D R A F T R E P O R T

Range & Pasture
Brush Control

California's Shrublands:
A Vast Area in Transition and Need

A P P E N D I C E S

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Appendix B.
Problems and ratings of priority[1] for attention
by a research, development, and extension program
for shrublands in California

Average ratings of priority by Users	Experts	Problem Number	
			Chapter 1 - General Shrubland Management Procedures[2]
3.6	3.9	1-1	Determine optimal rotation intervals and management techniques to maintain desired nutrient status, stand productivity, and vegetative composition
1.9	2.2	1-5	Determine effects of different methods of ignition on recovery after burning
3.7	4.4	1-6	Estimate the environmental impacts of a fire exclusion policy (Graves)[3]
3.5		1-7	Determine environmental importance of using livestock to manage vegetative composition of shrublands
			Chapter 2 - Biogeography and Past and Present Fire Patterns
3.5	4.3	2-1	Compare current, historical, and precontact patterns of burning
2.8	3.0	2-2	Compare contemporary, historical, and precontact distribution of shrublands
			Chapter 3 - Effects of Fire on Shrubland Vegetation
2.9	3.4	3-1	Determine for shrub seeds factors affecting their mobility, storage in soil, and predation
3.4	3.4	3-2	Determine for shrub seeds their requirements for germination and their lethal temperatures at various humidities

[1] For the priority rating scale, see Appendix C, footnote 1.

[2] Chapter numbers and titles are as in "Shrublands in California: Literature and Research Needed for Management." (DeVries, 1984)

[3] Name in parentheses after a problem shows the individual suggesting it.

4.4	4.8	3-3	Determine effects of frequency, season, and intensity of burning on composition of vegetation and survival of shrubs, seeds, and seedlings
4.0	4.7	3-5	Determine the need for and alternatives to use of herbicides (Miles)
3.8	4.4	3-6	Determine effects of season and intensity of burning on sensitive plant species

Chapter 4 - Effects of Fire on Shrubland Soils

Determine the effects of management, especially the effects of fire intensity and duration and season of burning on:

2.9	3.0	4-1	nutrient release and retention, especially nitrogen, phosphorous, potassium, and sulfur
2.8	3.2	4-2	physical properties, such as aggregate stability, particle size distribution, and bulk density
4.4	4.3	4-3	erosion susceptibility and slope stability
1.9	2.0	4-4	nature of organic by-products produced from burning
2.1	2.2	4-5	chemical properties, such as cation exchange capacity
3.1	3.8	4-6	biological population and activity including size, species, number, and distribution
3.5	3.4	4-7	long-term soil loss
2.4	2.2	4-8	Determine the rate of replacement of minerals lost after burning through weathering of minerals and other processes
3.6	2.9	4-9	Complete the inventory of soils and vegetation to provide information on site productivity
2.7	2.0	4-10	Determine extent and seriousness of nonwettable soils following burns on certain soils
3.2	3.4	4-11	Determine the effects of management, especially burning on soil moisture storage capacity and water budget
3.5	4.0	4-12	Determine the effects of management, especially burning on soil organic matter stability

2.9	3.4	4-13	Determine rates of addition of nutrients from atmospheric deposition
2.5	3.2	4-14	Determine spatial variability of processes in shrublands
3.3	3.7	4-15	Develop a site index for shrublands

Chapter 5 - Water Yield and Water Quality from Shrublands

3.8	4	5-4	Determine threshold for fuel load, intensities, and season of burning that changes the impact of fire on amount and timing water yield and sediment production
3.4	4	5-7	Determine how frequency, size, season, and intensity of fires effect the stream channel sediment balance equilibrium
4.5	5	5-8	Determine how frequency, size, season, and intensity of fires can be manipulated to increase water yield without incurring unacceptable penalties in sedimentation and degradation of water quality
2.6	2	5-9	Determine how frequency, size, season, and intensity of fires affect the loss of nutrients and chemistry of water
3.3	4	5-10	Relate season of burning to characteristics of sediment yield in various watershed regions
3.6	4	5-11	Determine how to phase sequential burns, so as to minimize deleterious downstream effects of increased yields of sediment resulting from channel storage
3.6	4	5-13	Determine how to estimate the health of a watershed and its capability to tolerate manipulation of vegetation without major changes downstream
2.6	3	5-14	Understand changes in the long-term geomorphic status of stream channels in shrublands
2.8	3	5-15	Develop a better awareness by the public of high sediment and water flux as a normal and natural part of shrubland watersheds
2.4	2	5-16	Understand the fate downstream and downslope of nutrients released in fires
3.7	4	5-22	Determine the 10-year or longer term impacts, on yields of water and sediment, of conversion from

