently come up. Individuals who come across plots in the field need to know if potential projects could affect important studies. Additionally, map displays of ongoing projects could be a valuable communication tool for the Adaptive Management Area.

At present I am in the beginning stages of putting together paper maps of the Adaptive Management Area projects listed in Chapter III. Just putting together a base map at a suitable scale (1" = 1 mile) turns out to be difficult because of the different map symbology used in the different agencies, and across different Ranger Districts. A high quality base map will require longer-timeframes.

To make this information useful and manageable for the long-term, I propose that we take the next step and create a GIS data layer for tracking all research, monitoring, and development and demonstration projects within the Adaptive Management Area. A GIS layer offers the following advantages:

- it can be readily updated
- it does not degrade over time
- it can be rapidly shared
- input and output can occur at any scale
- input and output can be in the form of points, lines, or polygons
- outputs or displays can be readily customized

- information can be overlaid or compared with other GIS layers

We can design, input and manage this with the Cascade Center GIS facilities at Blue River Ranger District. Information can be readily shared with the other management units and the Corvallis FSL GIS facilities. The value of this approach would be significantly enhanced if we developed and implemented protocols for sharing information concerning project location and status across management units.

Administrative and Other Opportunities

A number of other objectives and expectations for Adaptive Management Areas were set in the Record of Decision and the FEMAT report that could be considered as learning opportunities, but were beyond the scope of this Assessment. They include:

- technical training to qualify local community residents for employment
- innovative approaches for acquiring adequate and stable funding sources
- innovation in agency organization and personnel procedures to encourage greater skill development and retention
- innovation with contracting and other procedures to support a sustainable local community economy

Further work is needed to determine how these objectives might best be met, and the relative priority of doing so.

Appendix A - List of Scientists doing Research within the Adaptive Management Area

Scientists involved in Andrews LTER and allied ecosystem studies (their affiliation and specialty):

Steve Acker, Forest Science, OSU, Forest ecology, Succession
Linda Ashkenas, Fisheries & Wildlife, OSU, Stream ecology
Joe Beatty, Biology, OSU, REU Program Director, Herpetology
Fred Bierlmaier, Forest Science, OSU, Forest micrometeorology support
Jeff Borchers, Forest Science, OSU, Soils, Site productivity
Bernard Bormann, PNW, Site Productivity
Jim Boyle, Forest Resources, OSU, Site productivity
Gay Bradshaw, PNW, Remote sensing, Spatial statistical analysis
David Brooks, PNW, Economics
Mark Brunson, College of Natural Resources, Utah State Univ., Social acceptability
Lynn Burditt, Blue River Ranger District, Willamette National Forest, Land management
Richard Busing, PNW, Plant Ecology
Bruce Caldwell, Forest Science, OSU, Microbiology, Nutrient cycling, Decomposition
George Carroll, Univ. Oregon, Mycology
John Cissel, Blue River Ranger District, Willamette National Forest, Landscape ecology, Resource planning
Warren Cohen, PNW, Remote sensing
Craig Creel, PNW, Forest ecology support
Kermit Cromack, Forest Science, OSU, Nutrient cycling, Decomposition
Donna D'Angelo, Univ. of Georgia, Stream ecology
Bill Denison, Botany, OSU, Mycology, Lichen Ecology, Canopy ecology
Greg Downing, PNW, Hydrology and Meteorology support
William Emmingham, Forest Science, OSU, Forest ecology, Silviculture
Bill Ferrell, Forest Science, OSU, Forest Ecology, Carbon budgets
Jerry Franklin, University of Washington, Forest ecology
Steve Garman, Forest Science, OSU, Forest Modeling, Wildlife
Carol Glassman, Forest Science, OSU, Chemical analyses support
Gordon Grant, PNW, Geomorphology, Hydrology
David Greenland, Geography, Univ. of Oregon, Climatology
Stan Gregory, Fisheries and Wildlife, OSU, Stream ecology
Bob Griffiths, Forest Science, OSU, Carbon and nutrient cycling, Microbiology
James Hall, Fisheries & Wildlife, OSU, Stream ecology, Fisheries
Charles Halpern, Univ. of Washington, Forest ecology, Succession
Andy Hansen, Biology Dept., Montana State Univ., Wildlife, Landscape ecology
Hazel Hammon, PNW, GIS/Computing support
Mark Harmon, Forest Science, OSU, Decomposition, Global ecology
Steve Hart, N. Arizona Univ., Soil biology and chemistry
Miles Hemstrom, Regional Office, USDA Forest Service, Forest Ecology
Dave Hibbs, Forest Science, OSU, Forest ecology
Peter Homann, Forest Science, OSU, Soil carbon, Nutrient cycling
Elaine Ingham, Botany, OSU, Food webs, Soil biota
Wes Jarrell, Oregon Graduate Center, Beaverton, OR, Decomposition

K. Norman Johnson, Forest Resources, OSU, Policy, Planning, Economics
Cam Jones, Forest Science, OSU, Nutrient analyses support
Julia Jones, Geosciences and Forest Science, OSU, Soils, Hydrology
Loren Kellogg, Forest Engineering, OSU, Logging engineering
Jane Kertis, Willamette/Siuslaw National Forests, Forest ecology, Fire history
Mark Klopsch, Forest Science, OSU, LAN support
Olga Krankina, Forest Science, OSU, Forest production
Jack Lattin, Entomology, OSU, Invertebrates
Al Levno, PNW, Hydrology and Meterology support
George Lienkaemper, PNW, Director of GIS Laboratory
Dan Luoma, Forest Science, OSU, Mycorrhizal ecology, Sporocarp biomass
Jon Martin, Willamette/Siuslaw National Forests, Forest ecology
Jim Mayo, Blue River Ranger District, Willamette National Forest, Silviculture
Cindy McCain, Willamette/Siuslaw National Forests, Forest ecology, Riparian ecology
Bill McComb, Forest Science, OSU, Wildlife, Landscape
Bruce McCune, Botany, OSU, Forest ecology
Art McKee, Forest Science, OSU, Site Director HJA, Succession, Biodiversity, Forest ecology
Joe Means, PNW, Forest ecology
Charles Meslow, U.S. Fish and Wildlife Service, Wildlife
Andy Moldenke, Entomology, OSU, Soil invertebrates, Soil biota
Randy Molina, PNW, Mycorrhizae, Mycology
John Moreau, Forest Science, OSU, Hydrology and Meteorology support, NAPAP
Pat Muir, Botany, OSU, Forest ecology
Dave Myrold, Soils, OSU, Soil processes, N & C dynamics
Nadlini Nadkarni, Evergreen State College, Canopy Ecology
Ron Neilson, PNW, Global Change, Biogeography modeling
Dave Perry, Forest Science, OSU, Forest ecology, Soil biota
Steve Radosevich, Forest Science, OSU, Silviculture, Forest ecology
Bill Ripple, Forest Resources, OSU, Remote sensing
Tom Sabin, Forest Science, OSU, Statistical support
Peter Schoonmaker, Ecotrust, Portland, OR, Climate change, Paleoecology
Tim Schowalter, Entomology, OSU, Forest Invertebrate ecology, Canopy arthropods
Jim Sedell, PNW, Stream ecology
Jay Sexton, Forest Science, OSU, Decomposition support
Bruce Shindler, Forest Resources, OSU, Public involvement, Policy
Alok Sikka, Forest Science, OSU, Hydrology
Jane Smith, PNW, Mycorrhizae, Mycology
Phil Sollins, Forest Science, OSU, Soils, Nutrient cycling
Tom Spies, PNW, Forest Ecology, Remote sensing
Gody Spycher, Forest Science, OSU, Forest Science Data Manager
Susan Stafford, Forest Science, OSU, Director Quantitative Sciences Group, Forest Science Data Bank
George Stankey, Forest Resources, OSU, Public involvement
Brent Steel, Political Science, Washington State Univ., Vancouver Campus, Public opinion
Fred Swanson, PNW, Geomorphology, Disturbance, Ecosystem Team Leader
John Tappeiner, Forest Resources, OSU, Silviculture

Gabe Tucker, Forest Science, OSU, Silviculture
David Wallin, Forest Science, OSU, Landscape ecology, Remote sensing
Dick Waring, Forest Science, OSU, Remote sensing, Forest ecology
Jim Weigand, PNW, Economics
Randy Wildman, Fisheries and Wildlife, OSU, Stream ecology
Mark Wilson, Botany, OSU, Succession, Diversity

Graduate Students involved in Andrews Forest ecosystem studies in 1993-1994 (their affiliation and major professor).

