Preface

Ecosystem management aligns different uses of the land with ecological parameters and goals of environmental quality. An important USDA Forest Service mission is to balance the multiple uses of its lands in an ecologically sustainable way. This objective has been particularly challenging for National Forests of the Sierra Nevada in the face of heated controversies over the effects of even-aged timber harvest on old-growth forests and their associated wildlife, such as the California spotted owl (*Strix occidentalis occidentalis*). Much of the concern stems from loss of habitat attributes—closed-canopied stands, very old trees, large snags and downed wood, and multiple structural layers—believed to be needed by the owl and other wildlife species. Several of these attributes are also believed to be vital for sustaining healthy, productive forests.

The Kings River Sustainable Forest Ecosystems Project involves a formal administrative study and associated research, with joint leadership and collaboration among line officers and staff of the Sierra National Forest, the Kings River Ranger District, and the Pacific Southwest Research Station (PSW). District personnel are implementing two landscape-level management options, at watershed scales, while researchers study the effects of those options on various forest resources and values. Persons involved with the project are optimistic that both options, with minimal "zonation" for special needs, will sustain all key resources (soil, water, vegetation, and wildlife) and functions of the ecosystems involved, while reducing risks of catastrophic fire, restoring fire as a forest ecosystem process, promoting forest health, allowing sustainable levels of commodity extraction, and supporting recreational use by the public.

On January 13, 1993, the Forest Service's Pacific Southwest Region released the Decision Notice for an Environmental Assessment (EA) that provided interim guidelines largely driven by concerns for the California spotted owl. Effective March 1, 1993, this EA amended the Land and Resource Management Plans for all National Forests of the Sierra Nevada that have spotted owls, markedly changing options for forest management in these National Forests for an interim period of 2 years, not only for the owl but also for many other resources and values as well. In response to this new direction, and with encouragement from the Pacific Southwest Region to initiate an administrative study in ecosystem management, a small group of managers and scientists from the Sierra National Forest and the Pacific Southwest Research Station's Forestry Sciences Laboratory in Fresno, California, met in mid-February, 1993, to discuss opportunities. A coordinating group with members from the Forest, the District, and laboratory was formed after this meeting. This group continued to meet over the next few weeks and soon agreed on the basic features of a study plan that eventually developed into the Kings River Sustainable Forest Ecosystems Project.

Objectives of the Project include implementation of timber harvest that will maintain key attributes of late successional forest, provide for wildlife species that are closely associated with them, and deal with the growing threats of extensive and intensive wildfires as a result of heavy accumulations of surface and ladder fuels during the past century. Planning for the Project focused on a study area encompassing 64,000 acres and two major watersheds on the Kings River District of the Sierra National Forest. A prescribed burning program was already underway in the project area; and a demographic study of the spotted owl, begun in 1990, already encompassed most of the area. The scope of this owl study was enlarged in 1994 to cover the entire project area. Other studies were initiated in 1994 and 1995, and the first vegetation treatments were initiated in 1997. Results of these efforts are beginning to come in.

These proceedings comprise an interim report on the various management actions and research studies underway in the project area. Some projects and

studies have been completed, some are still in progress, and others have yet to begin. The paper by Verner and Smith provides an overview of the inception, objectives, and progress of the overall project; and Fleenor's paper describes the development of the Landscape Analysis Plan required to undertake the project. The plan and current updates can be viewed on the internet at www.r5.fs.fed.us/sierra/kras. Progress and lessons learned in the implementation of an uneven-aged strategy for forest management are described by Smith and Exline, and McCandliss reports on methods and progress in the program of prescribed burning. By September of 2001, prescribed fire had been applied to approximately 15,000 acres in the project area, including some Protected Activity Centers of the California spotted owl. Data on historic fire-return intervals within the project area are presented in the report by Phillips, and Gallegos reports on watershed analyses.

The paper by Powers details the effects of certain management activities on soil properties. Findings accumulating through this study may lead to improved soil-based standards of sustainable forestry. An experiment involving innovative methods of fuel reduction was established in 2000 as part of planned fuel break operations in mixed-conifer sawtimber on the Sierra National Forest near Shaver Lake. The aim is to evaluate alternative methods of reducing understory fuels on soil properties and the organic carbon cycle. Treatments range from a "do-nothing" control, through mechanical mastication, to incorporating masticated residues into surface soil. Experience from this helped to secure competitive grant funding to extend this study to a broader geographic base at the forest/urban interface. Two new installations have been established in northern California on Federal and private holdings, and more are planned for 2002.