			shrubs to forest or grassland vegetation types
3.7	4	5-23	Understand effects of manipulating shrublands upon: groundwater and soil-water regimes, baseflow volume, and timing of flow
2.9	3	5-24	Learn how to transfer or adapt existing hydrologic database on fire effects to extreme-value precipitation events and among geomorphic provinces
2.8	3	5-25	Determine for prescribed burns the applicability of data and relations derived from studies after wildfires
4.6	5	5-26	Develop methods for predicting water and sediment yield associated with shrubland watershed management. (Doty)
3.8	4	81-38	Understand processes involved in erosion on steep land, particularly mass-wasting
			Chapter 6 - Instream Effects of Shrubland Vegetation Management
3.7	4.1	6-1	Determine effects of vegetation management on the thermal, chemical, and biological character of stream systems over time
4.4	4.3	6-7	Define relationships between transport and deposition of sediment and stream habitat structures with emphasis on effects of increased water yields as a result of vegetation management
			Chapter 7 - Effects of Shrubland Management on Wildlife
4.0	4.4	7-7	Determine successional patterns and productivity of wildlife communities as affected by season, extent, intensity and spatial pattern of vegetation management in different chaparral communities
3.5	3.6	7-9	ouantify economic benefits of changes in game (deer, quail, etc.) associated with shrubland vegetation management
			Chapter 8 - Shrubland Management for Livestock Forage
3.8	4.3	8-2	Develop optimum livestock management strategies (season of use, grazing systems, type of animal, etc) for different shrublands

3.6	3.6	8-3	Develop ways to use livestock for vegetation manipulation
3.8	4.0	8-7	Determine interactions between wildlife and livestock following shrubland vegetation manipulation (burning etc.)

Chapter 9 - Air resources[4]

3.8	4	9-1	Develop systems necessary to support smoke management decisions. This task would provide mechanisms for making source assessments (meteorological projections and impact analyses) based on the expanding knowledge from research. Priority 1
2.9	3	9-2	Improve our knowledge of emission rates based on fuel consumption, fire behavior, heat release rates, and source control measures. Priority 2
3.5	4	9-5	Continue research that relates emissions and heat release rates to fuelbed characteristics and fire behavior. Priority 1
2.9	3	9-6	Advance our knowledge of the constituents of particulate matter and organic vapors in smoke. Identify hazardous and reactive compounds, relating their genesis to fuel and combustion character. Priority 2
3.0	3	9-7	Develop field methods to monitor emission rates and smoke chemistry from operational fires. Priority 3
3.4	4	9-9	Continue development of winds and dispersion models for boundary layer flow and mesoscale transport of smoke over mountainous terrain. Test models and derive suitable coefficients. Priority 1
2.5	3	9-10	Investigate the mechanisms of removal from the atmosphere for wildland smoke. Examine canopy interactions, fallout, and local deposition. Priority 2
2.8	2	9-16	Develop the necessary simulation models to evaluate interactions of policy with air resource management. Priority 1

[4] Problems with priorities 1-3 are from Sandberg et al., "Effects of Fire on Air: A State of Knowledge Review." USDA Forest Service Gen. Tech. Report WO-9, 1979, 40 p.

