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Land - Calif.

# SHRUBLANDS IN CALIFORNIA: LITERATURE REVIEW AND RESEARCH NEEDED FOR MANAGEMENT

edited by  
Johannes J. DeVries

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### 13. Summary and Conclusions<sup>1</sup>

J. DeVries and T. Adams<sup>2</sup>

There has been a great deal of research into the problems of management of shrublands in California over the past three or four decades. As attested to by the topics addressed in this document, the problems are many and wide-ranging. The work undertaken here is a coordinated effort to evaluate the current body of knowledge relating to shrubland management: this document evaluates what is currently known and what needs to be studied in the future.

This literature review document was originally intended to deal only with the problem of managing chaparral watersheds. The decision to broaden the subject to include California shrubland vegetation in general was made after the literature review was begun. As a consequence, the primary emphasis in most chapters is on chaparral. In general, however, what applies to chaparral can also be extended to other types of shrublands. Also, there is a major emphasis in this document on fire as the management tool. This is because fire is usually the only practical and economical way to manage shrubland vegetation.

There is currently a high level of interest in shrubland management. One of the strong motivating factors for organizing the work presented here is the fact that removal of shrub-type vegetation from watersheds can dramatically increase water yields. A second factor is, that although fire is a natural feature of shrubland ecology, over the past century complete fire suppression has been a major management objective in most areas in California. This has led to the situation where minor fires can usually be controlled without problems, but if these small blazes get out of control, the areas affected by the fire can become extremely large because fire suppression causes large amounts of fuel to accumulate. The economic and environmental consequences of these very large fires are many times greater than the combined effects of many small fires. A third factor is that a prescribed burning program, the California Department of Forestry's Vegetation Management Program, has been initiated to address the shrubland fire hazard. Through this program, the state assists landowners in management of shrublands for several specifically identified values including fire hazard reduction, water yield benefits, wildlife habitat improvement, fisheries habitat improvement, air quality protection and improvement, and range forage improvement. There is as a consequence a need for an expanded information base to support development of strategies that will permit more effective integration of watershed management objectives with fire.

<sup>1</sup>Chapter 13 in *Shrublands in California: Literature Review and Research Needed for Management*, Water Resources Center, Contribution No. 191, University of California, Davis, November 1984.

<sup>2</sup>Acting Assistant Director, Water Resources Center and Extension Wildlands Specialist, Agronomy and Range Science, respectively, University of California, Davis.

Abstract: This chapter provides a short summary of the material presented in this literature review document. Major factors which cause the current high interest in shrubland management include the following: 1) removal of shrub-type vegetation from watersheds can dramatically increase water yields, 2) suppression of fire has led to the situation where small blazes which get out of control produce fires which can become extremely large and produce great economic and environmental consequences, and 3) a prescribed burning program has been initiated by the the California Department of Forestry to address the shrubland fire hazard problem and to assist in management of shrublands for fire hazard reduction, water yield benefits, wildlife habitat improvement, fisheries habitat improvement, air quality protection and improvement, and range forage improvement. An expanded management program is needed and methods of accomplishing a successful management program are discussed.

This literature review presents a general treatment of management procedures and a description of the biogeography and prehistory of shrublands in the initial chapters. The effects of shrubland management (with emphasis on the use of fire) are presented next, starting with the effects on vegetation, then moving to the effects of fire on soils, effects on water yield and water quality, and effects on streams (with particular emphasis on the organisms that live in the streams) and on wildlife. A chapter on shrubland ecosystem dynamics permits the subjects discussed in the initial chapters to be considered from the perspective of how they relate to each other in the shrubland ecosystem.

The final chapters in this literature review document deal primarily with management concerns. These include management of shrublands for livestock forage, the effects of burning on air quality, the economics and policy of shrubland management, and fire behavior and burning technology.

#### STATE OF KNOWLEDGE OF MANAGEMENT PROCEDURES AND RESEARCH NEEDS

This report provides a description of the current state of knowledge concerning shrubland watershed management in California and the social and environmental effects of such management. Each of the chapters contains an extensive list of references which will allow the reader to undertake further investigation into the published literature on the subject. This should be a valuable source document for government agencies involved with shrubland management, as well as to the researchers who are interested in developing further knowledge on the various subjects. The publication of a detailed bibliography on chaparral and the fire ecology of other mediterranean ecosystems (Keeley, 1984) was also supported by this project. This extensive bibliography has about 3000 citations. It provides a valuable supplement to the lists of references provided in this document.