Greg Brenner, PhD, Entomology, OSU, Riparian soil arthropods (Lattin)
Leigh Cimino, MS, Soil Science, OSU, Gross rates of N mineralization, immobilization, and nitrification in soils under Douglas-fir and red alder (Myrold)
Chris Daly, PhD, Botany, OSU, Precipitation modeling, landscape vegetation-hydrology modeling (Neilson)
Jinfan Duan, PhD, Forest Engineering, Landscape energetics and landscape evolution (Grant)
Armando Equihua-Martinez, PhD, Entomology, OSU, Biosystematics of conifer Miridae (Lattin)
Edith Estrada-Veneges, MS, Entomology, Life histories and taxonomy of Oribatid mites (Moldenke)
Matt Freid, MS, Geosciences, OSU, Road network structure as a function of ownership in western Oregon (Pease)
Melora Geyer, Forest Science, OSU, Effects of early successional species on soil properties (Cromack)
Marla Gillham, PhD, Forest Science, OSU, Plant-soil interactions (Perry)
Matthew Goslin, MS, Forest Science, OSU, Structure and dynamics of multiple age class Douglas-fir/western hemlock stands (Spies)
Juri Halaj, PhD, Entomology, OSU, Predatory arthropods in forest ecosystems (Lattin/Ross)
Kikombo Ilunga, PhD, Geosciences, OSU, Wildfire effects on forest fragmentation and fragmentation effects on spotted owl nest sites (Jones/Swanson)
Andrew Jensen, PhD, Entomology, OSU, Biosystematics of Aphididae (Lattin)
Bill Langford, PhD, Forest Science, OSU, Integrated pattern recognition and image segmentation using machine-learning techniques (Cohen)
Tom Maiersperger, MS, Forest Science, OSU, Classification of spatially aggregated thematic mapper data: effects on vegetation mapping accuracy in western Oregon (Cohen
Karl Martin, MS, Fisheries & Wildlife, OSU, Movements and habitat associations of northern flying squirrels in second- and old-growth forests (Anthony)
Michelle Murillo, MS, Forest Science, OSU, Valley floor landscape dynamics-Andrews and Bonanza Creek LTER sites (Swanson)
Pete Oboyski, MS, Entomology, OSU, Arthropod fauna of major riparian trees (Schowalter)
Janet Ohmann, PhD, Forest Science, OSU, Regional plant diversity patterns (Spies)
Laurie Parendes, PhD, Geosciences, OSU, Spatial patterns of invasive plants in the Andrews (Jones)
JeriLynn Peck, Botany/Plant Pathology, OSU, Bryophyte and lichen ecology of old-growth Douglas-fir forests (McCune)
Reed Perkins, PhD, Forest Science, OSU, Hydrology, scaling properties of peak flows

(Grant/Jones)
Nathan Poage, MS, Forest Science, OSU, Canopy architecture (Spies)
Jennifer Powers, MS, Forest Science, OSU, Landscape ecology, Douglas-fir bark beetle (Sollins
Nestor Rojas, PhD, Forest Science, OSU, Nitrogen-fixation processes (Perry)
Dan Rosenberg, MS, Fisheries & Wildlife, OSU, Abundance of northern flying squirrels in second- and old-growth forests (Anthony)
Lynn Rosentrater, MS, Geography, Univ. of Oregon, Simulation of surface energy budget variations accompanying change from mature forest to clear cut and subsequent succession (Greenland)
Pablo Rosso, Botany & Plant Pathology, OSU, Tree vigor and susceptibility to armillaria root disease (Everett Hansen)
Don Sachs, PhD, Forest Science, OSU, Regional carbon budget (Sollins)
Steve Sillett, PhD, Botany & Plant Pathology, OSU, Ecology of canopy cyanolichens (McCune)
Amanda Six, MS, Sociology, OSU, Social attitudes about alternative forest management policies (Smith)
Chris Swanston, MS, Forest Science, OSU, Movement of fixed N from red alder leaves into soil organic N pools (Myrold)
Keith Swindle, MS, Fisheries & Wildlife, OSU, Fragmentation effects on spotted owl reproductive success (Meslow)
James Tang, MS, Soil Science, OSU, Estimating N2 fixation in mixed red alder/Douglas-fir stands using 15N (Myrold)
Christin Torgerson, Honors Program, Univ. of Oregon, Spatial patterns of soil organisms and edaphic properties in an old-growth patch (Jones/Moldenke)
Bibit Traut, MS, Botany & Plant Pathology, OSU, Retrospective studies of effects of green tree retention on herb, shrub and byophyte diversity (Muir)
Amy Tuininga, MS, Botany & Plant Pathology, OSU, Organisms versus inorganic nutrients in leachate from logs in Douglas-fir forests (Ingham/Harmon)
David Warrington, Forest Science, OSU, Soil carbon (Sollins)
Beverly Wemple, MS, PhD, Forest Science, OSU, Road effects on stream flow (Jones)
Pam Wright, MS, Forest Science, OSU, Effects of plant association and disturbance regime on coarse woody debris (Swanson)
Eric Zenner, MS, Forest Science, OSU, Retrospective studies of stand dynamics (Emmingham/Acker)

Appendix B - Research, Management, and Public Questions

This section contains several lists of questions or needs for studies. These lists are the product of group efforts by individuals in the local area. Most have been recently compiled, although a couple date back several years. Some groups identified priorities while others produced unprioritized lists. While these lists contain much information they are an incomplete sample and contain the biases of those who participated. All of the questions in these lists were evaluated according to the criteria in Section IV to produce the list of higher priority questions found in that section. Those priorities should be viewed as preliminary and as a starting point for a more broad-based process that directly involves citizens in identifying high priority needs. The lists are presented in reverse chronological order.

Oregon Cooperative Wildlife Research Unit - March 3, 1995

These topics were suggested as potential research subjects within the Adaptive Management Area to the monthly Cascade Center/LTER meeting in Corvallis by Bob Anthony and Keith Swindle.

1. What is the influence of forest management on spotted owl movements and home range, survival and reproductive rates, population demography, and seasonal diets?

2. What is the influence of forest management on the abundance and species diversity of small mammals in different forest types?

3. What is the influence of forest management on the movement and home range size of northern flying squirrels (a primary spotted owl prey species), and on the abundance and habitat associations of northern flying squirrels and Townsend's chipmunks?

4. What is the influence of forest management on the abundance and diversity of bird and small mammal communities in riparian areas?

5. How do changes in forest structure affect the abundance of fungi, small mammals, and spotted owl prey?

Blue River Ranger District Group - January 11, 1995

Present: Charlene Mikkelsen, Jim Capurso, Jim Overton, Chip Britting, Diana Bus, Tere DeSilva, Tim Kee, Greg Miller, Jim Mayo, Penny Harris, Sally Swetland, Pam Druliner, Rick Ley, Monty Wilson, John Cissel

1. Compare energy intensive, highly mechanized, large contract approach to forest operations to labor intensive, smaller operations in terms of economics (operator, administrative, community) and energy requirements.

2. Develop capacity (database, communications network) to provide information relevant to policy issues to all interested parties and decision-makers.

3. Develop better monetary values for recreational activities, water quality, air quality, biodiversity to support decision-making and budgeting processes.

4. Test thinning prescriptions in 25-40 year old stands at H.J. Andrews Experimental Forest.

5. Cougar Hot Springs:

- What is the value of the hot springs to the community (local and more broadly)?
- What are the impacts of Forest Service regulation of hot springs use on community economics and culture?
- What are sustainable levels of use in terms of water quality, vegetation and social interactions?
- Who are the customers of the hot springs?
- What is the contribution of the hot springs to the local economy?
- What are the trends in vegetation, soil, water quality, crime, user satisfaction?

6. Are there ways to get material from precommercial thinning sales available to the public for firewood without imposing additional costs on contractors?

7. Demonstrate innovative partial cutting prescriptions in mature Douglas-fir stands. Numerous examples from earlier cuttings exist.

8. What are the contributions and effects of special forest product harvesting to rural development and local communities?

Eugene District/McKenzie Resource Area Group - December 19, 1994

Present: Liz Aleman, Lee Lauritzen, Neil Armantrout, Ted Sexton, Greg Miller, John Applegarth, Raul Morales, Karen Dodge, Art Emmons, and John Cissel

1. Potential for genetic studies of cutthroat trout and aquatic macroinvertebrates in Bear Ck. Populations above and below the falls appear to be somewhat differentiated.

2. Cooperative stream restoration projects in Gate Ck. are being planned.

3. Potential to look at the effectiveness of federal land management policies in highly fragmented ownerships.

4. What are the effects of dam-altered stream flows on river users directly and indirectly (e.g., effects on fish habitat)?

5. How significant is river use to the upper valley economy?

6. What are the implications of the gradient of human communities along the river? Communities vary from very rural to Eugene/Springfield.

7. How effective are undisturbed subbasins as refugia when intermingled with disturbed subbasins? Marten Ck. Offers opportunities to investigate this question.

8. There is a big need for baseline data within the proposed ACEC, especially for sensitive species and species of concern in the new Regional Plan (USDA Forest Service and USDI Bureau of Land Management, 1994).

9. Basic habitat relationship information is needed for many sensitive species and species of concern in the new Regional Plan (USDA Forest Service and USDI Bureau of Land Management, 1994).

McKenzie Ranger District Group - December 15, 1994

Present: Frank Fay, Kevin Moran, Gene Skrine, Dean Vandrasco, Kathy Keable, Jon Allen, Phil Raab, Al Mikkelsen, Steve Keable, Eric Bergland, John Cissel

1. Social interactions and dependencies on the McKenzie River.

- What is the level of satisfaction of river users with current management practices?
- What is the role of the river in the upper valley economy and culture?
- What are appropriate and acceptable standards for river use within the Wild and Scenic River corridor?

2. The Adaptive Management Area or portions thereof presents an opportunity to describe and work towards an integrated vision of a sustainable forest and a sustainable human community.

3. Fire as an ecosystem process and concerns over smoke.

- What level of smoke resulting from prescribed natural fire is socially acceptable?
- Are people willing to accept relatively frequent occurrences of small amounts of smoke to avoid the larger amounts of smoke resulting from less frequent catastrophic fires?
- What is an acceptable balance between allowing fire to play a more "natural" role in the ecosystem and smoke?

4. There are opportunities to look at alternative approaches to precommercial thinning on the McKenzie Ranger District since there are over 300 acres of plantations of that age.

5. What kinds of disturbance patterns, especially fire, historically occurred in riparian areas?

6. Archaeological data may be sufficient to allow for a form of GIS based social mapping of cultural changes over the last 10,000 years.

7. Alternative approaches to mountain meadow maintenance and restoration could be evaluated on Bunchgrass Mountain.

8. Pocket gophers and plantations:

- What levels of pocket gopher populations are acceptable?
- Do pocket gophers act as agents of diversity?
- What are more environmentally benign methods of controlling gopher populations?

9. What kinds of silvicultural practices enhance natural regeneration?

10. How does the material left on site following timber removal influence the diversity of succeeding stands?

11. At the scale of the entire Adaptive Management Area, how can wild fish runs be restored given the presence of major dams?