The Teakettle Experiment (http://teakettle.ucdavis.edu) described by North is particularly complex and involves a rigorous experimental design. All thinning treatments were completed by August, 200l, and the prescribed burn was completed in November of 2001. All of the Teakettle studies have collected 2-3 years of pretreatment data at mapped sample points, and researchers began collecting response data in May, 2002, at these sample points to assess immediate effects of fire and thinning treatments on different ecosystem functions. The Experiment now includes 27 studies, 17 institutions, and funding from 20 different sources. Some of the new studies include the use of isotope ecology to investigate water and nutrient transfer between shrubs and trees, ground-piercing radar to investigate the influence of soil depth on vegetation composition, modeling of ecosystem energy and mass flow with water- and shade-manipulation experiments, and establishing Teakettle as a demonstration site and community outreach for information on fire and thinning efforts to reduce fuels. Several of the associated doctoral students are completing their projects, and new students and research projects have joined the experiment.

Hypogeous (underground) fungi play a key role in the establishment, nutrient uptake, and water uptake of trees in forest ecosystems. Fundamental research on their abundance and species composition, and response to fire, is described in North's paper on truffles and the paper by Bruns and his coauthors.

Three reports—by Munton and others, Steger and others, and North—describe results of various aspects of the general biology, ecology, and demography of the California spotted owl. The demographic work and studies of owl diets are continuing, with conclusions about the status of the owl population in the study area through 2001 essentially unchanged from those described here in the paper by Steger and others.

Purcell describes results of a labor-intensive study of forest songbirds in ponderosa pine (*Pinus ponderosa*), mixed-conifer, red fir (*Abies magnifica*), and lodgepole pine (*Pinus contorta*) forests. With additional years of data since the

symposium, some results of this study have changed, possibly related, at least in part, to annual variation in weather.

The paper by Laudenslayer and Fargo describes a study of small mammal populations and ecology in the project area, and Boroski and others report on research on the fishers (*Martes pennanti*). The fisher population in the study area is especially important, as apparently this medium-sized furbearer has been extirpated from the Sierra Nevada north of Yosemite National Park. Although Dr. Boroski has left the USDA Forest Service, the fisher research is continuing under the direction of Dr. Kathryn Purcell.

Two key studies have been added to the Kings River Project since the symposium: the first involving the use of new development in remote sensing of vegetation, and the second involving an intended long-term study of the effects of forest management actions on stream ecosystems.

A collaborative study, "Forest Structure from Remotely Sensed Imagery," by Dr. Carolyn Hunsaker of the Pacific Southwest Research Station, Dr. JoAnn Fites of Adaptive Management Services in Nevada City, California, and scientists from the University of Michigan, the University of Maryland, and the National Aeronautics and Space Administration (NASA) began with a planning workshop in 1998. Key initial objectives include compiling structural attributes desired by ecologists and proposing actions needed to more effectively measure forest structural attributes across the entire Sierra Nevada. NASA committed to obtain radar and lidar (laser altimetry) data with flights over the Kings River Project area, the Teakettle Experimental Forest, and field study sites in the northern Sierra Nevada. The remotely sensed data will be compared with ground data from 290 1-ha plots in the southern Sierra Nevada and 300 plots in the northern Sierra Nevada to allow calibration of remote-imagery classifiers. Attributes of interest include canopy cover, life-form diversity, large-tree density, tree size distribution, vertical diversity of tree crowns, biomass, crown volume, height to live crown, tree decadence, surface dead material, and moisture content. Development of map products is expected to begin in 2002.

In 2000, under the direction of Dr. Hunsaker of the station's Forestry Sciences Laboratory in Fresno, California, the Kings River Experimental Watershed was added to the Kings River Project to address issues regarding stream systems. This well-funded project is being developed to quantify the variability in attributes of stream ecosystems and their associated watersheds in the southern Sierra Nevada and to evaluate the effects of forest management (prescribed fire and uneven-aged, small-group tree selection) on those ecosystems. Instrumentation of the eight headwater watersheds, in mixed-conifer forest at 5,000 and 7,000 feet in elevation, will be completed by 2002. The study will investigate physical attributes (upland erosion, stream flow, channel characteristics, and weather conditions), chemical characteristics (nutrients, chloride, sulfate, calcium, magnesium, potassium, sodium, pH, electrical conductivity, and acid neutralizing capacity), and biological features (stream invertebrates and possibly algae, along with some riparian and upland vegetation).

The vision of the original coordinating group for the Kings River Sustainable Forest Ecosystems Project was open-ended. Members of the group knew that the process of converting the existing, highly modified forest into an uneven-aged structure by a process of small-group selection would take many years. They also knew that studies of the effects of this conversion on certain ecosystem values and processes, on spotted owls, on fishers, and on certain other resources would take years—even decades. This will require much effort and vigilance to maintain a strong commitment by the USDA Forest Service to continue this project, to maintain adequate funding, and to assure that dedicated personnel are continuously in place.