Each of the chapters in this report contain a list of research needs as identified by the chapter authors. Additional work in establishing priorities for these research topics using these needs and other factors as a starting point has been recently done (Callahan 1984). This work is being coordinated through the Wildland Resources Center of the University of California at Berkeley. A workshop was conducted at which an outline of a research, development, and extension (RD&E) program was produced by a group of



watershed managers and researchers. This outline provides a framework for the organization of a program aimed at solving shrubland management problems. Such an effort is no minor undertaking. An RD&E program just to solve the critical and urgent problems facing shrubland watershed managers requires doubling or tripling the current RD&E funding levels. A truly effective program would require even greater investments of RD&E funding. Considering the magnitude of the problem, the many and varied values of shrubland resources, as well as the undesirable consequences of improper or poorly understood management practices, an accelerated RD&E program would be a worthwhile public investment for California.

#### MANAGEMENT OBJECTIVES AND ALTERNATIVES

It is generally recognized that the policy of complete fire exclusion has produced (and will continue to produce) major problems in California shrublands. In addition to describing the effects of fire on all aspects of the shrubland systems, this report describes various management alternatives and objectives of management. Rotational prescribed burning is commonly regarded as the most effective management tool. If correctly done it is relatively inexpensive and can be done safely. When properly employed, prescribed burning can be used to create a mosaic of vegetation stands of different ages, a return to the vegetation patterns which existed prior to the current era of suppression. The existence of a mosaic inhibits the development of large-scale wildfires. Not only are the fires less destructive in terms of area affected, but they tend to be less intense. It should be kept in mind that fire is a natural process in shrubland ecosystems; not only is it needed for maintaining natural vegetation processes, but there is also a good deal of evidence that it produces long-term benefits to wildlife populations, even though there may be some deleterious effects in the short-term.

Although prevention of large-scale wildfires is an important need for the entire state of California, there are other shrubland management objectives which also have major economic importance. Two of the most important are the subjects of shrubland management for livestock forage and watershed management for increasing water yield. Because of their importance, these are briefly reviewed here.

#### Shrubland Management for Livestock Forage

Foothill rangelands in California are the most important area in the state for range livestock production. In nearly half of this area herbaceous vegetation is subject to competition by shrubs and brush for nutrients, light, and water. Management programs are needed to prevent brush invasion of these areas to permit their continuing use for range livestock grazing. The California Department of Forestry's Vegetation Management Program discussed above has range forage improvement as one of its goals, and assistance is being provided to land owners for this when other program goals can be achieved as well. As a result of this effort and the management activities by other organizations and by private land owners, an increasing amount of land will be managed through prescribed burning and other techniques in the years to come. Of the research needs that have been stated in Chapter 9, one of the most pressing is to compile information from currently available sources into a single data base that can be used for the assessment of current and future rangeland improvement projects. There is a need as well for computer models to predict the economic and vegetative results of

proposed management techniques which take into account the specific characteristics of individual sites. Evaluation of site potential is needed to optimize the success of future shrubland range improvements, and to insure that these improvements are applied to the most productive and suitable sites, while marginal and poor sites are managed for other purposes.

#### Increasing Water Yield

It has been established that reducing evapotranspiration from vegetation in a watershed can increase the amount of water that is available for streamflow. The basic hydrologic mechanisms of the processes involved are generally understood, and data are available for specific watersheds and specific management procedures. Techniques do not exist however, for applying the existing data base to prediction of effects of long-term management efforts in individual watersheds, taking into account specific responses of the watershed to such variables as fire temperatures, size and season of burn, and variations of conditions within the watershed.

There is a need for models of the hydrologic behavior of watersheds which accurately reflect the response of a basin to changes induced by fire and other management techniques. The models must account for changes in hydrologic processes such as surface runoff, infiltration, and movement of water through the soil in ways that permit the changing response of the basin with time to be analyzed as vegetation is regenerated and changes in character. Hydrologic models are needed to serve as management tools to allow the effects of alternative management techniques to be evaluated, so that the managers can select the most suitable techniques. In combination with the economic models discussed above, the hydrologic models will allow the managers to make the best overall decision for management.

#### CONCLUSIONS

This document is intended to provide the first step in a long-range process to deal with problems associated with management of shrubland watersheds in California. These problems are being grappled with at a wide range of levels within the state. The material provided in this document represents a great deal of effort on the part of a number of dedicated individuals. The individuals involved in the preparation of this document are to be commended for their outstanding contribution. The material presented here makes available for the first time a comprehensive treatment of the subject of shrubland vegetation management, and this alone makes it a valuable contribution. We see this work as the first of a series of guidelines that will be directed to the solution of the problems of managing the very important natural resources of our state.

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