12. How are wildlife species that are dependent upon fish influenced by various riparian area management strategies?

Wildlife Monitoring and Research Needs Group - December 14, 1994

Attendees: Cheryl Friesen (Facilitator, McKenzie Ranger District Wildlife Biologist); Ken Byford (Willamette National Forest Biologist); Matt Hunter (Oregon State University, Biologist); Jim Thrailkill and Keith Swindle (Research Assistants, Oregon Cooperative Wildlife Research Unit); John Cissel (Cascade Center); Kim McMahan (Oakridge Ranger District Botanist); Rick Breckel and Lauri Turner (Detroit Ranger District Wildlife Biologists); Kirk Lunstrum (Lowell Ranger District Wildlife Biologist); Dede Steele (Oakridge Ranger District Wildlife Biologist); Lisa Lyon (McKenzie Ranger District Wildlife Biologist); Virgil Morris (Sweethome Ranger District Wildlife Biologist); Ruby Seitz (Blue River Ranger District Wildlife Biologist).

NOTE: The following questions were produced from a brainstorming session. Each biologist "voted" for 8 questions they felt were of the highest priority. The number of votes each question received is shown prior to the question. Questions of the highest priority are listed first.

8 What are the consequences of fire suppression on special habitats, and how do we sustain these areas?

7 What silvicultural practices accelerate/enhance the development of a late successional condition?

6 What are the keystone species for the ecosystem we manage, and what are survey and management strategies for them?

6 What is the role of large woody debris in nutrient/water cycling; providing dispersal/connectivity for small mammals, fungi, bryophytes, etc? (question relates to salvaging in LSR's)

5 What is the distribution of great gray owls on the Willamette, and what habitat types do they use here?

5 How does the harvest of special forest products impact wildlife habitat, particularly the food base?

5 What are the consequences of eliminating the shrub/herb stage during plantation management?

5 What is the effectiveness of the default riparian reserves for dispersal/migration?

4 What is the distribution of goshawks on the Willamette, and what habitat types do they use here?

4 What are the benefits/detriments of scattered and/or aggregated green trees vs. intact patches?

4 How do landscape patterns affect the quality of wildlife habitat? (e.g., corridors, fragmentation, etc.)

4 What are the effects of the conversion of hardwoods to conifers in riparian systems (ie nutrient input, etc) and upslope (retention in harvest areas)?

3 What is an "acceptable" level of road density to maintain wildlife habitat?

3 What is the distribution of bat, invertebrate and other species of interest on the Forest; what habitat do they use; and how do we survey for them?

2 What is the effectiveness of underplanting/density control versus natural recovery after thinning, burning, salvaging of blowdown, etc. on stand development?

2 What affect does underburning stands of varying ages and structure have on wildlife?

2 What is the distribution of black-backed woodpeckers on the Willamette, and what habitat types do they use here?

1 What are the minimal habitat needs of large ranging species on the Forest?

1 What are the affects of noxious weeds on natural systems?

1 What is the effectiveness of the default riparian reserves, and how can/ should their boundaries be adjusted to increase their effectiveness?

1 What is the potential for enhancing forested riparian habitat that is in a second growth condition?

1 What is the value of thinning in 80+ year old, single story stands created by fire?

1 What is the economic value of some wildlife species on the Forest?

1 What are the successional stages of special habitats on the Forest?

1 What are the short and long term responses of wildlife to wildfire?

1 How do wildlife species respond to different management activities?

1 What will the effects of LSR management be on peregrine falcon sites?

0 How do we survey for red tree voles, and how are their populations monitored?

0 Is the pileated woodpecker and pine marten management strategy from the Land Management Plan still needed on the Willamette?

0 What are the potential affects of the ROD's default landscape design, which will result in short-rotations in the upslopes and reserves in riparian areas downslope? (ie. logging of all ridgeline habitat)

0 What is the value of small snags and small down woody material retention? (COULD DO WITH KV)

0 What is the quality of elk forage in managed stands? (ie commercial thins) (COULD DO THIS WITH KV)

0 What types of planting, precommercial thinning, and other silvicultural practices can be used to enhance the quality of wildlife habitat? (COULD DO THIS WITH KV)

0 How do harvest practices affect potentially critical habitat features (such as soil depth) for the red-backed vole?

0 How do beaver change habitat and species composition?

0 What affect does thinning within the matrix have on neotropical migrant birds?

0 What is the distribution of the white-footed vole on the Willamette, and what habitat types does this species use?

0 What are acceptable research methods for marking/taking small mammals?

0 How can native grass/forb species be used to enhance elk forage?

0 What will be the effects of the decline of early seral habitat on landscape with the implementation of the President's plan?

0 What is the value (cost) of extirpated species and habitats?

0 What will be the change in big game density and distribution as a result of the President's Plan?

0 Does wildlife use differ between fire-hardened, natural, or artificially created snags? (COULD USE KV FOR THIS)

0 How does the Willamette National Forest contribute to provincial/ or inter-regional biodiversity?

Willamette National Forest Ecology Group - November 28, 1994

Present: Jon Martin, Jane Kertis, Cindy McCain, Diana Bus, John Cissel

1. What fire regimes operated historically in the western Cascade foothills?

2. What fire regimes operated historically in riparian areas?

3. What is the relationship of fire regimes to landforms, plant communities or other environmental gradients?

4. What was the role of American Indian burning in the Cascades?

5. How well do valley segment types correlate with landforms and riparian vegetation?

Willamette National Forest Fire Group - November 21, 1994

Present: Jon Robison, Sam Swetland, Lowell Nelson, Mike Matarese, Mike Dudley, Rick Ley, and John Cissel

1. Is fire necessary or desirable to maintain special or unique habitats? Wildcat Mt. and/or Bunchgrass Mt. may provide good opportunities to investigate this question.

2. What are the consequences of fire suppression on future fire frequency and severity?

3. What are the implications of altered fire regimes on vegetation, habitats, or other ecosystem processes?

4. What was the historic role of low-severity underburns on snag recruitment?

5. Is fire an effective tool to promote development of late-successional forest characteristics? Best opportunities may be found in mature (100-150 year old) stands.

6. What are efficient approaches to protecting Late Successional Reserves? What mix of fuel reduction and fire suppression meets Late Successional Reserve objectives in an efficient manner?

Fisheries Biologists and Aquatic Ecologists - October 17, 1994

Present: James Capurso, Wayne Somes, Todd Buchholz, Karen Dodge, Diana Bus, John Cissel, Jeff Ziller, Mark Wade, Randy Wildman, Niki Swets

1. Each district (and BLM RA) could choose two similar creeks with low amounts of large instream wood. One gets treated with large wood and the other does not (control). The districts (and BLM RA) utilize all their stream rehabilitation resources that year on treating that one creek. In other words, they "go to town." Effectiveness monitoring would compare the treated creek with the untreated similar creek on the same district (and BLM RA) and compare treatments between districts (and the BLM RA). There would also be an opportunity to monitor the effectiveness of different treatment methods/preferences across the forest and BLM RA.

2. There is an opportunity to study riparian silviculture techniques and effectiveness. We could monitor tree growth with different thin and release spacings; and compare the effects on the aquatic ecosystem of leaving thinned trees in the riparian area, moving them to the creek, or taking them out for the mills. Riparian silviculture is thought to be very labor intensive. There is an opportunity to monitor the amount of labor/expense involved. In lower gradient streams, we can study the effectiveness of beaver introductions to keep hardwoods controlled in a mixed stand of trees.

3. There is an opportunity to study wild spring chinook population response to habitat manipulation. Gate Creek is a good potential for this, particularly considering the Gate Creek Cooperative Watershed Planning effort. Through stream rehabilitation, we can study the effect that additional large pools and side channels in the the McKenzie River would have on the wild salmon populations. We could monitor the effect of reintroducing adult spring chinook in Blue River and the South Santiam River above the dams. Monitoring can include nutrient cycling and a comparison with the current practice of releasing juveniles above the dam.

4. Study the effect that the introduction of hatchery catchable rainbow trout have upon the aquatic ecosystem, particularly wild rainbow trout. There was some speculation that the major effect from hatchery trout introductions upon the wild trout would be hook/injury mortality increases and that we may need creeks involved in the study that are closed to angling. Moose, Canyon, and Lookout Creeks were identified as closed to fishing. If the introduction of hatchery rainbow trout is out of the question in Lookout Creek, there would be a potential to close another creek in the AMA to angling for the duration of the study.

5. Canyon Creek provides some opportunities for immediate studies because a lot of the creek runs through private land and has been cut over. With partnerships with private landowners, we have the opportunity to implement some studies soon and apply what we learn to public land.

6. Study the effectiveness of designated riparian area widths, edge effects, and microclimates.

7. Study the effect of road building and obliteration in the riparian management zone. Monitor the amounts of instream sediment before and after road obliteration. Compare amounts of instream sediment in similar creeks where one of the creek riparian area is heavily roaded and one is not.

8. Study the effect that additional over-wintering habitat has upon trout populations. It is suspected that over-winter mortality may have a large effect upon resident trout populations.

9. Study the effects that dam-related drastic flow changes have upon aquatic ecosystems downstream of dams. There are 3 major dams located in the AMA.

10. Study and compare "engineered-looking" (v logs) and "natural-looking" (log jams) human-placed instream structures.

11. Study the socio-economic effects of Jobs in the Woods Program.

Adaptive Management Area Public Meetings - April and May, 1994

Present: Ten to twenty citizens attended each of four public meetings held in Blue River, Sweet Home, Eugene/Springfield, and Corvallis. Agency representatives also attended.

NOTE: The questions listed below are not verbatim versions of questions asked at the meetings, but represent the authors synthesis of flip chart notes that usually contain only phrases and fragments of ideas and comments. However, I believe they capture most of the main interests recorded at those meetings; these themes tended to be repeatedly expressed in one form or another.

1. What kinds of public involvement techniques will help ensure that all interested voices are heard up front and throughout the process?

2. What form of collective decision-making process will help ensure that decisions made can be implemented? How can common ground be found? Can consensus be reached? Will an advisory group be formed, and if so, what is the best way for it to function?