3.5	4	9-25	Develop inexpensive instruments and field methods for the collection of meteorological data and its compilation by computers to support planning and smoke management activities
2.8	3	9-26	Develop better analytical methods for measuring the contribution of vegetative combustion to regional visibility reduction
		9-27	Develop a public information program that explains technology and options for smoke management[5]
			Chapter 10 - Shrubland Ecosystem Dynamics
3.6	4.5	10-1	Determine ways in which community composition is shifted by various management practices
4.3	4.6	10-2	Determine effects of changes in composition of vegetation on key ecosystem processes, including flammability, productivity, water use, erosion, nutrient status, and burn characteristics
4.0	4.6	10-3	Determine effects on ecosystems of maintaining mosaics of different aged stands of varying size, including effects on wildlife, vegetation, fire, and erosion
2.9	3.3	10-4	Understand the dynamics of nutrient cycling and uptake of nutrients by riparian communities
			Chapter 11 - Economics and Policy of Shrubland Management
3.0	4.1	11-2	Develop socioeconomic models for decisions about alternatives for management and use of shrublands, including policies, constraints, and benefits in relation to costs
4.2	4.0	11-3	Develop inventories of shrubland resources
3.3		11-4	Develop methods for measuring the value of market and non-market resources
3.8	4.0	11-7	Analyze and create possibilities for cooperative arrangements, between ownerships, different forms of ownerships, jurisdictional authorities and resources of federal, state, and county government units, and probable effects of changes in distributions of these, that are necessary for various

[5] New problem identified but not rated as to priority by users.

			aspects of shrubland management, e.g. the management of fire hazard, water yield, water quality (Romm)
3.7	4.0	11-11	Analyze incentives, such as taxes, insurance, and zoning, to reduce fire and flood impacts within hazardous areas
3.5		11-12	Develop methods for incorporation of risk analysis for decisions about management of shrublands[6]
			Chapter 12 - Fire Behavior and Burn Technology
4.5	5	12-1	Determine how to specify burning conditions and methods to use fire in conjunction with other management practices to accomplish specific objectives in various vegetation types and conditions
4.0	5	12-2	Provide data on the effects of fire over time on various aspects of ecosystems
3.3	4.4	12-3	Understand the mechanisms by which fire brings about observed effects
3.7	4.1	12-4	Model critical upper and lower values for flammability, based on vegetation type and aspect (Haggenmiller)
3.9	4.9	12-5	Develop a program for disseminating information on fire effects, prescribed burning, and fire management (Martin)
4.6	5.0	12-6	Develop fire prescriptions for problems, such as old growth stands, north-facing slopes, urban-wildland interfaces, and areas of mixed ownerships.
			Chapter 81. Utilization of Biomass[7]
3.0	3.2	81-1	Compare energy requirements for processing shrubby biomass to energy derived from such processing
3.8	4.5	81-2	Estimate how much shrubby biomass is available through inventories and determination of suitability of sites for harvesting

[6] New problem identified and rated by users.

[7] Research needs identified at the Symposium on Mediterranean-Type Ecosystems, San Diego, California, 1981.

2.6	3.6	81-3	Clarify the nutrient budgets of shrub species
2.8	3.6	81-4	Gather additional data on biomass production from sprouting, seedling, and mature shrubs
3.3	3.5	81-5	Determine effects of mechanical harvesting on water relations and photosynthesis in shrub species
2.8	3.9	81-6	Determine the processes in shrubs controlling storage of carbohydrates and their availability for sprout growth
3.0	3.2	81-8	Understand influences of site on hardwood biomass within shrublands
2.2	1.7	81-9	Develop volume tables for important hardwoods found in shrublands
3.9	4.6	81-10	Define site conditions that specify present and near-future limits to harvesting, i.e., angle of slope and trafficability of soils
2.7	3.4	81-11	Determine what is usable (i.e., large stems) and unusable (i.e., leaves and fine stems) biomass and provide criteria for inventorying shrubby biomass
4.2	4.9	81-12	Analyze the biologic and economic feasibility of supplying reasonable amounts of shrubby biomass to energy generating facilities
2.4	2.9	81-13	Define reasonable costs, including potential subsidies for wildfire avoidance, for harvesting and processing shrubby biomass
2.8	3.7	81-14	Improve technology for harvesting and processing shrubby biomass
4.1	4.8	81-15	Determine long-term environmental implications, such as vegetative change and movement and loss of soil, resulting from mechanical removal and utilization of shrubby biomass to generate energy
2.5	3.1	81-16	Determine the BTU value per pound of the California hardwoods and brush species for 10, 20, 30, 40, 50 percent moisture (Burton)
2.6	2.6	81-17	Determine the value of charcoal from hardwoods for fuel, water filtration, air filtration, and toxic waste control (Burton)

Appendix C.