3. What is the linkage among the Adaptive Management Area and community goals? What are the communities and how are they linked?

4. What is a meaningful and useful definition of sustainability that includes both social and ecological objectives?

5. Are selective harvesting and thinning practices more sustainable?

6. How can we encourage local processing and value-added products from resources harvested from the forest?

7. How can dollars earned from harvest of public resources be retained locally for reinvestment in the Adaptive Management Area?

8. What mechanisms can make ecosystem management more effective in areas of multiple ownership's?

NOTE: Craig Patterson, McKenzie Bridge resident, stressed his interest in questions #2, #5 and #6 in followup conversations with the author.

Willamette National Forest Botantists - December 16, 1993

Present: This is a list of restoration research needs assembled by Jenny Dimling and refined by Willamette NF botanists.

1. What type of seeding techniques (drill, broadcast, hydroseeding, or mulching) work best on different sites for high priority species? Which produces the highest germination rate?

2. What are the best growing techniques for shrubs (rooted cuttings, plugs of rhizomatous species, or mulching) on different sites? Which technique produces the highest survivorship?

3. What are the seral stages in riparian communities (plant species, relative abundance, and site specificity)?

4. Does skipping steps in succession adversely affect subsequent successional stages? Does one stage create seed beds, nutrient banks, or slope stability needed for the next stage? Are some plants or animals excluded from the landscape if a successional stage is skipped?

5. Evaluate ecotypic variability versus phenotypic plasticity within native plant species to determine seed zones (common garden, reciprocal transplants, seed germination characteristics).

6. If ecotypic variation is an important component, identify and select those ecotypes best suited to target areas (genetic evaluation, collection, breeding, field trials).

7. What are the high priority species for riparian areas, ripped roads, and for erosion control?

Cascade Center - Corvallis Session - 12/3/93

Present: Jon Martin, Stu Johnston, Gabe Tucker, Jim Boyle, Jim Mayo, David DeMoss, Cindy McCain, Steve Acker, Dave Wallin, Randy Molina, Sarah Greene, Jane Smith, Steve Garman, Ted Dyrness, Jack Lattin, John Cissel, Fred Swanson, Gordon Grant

NOTE: The numbers to the left of some questions indicates the number of individuals that voted for that question as being a top priority question.

-9- 1. Special forest products.

a. Impact of immigrant collectors on local comm.

b. Inventory of occurrence.

c. Impact of disturbance and harvest.

d. Ecological functions.

e. Economics.

-4- 2. Large range pop'n interactions w/various mgmt systems and small-ranging verts and ecosystem properties.

3. Public involvement in adaptive mgmt.

4. Landscape experiments.

5. What are old/new drivers shaping landscape patterns.

6. Indicators of forest landscape carrying capacity for human communities.

-5- 7. Monitoring human community effects of AMA (econ., jobs).

-3- 8. Compare disturb. history documentation techniques (efficient and sufficient).

9. How to link to other ecosys. components, e.g., riparian and their disturbance regime.

10. Fire - how/how much to reintroduce.

-2- 11. Test watershed basis for ecosys. mgmt.

What does it buy you?

Try ecosystem analysis w/ and w/o watershed basis.

Significance of watershed basis for public involvement.

-2- 12. Methods of monitoring--efficient, socially based monitoring to see if we are meeting (define biol. objectives for AMA).

-2- 13. How wide should riparian resources be?

14. Can we identify canaries, e.g., water quality, fish communities?

15. Improve reuse of products.

16. Thresholds of landscape condition (incl. in natural state) needed to sustain biodiversity.

17. How to mix objectives across landscape.

18. Exotic spp.--a growing issue--how to manage.

19. Public involvement--how to find out their true wants.

20. Social correlates of land use change of areas adjacent to AMAs--what will mgmt be on those lands.

21. Develop models of critical pieces to "game" futures.

-11- 22. Inventory flora/fauna, soil/veg/land form maps.

23. Expand comparisons of large land areas with contrasting management pasts/futures--attend to matrix--not just islands.

-4- 24. Inventory nonindigenous spp. as indicators of degrees of disturbance.

25. To what degree do landscape/landform features predict disturbance regimes.

26. Develop tools to predict interactions of mgmt and wild disturbance regimes.

-8- 27. What are parameters of ecosystem to base our mgmt on? Emphasize relationships in what we measure of ecosystem condition.

-3- 28. Interownership Interactions - biological & physical

-4- 29. Roles of steep gradients/abrupt ecotones. Can't put all our attn to the Federal AMA acres. Fed ----> Pvt. forest ----> Agriculture

30. Need to know more about local extinctions.

Cascade Center - Eugene Session (11/30/93)

Present: Art McKee, Neal Forrester, Deigh Bates, Gabe Tucker, Steve Acker, Del Skeesick, Rex Storm, Jenny Dimling, Ruby Seitz, Cheryl Friesen, Sarah Greene, Karen Geary, Carolyn Sands, Lyle Ang, Steve Sorseth, Stu Johnston, Julie Stangell, David DeMoss, Lee Lauritzen, Jim Mayo, Dan Howells, Cindy McCain, Bill Funk, Rich Fairbanks, Gary Marsh, Rick Ley, Bob Sanders, Dave Leach, Bill Porter, Sam Swetland, Dean Vendrasco, Jim Green, Mike Morris, Fred Swanson, Lynn Burditt, John Cissel

NOTE: The number of asterisks to the left of each question identifies the number of times the question appeared as a top priority on the small-group flip charts.

1. RANGE OF NATURAL/HISTORIC CONDITIONS AND DISTURBANCE PATTERNS

** -- What is the range?

-- How do we determine without intensive studies?

** -- What kinds of management practices are consistent with the range?

* -- What are the risks of being outside of the range?

-- What are the natural/historic successional pathways? (including dead wood)

-- What is the spatial and temporal distribution of small-scale disturbance in natural stands?

** -- How can we imitate natural stand dynamics? (difference between natural and managed)

** -- What is public understanding and acceptance of managing within the range?

-- How can we predict interaction of natural disturbance patterns with management patterns?

* -- What is the role of fire in ecosystem management?

* -- Are there better ways to deal with public concern over smoke from prescribed fire?

-- What are the effects of fire suppression policies?

2. STAND STRUCTURE AND MANAGEMENT

** -- What stand features are keystone species dependent upon?

* -- How can we manipulate young stands to create these features?

-- What are economics and opportunities for commodity production in young stands? (especially stocking-level control)

-- What kinds of reforestation strategies best promote biological diversity and timber production?

* -- Need to develop growth and yield models that can project multicohort, multispecies, and long-rotation management. And link to habitat models.

-- How fast do canopies close after thinning?

-- How can we link canopy closure to other stand measurements or parameters?

-- What are the effects of green tree retention on stand development, growth, and yield?

-- Need to develop a taxonomy of stand types and conditions.

-- Are there silvicultural methods that develop or perpetuate old-growth conditions?

-- What are the snag dynamics at a landscape scale?

-- What kinds of logging systems can preserve snags safely?

-- How much organic matter is needed to maintain ecosystem function?

-- What is the development of yew across successional stages?

-- What are indicators of late-successional conditions? (e.g., lichens, fungi, insects)

-- How is a uniform stand differ from a patchy stand in terms of habitat? (especially young stands)

-- What thinning strategies will promote old-growth habitat?

-- Is there a tradeoff between structural diversity and wood quality in young stand management?

-- Can pruning help develop late-successional forests?

-- What is the persistence and decomposition of logs, snags, and green trees left in cutting units?

-- What are the tradeoffs of leaving whole trees versus leaving logs in cutting units?

3. SPECIAL FOREST PRODUCTS

-- How does composition and abundance vary by successional stage?

* -- What silvicultural prescriptions will enhance production?

* -- What are the ecological effects of extraction?

-- Is it possible to develop a local, sustainable market?

** -- How can we manage to sustain habitat?

4. MEASURABLE OBJECTIVES

* -- What output levels are linked with alternative management strategies?

** -- What are measurable objectives of ecosystem management?

** -- How do we establish and link objectives at different spatial and temporal scales?

** -- What is the role of the public in establishing these objectives?

-- What is appropriate scale for planning of continuous flow of outputs?

5. RIPARIAN MANAGEMENT

* -- What criteria should guide riparian reserve boundaries?

-- What is the role of 4th order (class?) streams in amphibian distribution?

** -- What kind of silviculture is appropriate in riparian areas?

** -- What are the physical and biological effects of riparian silviculture?

-- How do we design in-channel structures to incorporate physical properties of streams?

-- What is the role of stocking-level control in riparian vegetation management?

-- How have riparian stands and channels changed over time?

6. ECONOMIC

* -- What types of Federal forest activities put money into local communities? How much and where does it go?

* -- What are the economic effects on local communities from Federal forest activities?

* -- What are the best methods to measure and monitor local economic effects?

-- What changes in contracting procedures can be made to favor local businesses?

-- How should local people be trained to do AMA work?

* -- What are the efficiency implications of new approaches to ecosystem management?

-- Are there new economic opportunities due to new wood utilization standards?

7. SOCIAL

-- How do we effectively involve the public in Federal forest decisions and projects?

-- How do we foster long-term perspectives?

-- What tools are effective? (questionnaires, slides, video, continuum of interpretative sites?)

-- How do we involve the public in an efficient manner, so resource decisions are made in a timely manner?

-- How do we monitor the effectiveness of involvement processes?

-- Which activities best serve social needs?

-- What are the social effects on local communities from Federal forest activities?

-- How do we reestablish public trust in resource managers to be stewards of public lands?

-- What is social acceptability of the use of fire in ecosystem management?

-- What is the public understanding and acceptance of managing within a range of natural variability?

* -- Is there any overlap between public desire for maintaining the aesthetics of the forest and maintaining the functions of the forest? (e.g., can wildlife trees be aesthetically pleasing?)

-- How do you develop an educational program for the public to instill an understanding of general ecosystem processes?

-- What are the effects of the numbers of forest visitors on fish, trails, rivers?

-- What is an acceptable level of road closures? (especially given the increase in 4-wheel vehicle use?)

8. WILDLIFE

** -- What type, size, and location of corridors meet wildlife objectives? Are corridors effective?

-- How does landscape pattern affect vertebrates, especially large vertebrates?

* -- What is vertebrate response to disturbance during operations; e.g., tree cutting, planting, road building? e.g., bird nesting.

-- What species and populations occur in the Adaptive Management Area?

-- What levels of elk forage are available under different levels of canopy closure and prescriptions? Effect of fertilizer?

* -- What are the minimum viable populations of keystone and indicator species?

-- What are the large landscape wildlife flows?

9. FIRE MANAGEMENT

-- What are the implications of new silvicultural prescriptions and road maintenance approaches on fire incidence, size, and intensities?

* -- How do we integrate fire protection measures with ecosystem management? (fuel loading, road closures, prescribed burn policies, use of fire retardant, etc.)

* -- What fuel treatments are consistent with developing late-successional forests?

10. WATERSHED ANALYSIS

* -- What is the best, most efficient way to do watershed analysis in key watersheds?

11. CATASTROPHIC DISTURBANCE

* -- How should we management following catastrophic disturbance?

* -- What questions will we need to respond to following catastrophic disturbance?

12. MULTIPLE OWNERSHIPS

-- How can we encourage private landowners to participate in these studies?

-- What are the important interactions among ownerships in the Central Cascades and what are the implications for management?

13. NONFOREST TYPES

-- What are sampling protocols for nonvasculars?

-- How should we monitor the effects of harvest on nonvasculars?

-- What species of plants occur in the Adaptive Management Area?

-- Need inventory of nonvasculars.

-- How does timber management affect nonforest habitats?

-- How can buffers around nonforest habitats maintain or accelerate succession?

-- How is tall bugbane affected by silvicultural treatments?

14. GENETICS

-- What is the effectiveness of tree improvement projects?

-- Will open-grown trees in our orchards survive underplanting?

15. MISCELLANEOUS

-- What are the impacts of frequent entries on soil, vegetation, and habitat? What are the economic and ecological tradeoffs?

-- Can we develop tools to describe ecosystem functions, rather than traditional forest measurements?

-- Can we use the Adaptive Management Area to test ecological classification systems?

-- What are the effects of fire on the above and below ground environments?

Blue River Ranger District Group - Winter 1991

Present: Sam Swetland, Pam Skeels, Karen Geary, Cynthia Orlando, Jim Overton, Michelle McSwain, John Cissel

1. Are riparian buffers of sufficient size to maintain water quality and fish habitat?
2. What are effective ways to mitigate unstable soils?
3. What spatial patterns or topographic positions provide the most protection against blowdown for residual green trees or snags in harvest units?
4. How can we improve habitat for bull trout?
5. What level of stand density increases use by deer and elk for thermal cover?
6. What kinds and densities of birds are using residual green trees and snags in harvest units? Small mammals and amphibians?
7. What are the growth rates of plantations with varying levels of residual green trees?
8. What are the fire risks associated with increased fuel loadings from reduced slash burning?
9. Are the 8-15 pieces of large down wood required in the Forest Plan meeting site productivity and wildlife habitat goals?

10. How do you account for blowdown from residual green trees and snags, and tops from snag creation projects, in down wood and fuel treatment prescriptions?

11. Does the species of down log left in harvest units affect site productivity and wildlife habitat differently over time?

12. Can we improve habitat for sensitive plants?

13. How do we manage for sustained production of plant commodities such as beargrass, mushrooms, huckleberries, and pacific yew?

14. How can we enhance areas for use by Native Americans?

15. How could alternative silvicultural systems be applied over time, and what would be the benefits and costs? (e.g., long rotations and uneven-aged systems)

16. Are the rate of cut limits and green tree retention guidelines in the Forest Plan effective at meeting scenic goals?

17. Are there alternative silvicultural systems that would be effective in meeting scenic goals?

18. What is "acceptable" to interested publics in terms of harvest unit appearance?

19. Do road closures increase habitat use by deer and elk?

20. Does planting of minor species in plantations enhance biodiversity?

21. How many mature forest/old growth connective corridors provide sufficient connections to adjoining stands?

22. What size mature forest/oldgrowth connective corridors are sufficient to maintain connective functions?

23. Are particular topographic positions for connective corridors better or worse at providing connections?

24. What structural guidelines or silvicultural prescriptions are appropriate for connective corridors?

25. What mix of successional stages over time best meets viable wildlife population goals?

26. Over what geographic area should a mix of successional stages be maintained?

27. How should successional stages be distributed, geographically and elevationally?

28. What kinds of silvicultural prescriptions can enhance spotted owl habitat?

29. What mix of patch sizes best contributes to biodiversity?

30. How can the growth of unwanted trees and shrubs be prevented?

31. What are the effects of burning and compaction on soils and long term site productivity?

32. Are stream enhancement projects enhancing fish populations?

33. Are there increased costs, or reduced values, associated with green tree or snag retention? down log retention?

34. How can we enhance, or best protect, unique or special plant and wildlife habitats?

35. What is an ecologically sound distribution of successional stages and plant associations?

36. Which landscape approach is more effective and efficient for organism dispersal - corridors vs. stepping stones vs. softened matrix?

37. Is it feasible or desirable to mimic natural disturbance patterns? If so, how do we do it - patch size, scheduling, prescriptions?

38. How do we establish a Desired Future Condition at the landscape level?

39. Are plant association groups by seral stage good indicators of habitat or species diversity?

40. How should plant association groups/seral stages be distributed geographically and by elevation?

41. What kinds of stand structures best meet the needs of various animal guilds? How do you measure the effects?

42. How do we evaluate vulnerability to disturbances, esp. fire & wind?

43. How do we evaluate the feasibility of alternative logging systems & prescriptions in steep, dissected terrain? What are the trade-offs?

44. What is the effectiveness of various public participation techniques?

45. How do we establish credibility as professional experts?

46. How do we know our decisions are aligned with public values?

47. How effective is ARP at minimizing detrimental peak stream flows?

48. Do harvest histories & patterns affect the size of peak stream flows?

49. Under what conditions do increases in peak stream flows cause detrimental changes?

50. Are Standards & Guidelines effective in meeting Water Quality Standards for turbidity?

51. Are Standards & Guidelines effective in meeting Water Quality Standards for temperature?

52. Are Standards & Guidelines effective in limiting mass movements?

Willamette Forest Plan Information Needs - 1990

Compiled by the Willamette National Forest Interdisciplinary Team

This section lists the information, inventory, and research needs that have been identified for the Forest. This information recognizes gaps in data, or scientific knowledge, that would be desirable to fill prior to preparation of the next Forest Land and Resource Management Plan. The concept used to organize and develop these needs recognizes that biological, physical and social ecosystems are the foundation of the planning process.

This ecosystem perspective has been used to develop a comprehensive framework for identifying and organizing information, inventory, and research needs. This framework is intended to encourage integrated research approaches that address interdisciplinary needs rather than the traditional functional approach. The ecosystem approach has been taken to meet planning needs.

Of the many ecosystems found on the Forest, several were identified as having particular current importance in forest planning. Old growth and riparian/aquatic ecosystems are examples where more information would be desirable to test planning assumptions as future plans are developed. Human visitors in the forest are an integral part of these ecosystems, and their needs and expectations should be considered in forest planning.

Information needed to address these concerns fall into six general categories. This is not a complete list, and may expand as changing conditions, monitoring, and evaluation indicate additional needs.

Interactions/Processes - This category includes information leading to a better understanding of interactions within and between ecosystems, effects of one resource on others, and the physical, biological, social and political processes that influence these interactions and resources.

1. Clarify wildlife and fish (especially MIS) response to patterns of habitat created or altered by management activities and natural succession.

2. Assess the relationships between the hydrologic recovery concept, peak flows, and channel stability as a result of rain-on-snow flood events.

3. Assess the occurrance and role of fog drip in precipitation on the Forest.

4. Improve knowledge of distribution and habitat requirements of the northern spotted owl and other species (plant and animal) associated with old growth.

5. Improve knowledge of riparian dependent species and interaction with management activities.

6. Determine the effects of vertebrate species on other ecosystem components (e.g., effects of insectivorous birds on forest insect populations).

7. Develop an understanding of ecosystem response to global atmospheric warming.

8. Clarify relationships between old-growth characteristics and ecological and visual diversity, and maintenance of natural gene pools.

9. Assess the effects of landscape patterns of timber harvest and road construction on plant and animal diversity, and stability of special habitat areas like Research Natural Areas.

10, Identify more precisely the ecological conditions that result in growth of unwanted trees and brush, to provide information for prevention and control of these species.

11. Identify the appropriate number and distribution of spotted owl habitat areas needed to ensure the viability of the species.

12. Improve total tree biomass information that is needed to evaluate harvest practices.

Long-Term Productivity - This section includes studies leading to better understanding of ecosystem needs in order to maintain various aspects of long-term productivity.

1. Determine the amount of in-stream large woody debris necessary to maintain stream channel stability and productivity of fish habitat.

2. Determine the effects of harvest practices and removing biomass on long-term productivity.

3. Determine the effects of forest fragmentation on ecosystem integrity and function, including viability of vertebrate species.

4. Further assess the effects of burning and compaction on soils and long-term site productivity.

5. Determine the effects of management practices on the incidence and severity of pathogens and insects as they affect long-term productivity.

Cumulative Effects - This section includes studies to examine the cumulative effects of naturally occurring and human-induced activities on various aspects of selected ecosystems and resources.

1. Improve knowledge and modelling of cumulative effects of timber management practices on peak flows, water quality, stream stability, wildlife habitat and other resources.

2. Identify the effects of changing habitat patterns on management indicator species.

3. Develop criteria to predict when recreational user patterns change as a result of intensive forestry practices.

Management Strategies and Techniques - Studies are identified that are needed to improve understanding of resource responses to prescribed management actions, to develop or improve inventories and monitoring techniques, and to enhance resource protection. Information is also needed to evaluate effects of certain management strategies for a variety of resources.

1. Evaluate the effects of planting genetically-selected stock on stand growth and yield, and pathogen and insect population dynamics.

2. Identify specific sites and situations where natural regeneration can be a successful management option.

3. Improve effectiveness of using fire to manage vegetation when necessary and as an alternative to herbicide use.

4. Develop effective techniques for reforesting areas of harsh microclimates, gravelly soils, and/or competing vegetation.

5. Determine the results of alternative timber management strategies on wood product properties, net value recovery, and the competitiveness of the timber industry in national and international markets.

6. Evaluate alternatives for managing old-growth forests and for maintaining habitat characteristics (e.g., snags, green trees and logs) in young managed stands.

7. Develop and refine monitoring techniques to improve procedures for using habitat information to make inferences about populations, and designing cost-effective sampling schemes that provide information about both habitats and populations with appropriate reliability.

8. Improve understanding of the effects of fertilization on timber yields, water quality and soils.

9. Further assess the response of elk to spatial distribution and size of timber harvest units, forage enhancement projects, and human activities.

10. Develop a Forest-wide, quantitative stream inventory database.

11. Assess the results of stream rehabilitation projects on fish population dynamics and stream hydrology.

12. Determine the amount, sizes and characteristics of timber in riparian areas needed to provide for in-stream large woody debris recruitment.

13. Determine the thresholds of sediment production above which negative effects on water quality and fish habitat occur.

14. Baseline inventory of water quality characteristics of sample lakes on the Forest.

15. Establish a baseline inventory and population trends for martens and pileated woodpeckers. Also dispersal patterns, behavior and habitat needs for all management indicator species.

16. Baseline inventory and population trends for anadromous and resident salmonids.

17. Identify specific cover/forage needs for deer and elk.

18. Develop information for modeling predictive capability regarding the location of prehistoric cultural resources.

19. Refine information regarding the location of mineral and energy related resources, and probabilities of development.

Social-Economic Analysis - Additional studies are needed to increase our understanding of the economic and social effects of many planned wildland activities.

1. Evaluate the social and economic impacts of various alternative harvest plans and the aggregate implications of the harvest plans for larger areas.

2. Assess the tangible and intangible factors affecting carrying capacity for wilderness and other recreation settings, to determine the practical maximum capacities.

3. Evaluate user need and expectations for recreation opportunities.

Wildland-Community Relations - The relations and interactions between wildlands and the human communities within and near them need to be better understood.

1. Determine potential effects of increased human densities in and near the Forest on recreational use, water quality, T&E species protection, timing and location of harvest activities, road construction and use, cultural resource protection, etc., and develop strategies to respond to these relationships.

Additional sources

Other sources of questions in need of further study include:

1. A long list of questions related to mushroom harvesting is included in "Commercial Harvest of Edible Ectomycorrhizal Fungus Sporocarps from Pacific Northwestern Forest: Ecological and Management Implications" by R. Molina, M. Amaranthus, D. Pilz, and C. Fischer (1994).

2. A 24 page list of stand-level information needs was produced as a New Perspectives initiative in August 1990 by a Pacific Northwest Research Station Team (D. DeBell, C. Harrington, and M.Raphael).

3. The Research Working Group of the Interim Interagency Implementation Team produced a broad strategic plan for research in the region, dated January 31, 1994. Appendix 4 contains a review of research needs identified through analysis of the FEMAT report.

These reports are available for review from the author.

Appendix C - Research Needs Identified by the Research Work Group, Interagency Implementation Team (January, 31 1994)

The following pages contain an abridged version of Research Needs as identified in the Research Plan to Support Implementation of Ecosystem Management. An Interagency Research Work Group developed a research plan for the region following release of the FEMAT report (final report is dated January 31, 1994). This report contains the most current regional view of research needs. The Research Needs section was excerpted from the main body of the report for this appendix. Although some detail was omitted, and some changes in formatting were made, no changes in wording or substance occurred. Contact the author for copies of the entire report, if desired.

RESEARCH PLAN TO SUPPORT IMPLEMENTATION OF ECOSYSTEM MANAGEMENT

Report of the Research Work Group
Interagency Implementation Team

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EXECUTIVE SUMMARY

The Research Work Group was established by the Interagency Implementation Team to develop a research plan to help organize and guide research for implementation of the option eventually selected for the President's Forest Plan. This research plan is a first step for ensuring that research responds to the needs of adaptive ecosystem management and that a dynamic process is established for continuing long-term research response. The research plan describes a broad framework of ecosystem management research that reflects input from resource managers and others; briefly describes current and planned research of many of the organizations that do ecosystem management research; and proposes a long-term process to coordinate and integrate research results.

The plan represents a fundamental change in how research and management communities interact throughout the adaptive ecosystem management process. The research plan will facilitate broadening the context in which adaptive management is carried out—a context that includes biological, physical, chemical, social, cultural, and economic perspectives; promotes integration of knowledge and timely transfer of information to resource managers; and defines new research needed to foster further integration.

This report is divided into the following sections:

Introduction - Outlines the reasons for undertaking this effort, its objectives, procedures used to accomplish the objectives, and limitations of this assessment.

Research Needs Assessment - Describes the research-needs agenda as determined from (1) existing agency research plans, (2) responses to a questionnaire mailed to resource management agencies and organizations, and (3) a detailed review of the FEMAT Report.

Current Status of Ecosystem Management Research - Provides a summary of results from other questionnaires sent to research organizations.

Research and Monitoring Committee Proposal - Recommends a permanently staffed committee to respond to present and future research needs identified in this plan.

Conclusions - Presents concluding remarks.

References

Appendices - Contain the questionnaires used in the assessment; research needs and issues identified in a detailed analysis of the FEMAT Report; and a summary of missions and objectives of research organizations in the region that responded to a questionnaire.

RESEARCH NEEDS

Major Research Categories

The FEMAT effort resulted in two important major research emphases. One centers on long-term ecosystem research at landscape scales, focusing on ecosystem dynamics, restoration, and low-impact management practices. The other research emphasis is to build better understanding of basic social, economic, and community processes and the way these processes link to natural resource policy, management practices, and transition strategies for communities within a local as well as global context.

Taking the next step, we recognized the complexities of understanding, implementing, and sustaining ecosystem management. For simplification, we organized the research plan into six broad research categories that need to be addressed over the next 5 to 10 years to implement ecosystem management. The categories closely follow recommendations in the FEMAT Report (1993):

A. Understanding Ecosystems

B. Evaluating Alternative Management Strategies

C. Economic and Social Dimensions of Cultural and Natural Resources

D. Monitoring and Inventory Systems

E. Decision Support for the Adaptive Management Process

F. Synthesis Framework

Research needs for monitoring and inventory and the adaptive management process are classified in this research plan to facilitate integration with those respective work groups. To help focus information needs, we have specified the spatial scales where greater understanding is needed (as identified by analysis of the questionnaires sent to resource management organizations and other work groups). As emphasized above, the scales that might suffice for abiotic of biotic research objectives may not work for questions of human and community interest. Although separate sections are presented for ecosystem and for economic and social research needs, we want to emphasize that social and economic studies must be integrated with biological, physical, and chemical research if ecosystem management is to be successful.

<u>Results from Managers Questionnaire</u>

Forty-four questionnaires were returned by January 21, 1994, a 56% response rate. Following each topic statement, we indicate, in brackets, the spatial scales for which at least 20 percent of the respondents interested in the particular topic wanted research information (region, province, watershed, site). We arbitrarily chose the 20-percent level to provide focus. Otherwise, all scales would have been indicated for all topics. Also, we asked the managers to identify the importance of the various research topics by indicating the emphasis—low, medium, or high—they believed each should receive. The average emphasis that managers believe various research topic should receive are shown in the Research Framework below in parentheses as: H (high emphasis); M (medium emphasis) and L (low emphasis). Remember that this represents the views of those who received and subsequently replied to the resource-manager questionnaire (Appendices 1 and 3).

<u>Research Framework</u>

A. Understanding Ecosystems

Although existing knowledge may be sufficient at some scale(s), understanding needed to sustain ecosystems, protect habitat, and provide multiple forest values is incomplete. Research is needed to answer fundamental questions, develop standards and measures, and evaluate species and habitat requirements. In each of these three categories, present knowledge provides a foundation for planning ecosystem management research that will address relevant future issues.

Fundamental ecosystem research:

1. Classification and definition of ecosystems at each scale and refinement and extension of current terms and glossaries. [region, province, watershed, site] (M)

2. Synthesis of what is known and what is being learned about biological, physical, and chemical components of the defined ecosystems. [region, province, watershed] (H)

3. Biological, physical, chemical, and social requirements for ecosystem sustainability, resilience, and integrity. [region, province, watershed] (H)

4. Basic ecological processes controlling ecosystem structure, function, health, long-term productivity, and response to disturbance in forest ecosystems and areas adjacent to or influenced by forest ecosystems (including Indian reservations and ceded lands). [region, province] (H)

5. Climatic and air quality influences on ecosystem function. [region, province] (L)

6. Natural and human-caused factors affecting water quality and aquatic systems in forest, shrubland, and grassland environments. [province, watershed, site] (M)

7. Characterization of biological diversity within, between, and beyond the level of individual species. [region, province, watershed] (M)

8. Enhanced models of succession. [province, watershed] (L)

Measurement techniques:

9. Indices and measures of landscape characteristics, distribution, abundance, and spatial heterogeneity, including indices for measuring characteristics of areas adjacent to forest ecosystems and how those areas influence forest ecosystems. [province, watershed] (M)

10. Processes for validating remotely sensed data and generalizations of landscape characteristics from such data. [province, watershed] (M)

11. Structural development of vegetative cover by defined measures (e.g., leaf-area index, productivity). [province, watershed, site] (L)

12. Sustainability indices for ecosystems. [province, watershed] (H)

13. Improvement of species viability assessments. [region, province] (H)

Species and their habitat requirements:

14. Habitat requirements and other life history information, distribution, and utilization for plant (including fungi), animal, and fish species. Include species that exist on special habitats such as in downed logs or on rock outcrops. [province, watershed, site] (H)

15. Ecology, biology, and physiology of key insects, pathogens, and soil microbes to develop food-web dependencies on fungal productivity and influences of disturbance. [province, watershed, site] (L)

16. Propagation, distribution, abundance, sustainability, and utilization of native and introduced non-traditional forest products; impacts of their harvest on forest ecosystems, including aquatic systems. [province, watershed, site] (L)

17. Direct, indirect, and cumulative effects of land-use activities and human population growth on ecosystem function. [region, province, watershed] (H)

18. Ecology, basic biology, and physiology of key aquatic organisms that affect aquatic-system vitality and sustainability. [province, watershed] (H)

19. Identification of species at risk. [not included in questionnaire]

B. Evaluating Alternative Management Strategies

The FEMAT Report calls for an adaptive management process in which the effectiveness of decisions is continually evaluated and management programs altered accordingly. Management decisions, by necessity, must often be based on incomplete knowledge and assumptions that have not been fully tested. Thus, research is needed to assess the validity of these underlying assumptions, to evaluate the ecological consequences of alternative management strategies and techniques, and to identify new and better management options. Adaptive management areas have been proposed specifically to assess and evaluate alternative management approaches. Information needs relating to alternative management strategies fall within six sub-categories.

Refinement of a regional conservation strategy to sustain the biological and physical capacity of ecosystems:

1. Systematic procedures and measurable goals for updating, expanding, and evaluating the FEMAT regional conservation strategy to protect aquatic and terrestrial species and habitats as our databases and understanding of the principles of ecosystem sustainability improve. [region, province] (M)

2. Methods and procedures for more effective management of gene resources. [region, province] (L)

3. Standards and guidelines for managing landscapes at multiple scales for stated desired future conditions, which translate the broad goals and prescriptions defined by a regional conservation plan into specific targets, procedures, and measurements of success (e.g., thresholds or criteria for aquatic ecosystem protection). [region, province, watershed] (H)

Interactions between natural and human disturbances:

4. Extent to which management practices can and should be used to mimic scale, distribution, intensity, duration, and frequency of historical disturbances. [province, watershed] (H)

5. Methods to enhance or maintain terrestrial and aquatic ecosystem health and resource values through management of disturbances. [province, watershed, site] (H)

6. Characterization of the differences between types of major disturbances. [province, watershed] (L)

Ecological effects of specific management practices and land management policies:

7. Effectiveness of interim and adjusted riparian reserves for achieving riparian habitat conservation strategy objectives. [province, watershed] (H)

8. Effects of land management activities on basin hydrology and water quality during major storms and under rain-on-snow conditions. [province, watershed] (M)

9. Effects of different silvicultural regimes on long-term ecosystem health and productivity, and specifically the role of (and interactions among) forest genetics, soils, animals, nutrients, and wood quality objectives as factors influencing ecosystem responses to different silvicultural regimes. [province, watershed, site] (H)

10. Innovative harvesting systems designed to address removal of forest products consistent with emerging standards and guides including reduced roads, overstory retention, and sophisticated commercial thinning regimes. [region, watershed, site] (M)

Ecological restoration and enhancement techniques:

11. Restoration activities such as silvicultural options to: create or restore plant (including fungi), wildlife, and fisheries habitat; enhance riparian areas; and accelerate production of late-successional forest characteristics. [province, watershed, site] (H)

12. Riparian, wetlands, and other special habitat restoration and management systems designed and evaluated in terms of biological and economic benefits that are consistent with fisheries and water quality protection requirements. Include how these factors impact forest ecosystem functions. [province, watershed, site] (H)

Predictive tools for estimating future and long-term effects of alternative management practices and strategies on ecosystem health and productivity:

13. Methods and models to predict forest commodity yields under various forest management practices. [region, province, watershed] (L)

14. Methods and models to predict terrestrial and aquatic species occurrence, distribution, and habitat condition in response to anticipated forest land use and management. [province, watershed] (H)

Specific management guidelines:

15. Innovative management programs designed to ensure habitat protection while producing additional multiple forest values. [province, watershed] (M)

C. Economic and Social Dimensions of Cultural and Natural Resources

Research and development must be planned and conducted to improve understanding of societal values, desires, and needs related to cultural and natural resources. The shift in management emphasis from stands to ecosystems is accompanied by the need to reframe social and economic research and development that has traditionally been done at the stand and forest level. Reframing needs range from conceptual issues such as how different components interact within a landscape, to methods that evaluate the value of the bundle of goods and services produced by a specified ecosystem. There is a need to identify the linkages between natural resources and local communities with emphasis on rural resource dependent economies. Such an understanding could be the basis for methods to predict structural change and dynamic adjustment in local and regional economies that follow major changes in resource output levels.

1. Methods, techniques, and information about resource management choices relevant to easing the change in the economic and social life of rural, resource-dependent communities, sets of communities, Indian tribes, families, and individuals. [region, province] (M)

2. Assessments of the expectations society has for forest lands and the associated values and political, legal, and social problems and opportunities, and monitoring techniques to evaluate how well expectations are being met. [region, province] (M)

3. Economic and social values of ecosystem components, systems, and processes. [region, province] (M)

4. Economic and sociological determination of how perception of risk to resources and ecosystem sustainability from insects, disease, fire, Endangered Species Act listings, and the like affects societal and cultural values and preferences. [region, province] (M)

5. Assessment of social and economic costs, benefits, risks, efforts, and tradeoffs associated with alternative management approaches and rates of investment in ecosystem management. [region, province, watershed] (H)

6. Relationships between resource use or conservation, the urban and rural economy, and social development policies and opportunities. [region, province] (L)

7. Management, harvesting, and marketing strategies for native and introduced non-traditional forest products. [region, province] (L)

8. New frameworks to assess regional issues of timber, recreation, and salmonid fisheries supply and demand, and links with national and international resources. [region, province] (M)

9. Procedures to consider and compare mixes of commodities and nonmarket values in planning alternative landscape designs and alternative investment futures. [region, province, watershed] (M)

10. Resources and methods to facilitate incorporation of diverse social and cultural/cultural resource values in resource planning and decision-making. [region, province, watershed] (M)

D. Monitoring and Inventory Systems

Inventory and monitoring are key components of adaptive management and are needed to successfully track and evaluate progress toward achieving the goals of ecosystem management. Without accurate inventories of existing resources at the time of a management action and scientifically credible monitoring following a land management action, the information needed to practice adaptive management will not be available. To be successful, these programs also must make use of accepted ecological indicators and follow statistically valid designs for assessing baseline condition and trends in ecosystem and species health at multiple scales.

The SAT (1993) concluded that research and monitoring were extremely important to identify critical resource management questions for (1) species or standards and guidelines used in management, (2) describing appropriate inventory standards and protocols, and (3) identifying and coordinating interactions between monitoring and research programs. They also emphasized the importance of research and monitoring to describe how variations in inventory standards will result in varying levels of reliability in estimates of population status or trends in habitat condition. Research is needed to develop and apply new monitoring and inventory technology.

1. Cost-effective, multivalue, multiresource, and multiorganizational resource inventory and monitoring systems for use in adaptive ecosystem management. [region, province, watershed] (H)

2. Assessment of existing integrated programs to monitor ecological conditions and trends. [region, province, watershed] (M)

3. Remote sensing systems for landscape assessments. [region, province, watershed] (M)

4. Ecological indicators and statistical designs for assessing baseline conditions and trends in ecosystem and species health. [province, watershed] (H)

E. Decision Support for the Adaptive Management Process.

Decision-support systems are designed to manage information necessary for decision-making. They present information that provides decision makers with the maximum available knowledge about the conditions under which specific decisions must be made. Within the context of ecosystem management, decision-support systems and related analysis methods would facilitate setting priorities, assessing risks, and refining management options. This should be done at all spatial scales and from both socioeconomic and ecological standpoints.

1. A process for decision making—the kinds of decisions that need to be made, who should participate in making those decisions, and how they should be made. [region, province, watershed, site] (L)

2. Methods for better incorporation of ecological knowledge into the decision process and decision support systems. [region, province, watershed] (H)

3. Methods for integrating social and cultural resource values and knowledge in the decision process and decision-support systems. [region, province, watershed] (M)

4. Decision-support tools to determine when and where to apply technology and practices designed to protect and enhance forest health and productivity. [region, province, watershed] (M)

5. Statistical methods and other design and analysis procedures appropriate for experimentation, monitoring, and decision-making to implement adaptive management. [region, province, watershed] (M)

6. Technology for supplying resource information to support complex management and policy decisions. [region, province, watershed] (L)

7. Methodologies for risk assessments specific to the array of forest and land conditions (including riparian and wetland areas). [region, province, watershed] (H)

8. Methodologies for assessment of options for protection and restoration of at-risk terrestrial and aquatic populations and species. [region, province, watershed] (H)

9. Extrapolation techniques—applying results for similar areas and at larger scales. [region, province, watershed] (L)

F. Synthesis Framework

A framework is needed to merge biological, physical, sociological, economic, and cultural aspects of ecosystem management. Such a framework would need to provide for variable analysis including national and global scales. (This section was developed through the review process and from responses to the questionnaire. Therefore, there were also no emphasis or geographic scale assessments made).

1. Develop explicit models for ecosystem outputs that show the effects of joint production of multiple ecosystem resources (i.e., timber, mushrooms, late seral stages, carbon storage, etc.).

2. Develop a systems view of a forest ecosystem's biophysical and societal processes to explore future management strategies.

3. Develop methods that can provide ordinal measures for alternative levels of ecosystem management.

4. Characterize uncertainty, hazard, and future risks to determine the most and least robust of alternatives.

5. Develop methodologies to evaluate the full range of values for various goods, services, and ecosystem conditions that society expects from ecosystem management.

6. Develop methods, policy, regulations, and incentives to integrate all landowners, including Indian tribes, which have retained legal rights, into total ecosystem management.

7. Develop methods to assess long-range alternative demand scenarios for forest products and alternative supply scenarios (aluminum in buildings, increased wood harvest from alternative areas, etc.)

8. Develop methods to determine changes in global resources resulting from decisions made on Pacific Northwest ecosystems. The models could include such items as global climate change, potential desertification resulting from increased timber harvest outside the Pacific Northwest, changes in the balance of trade, etc.

9. Develop appropriate techniques to ensure that tradeoffs include all externalities and are not limited in scope to regional boundaries.

<u>Critical FEMAT Research Elements</u>

From the review of specific research needs in the FEMAT Report (1993) (appendix 4), we identified ten research topics as particularly important to support implementation of the President's Forest Plan. These are not necessarily the ten most important elements nor the only ones necessary to study. Each of the ten elements is identified in two ways: (1) with a Roman numeral referring to the FEMAT section where it originated and (2) with a letter designation referring to where it fits in the research framework used in this report. This step was taken to ensure that all the most critical research topics are covered in this research plan. The elements are described more fully in appendix 4.

1. Corridors: How are corridors used and what corridor attributes are important? [II; A, B]

2. Habitat condition: What are the effects on species population dynamics? [II; A breeding pairs] [II; A nest sites, late-successional cover] [IV; A, D viability]

3. Salvage: What are the tradeoffs between product and ecological process? [II, IV; A, B]

4. Viability on Federal lands: To what extent can conservation management on Federal lands bear the brunt of ecosystem viability? [II; A, F]

5. Key species management: Will habitat for owls, salmon, murrelets, and threatened plants also be sufficient for all other species associated with late-successional forests? [III; A, B]

6. Disturbances: What are the attributes and processes of disturbances, and what management regimes capture their values and benefits? Where disturbances have been harmful, what are appropriate strategies and treatments for restoration? [IV and V; A, B]

7. Late-successional attributes: Is it possible to accelerate development of these conditions in second-growth forests through silvicultural methods? What treatments are necessary to retain or re-establish late-successional characteristics in mature or old-growth stands? [IV; B]

8. Riparian buffer zones: How do different widths and extents of riparian reserves provide key ecosystem functions to aquatic ecosystems and watersheds? [V; B]

9. Tourism jobs replacing lost jobs: What demand, what tradeoffs, how many? [VI; C]

10. Rural community assessment: Does the approach used provide the framework for more comprehensive assessments? [VII; C]

Appendix D - Description of Adaptive Management, Forest Service Washington Office, Ecosystem Management Group (January 1995) - DRAFT

PLANNING AND DECISION MAKING - ADAPTIVE MANAGEMENT

A formal process of adaptive management will be required to maximize the benefits of any option for land and natural resource management and to achieve the long-term objective of ecosystem management. The process itself is straightforward and simple: new information is identified, evaluated, and a determination is made whether to adjust strategy or goals. Adaptive management is a continuing process of action-based planning, monitoring, researching and adjusting with the objective of improving the implementation and achieving the desired goals and outcomes (ROD 1994). The general planning model illustrated in Figure 1 illustrates the adaptive approach to management (FEMAT 1993). This approach (Walters and Holling 1990) provides a basis for immediate implementation of ecosystem management. In this process goals and objectives are clearly stated, an initial hypothesis of ecosystem behavior is described, and monitoring is conducted to provide rapid feedback for redirection of management experiments.

In an adaptive management approach, Walters and Holling (1990) offer challenges for justifying and designing experimental management programs. These are:

1. To demonstrate that a substantial, deliberate change in policy should even be considered, given the alternative of pretending certainty and waiting for nature to expose any gaps in understanding.

2. To expose uncertainties (in the form of alternative working hypotheses) and management decision choices in a format that will promote both intelligent choice and a search for imaginative and safe experimental options, by using tools of statistical decision analysis.

3. To identify experimental designs that distinguish clearly between localized and large-scale effects, and hence, make the best possible use of opportunities for replication and comparison.

4. To develop designs that will permit unambiguous assessment of transient responses to policy changes, in the face of uncontrolled environmental factors that may affect treated and reference experimental units differently.

5. To develop imaginative ways to set priorities for investments in research, management, and monitoring, and for design of institutional arrangements that will be in place for long enough to measure large-scale responses that may take several decades to unfold.

While the concept of adaptive management is relatively straightforward, applying it to complex management strategies requires answers to several critical questions (ROD 1994). What new information should compel an adjustment to the management strategy? What threshold should trigger this adjustment? Who decides when and how to make adjustments? What are the definitions and thresholds of acceptable results? Adaptive ecosystem management depends on an continually evolving understanding of cause-and-effect relationships in both biological and social systems (Everett et al. 1994). The key features in an adaptive approach are (McConnaha, personal communication):

1. An experimental design for implementation—Adaptive management demands taking a rigorous scientific approach to management. Holling (1978) noted that the "heart of adaptive environmental management" is "an interactive process using techniques that not only reduce uncertainty but also benefit from it. The goal is to develop more resilient policies." Holling (1978) recommended that in an adaptive management context "environmental dimensions should be introduced at the very beginning of the development, or policy design process, and should be integrated as equal partners with economic and social considerations, so that the design can benefit from, and even enhance, natural forces." Experiments designed to produce information should be an integral part of the actual management activities. Managers and scientists can learn from changes over time. This can only be effective if monitoring and evaluation procedures are an integral part of the original design and incorporated at the beginning of the process and not simply added post hoc after implementation (Holling 1978).

2. An explicit description of the system—In order to answer critical questions related to resource management, there is a need to understand the current ecological conditions of ecosystems of interest, changes in the ecosystem components over time, and the likely ecological trends within the ecosystems. That is, we need to know where we are today, how we got here, and what the future scenarios are likely to be under different management regimes. Therefore, it is necessary to develop scale relevant assessments to put the social, biological, chemical, and physical components of the management area for which we have stewardship into the larger ecological context.

3. Well defined goals and objectives—The planning process, a collaborative and cooperative approach, uses the assessment to assign values to the current condition and describes the "desired future ecological condition" of the resources. Public ownership in this process is critical to the future success of implementation. An inappropriate decision is likely to occur without widespread understanding, acceptance, and support for the desired future condition.

Goals and objectives provide the guidance for managing towards the agreed upon desired future ecological condition. An overarching goal explicit in taking an ecological approach to management is that of sustaining ecosystems. Two working hypotheses formulated by Everett et al. (1994) are: (1) Human values and expectations can be incorporated into ecosystem management by identifying landscape patterns that are representative of these values, and (2) sustainable ecosystems can be achieved by integrating people's expectations with the ecological capacities of ecosystems.

4. Identification of critical uncertainties—Because there is no such thing as perfect information, there is always a level of uncertainty in any decision. The concept of adaptive management acknowledges the need to manage resources under circumstances that contain varying degrees of uncertainty, and the need to adjust to new information (ROD 1994). Even the best decisions may have unacceptable outcomes. To reduce the level and impact of unacceptable outcomes the decision-maker needs to focus on critical uncertainties. Obtaining the best information on these uncertainties and designing a monitoring and evaluation process to track decisions is therefore an essential step in the process. Holling (1978) notes that "some systems are inherently more capable than others of absorbing insults and changes without losing their integrity." He describes an "axiom that underlies any design for uncertainty ... There exists a serious trade-off between designs aimed at preventing failure and designs that respond and survive when that failure does occur." It's the latter that needs to be incorporated into an adaptive approach.

5. A monitoring and evaluation program -- What new information should trigger an adjustment of strategy or direction? New information can come from monitoring, statutory or regulatory changes, organizational or process assessments, or a variety of other sources (ROD 1994). There are two distinct phases in a monitoring and evaluation program. The first phase, traditionally, monitors and evaluates the consequences of our management actions. It constantly measures our progress towards our stated desired future ecological condition and provides for mitigation when our actions steer off course. During the evaluation process, information is analyzed to determine the nature, scope, and importance of that information (ROD 1994). Adaptive management depends on both negative and positive feedback in the reiterative evaluation of both the continued desirability of previously selected management goals and progress toward their achievement (Everett et al. 1994).

The second, and less traditional, phase monitors and evaluates social needs in relation to changing societal values and settings. Here social values and needs are constantly assessed in relation to the validity of the desired future ecological condition. Societal values often change more rapidly than ecological condition. Also, in this second phase, unexpected change in the ecosystem may significantly deflect our trajectory towards the desired future ecological condition. In this case the supply of goods and services may be disrupted and ecological restoration may become an immediate need. Lastly, in phase two, technology transfer of new knowledge is formally incorporated into the adaptive management system. Previous assumptions are validated or modified. This is where research and management join to ensure that best science is incorporated into the adaptive management process.

Monitoring and evaluation leads to a trigger which can have three consequences. If the impacts detected during monitoring and evaluation are of little significance, then the management regime can be adjusted without adjusting the long-term plan. If, however, the impacts are significant the plan will need to be revised. This can be done directly or, if needed, by modifying the assessment to bring it into line with new knowledge, changed social values, impacted environments, etc...

6. An aggressive approach to learning—As noted above the less traditional approach to monitoring and evaluation requires active learning in all aspects of ecosystem management. Resource managers, scientists, and the general public must learn more about the social, biological, and physical attributes of ecosystems and adapt more quickly to new knowledge. Technology transfer must be an inherent and valued part of ecosystem management.

7. An adaptable structure—Lastly, the adaptive management structure itself must be inherently adaptive. This includes the organization responsible for implementing the process. The key element in this flexibility is the development of a management system that operates strategically and not functionally. This system emphasizes functional skills and eliminates functional organizational barriers.

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