Average ratings of priority[1] for attention to 91 shrubland problems by small groups of users.

Problem[2]	Public		Private		Gov't. Agency		County Gov't.		Conserva. Group		Profess. Society		All		Individuals Not Rating
	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	
1-1	3.9	11	4.0	4	3.4	5	3.0	3	4.3	3	3.0	5	3.6	31	1
1-5	2.2	8	1.8	4	1.6	5	1.5	4	2.3	3	2.0	5	1.9	29	3
1-6	4.2	11	3.5	4	4.0	5	2.7	3	4.3	3	3.0	5	3.7	31	1
1-7	3.6	8	4.5	2	2.8	5	3.3	3	4.5	2	2.0	1	3.5	21	11
2-1	3.7	10	3.5	4	3.0	5	4.0	3	4.3	3	2.6	5	3.5	30	2
2-2	3.1	9	3.0	4	2.2	5	2.8	4	4.0	3	2.0	5	2.8	30	2
3-1	3.1	8	3.0	4	2.8	4	2.7	3	3.0	3	2.4	5	2.9	27	5
3-2	3.4	8	3.5	4	3.5	4	3.5	4	3.3	3	2.0	5	3.4	28	4
3-3	4.3	10	4.0	4	4.8	4	3.8	4	4.7	3	5.0	5	4.4	30	2
3-5	4.2	11	3.8	5	4.4	5	4.7	3	4.0	3	3.1	5	4.0	32	2
3-6	3.8	11	3.8	5	4.8	4	4.0	3	4.0	3	2.8	5	3.8	31	3
4-1	3.2	10	2.8	5	2.4	5	3.0	2	3.3	3	2.2	5	2.9	30	4
4-2	3.0	9	3.2	5	2.2	5	2.0	2	3.3	3	2.4	5	2.8	29	5
4-3	4.3	12	4.2	5	4.5	6	4.3	3	4.7	3	4.6	5	4.4	34	0
4-4	2.2	11	1.8	5	1.8	5	3.0	2	2.7	3	1.8	5	2.1	31	3
4-5	2.3	9	2.0	5	1.4	5	3.5	2	2.5	2	2.0	4	2.1	27	7
4-6	3.1	10	3.2	5	3.2	5	3.7	3	4.0	3	1.5	4	3.1	30	4
4-7	3.9	12	3.2	5	3.5	6	3.7	3	3.7	3	2.8	5	3.5	34	0
4-8	2.0	9	2.8	5	2.2	5	2.5	2	3.0	3	2.6	5	2.4	29	5
4-9	3.5	12	3.0	5	4.2	5	2.3	3	4.3	3	4.4	5	3.6	33	1
4-10	2.6	11	2.8	5	3.2	5	2.5	2	2.7	3	2.4	5	2.7	31	3
4-11	3.2	12	4.0	5	3.0	6	3.7	3	3.3	3	2.2	5	3.2	34	0

[1] Priority rating scale:

1. Marginal. Research, development, or extension is needed but the problem is not important over the next 10 years. The problem should receive very low priority in allocating new funds or for retaining funds at existing levels of funding.
2. Moderate. The problem is more than marginal in importance in terms of needs over the next 10 years but is definitely not very urgent. The problem should have low priority for funding.
3. Important. The problem is definitely of priority in terms of needs over the next 10 years. Not undertaking work on the problem would significantly limit ability to manage lands or resources. The problem should receive priority for funding.
4. Urgent. The problem is very important and work not being undertaken would have serious adverse effects on ability to manage lands or resources. Urgent that activities in this area be expanded. The problem is of high priority for funding.
5. Critical. The problem is definitely of extreme importance over the next 10 years: the urgency of the problem and the possibility that solution promises significant public benefit warrant giving the problem highest priority. Extremely urgent that activities in this area be expanded.

[2] Problems are described in Appendix A.

Appendix C. (Continued)

Problem	Public Prior.	No.	Private Prior.	No.	Gov't. Agency Prior.	No.	County Gov't. Prior.	No.	Conserva. Group Prior.	No.	Profess. Society Prior.	No.	All Prior.	No.	Individuals Not Rating
4-12	3.6	12	4.0	5	3.4	5	4.0	2	4.0	3	2.6	5	3.5	32	2
4-13	2.9	10	3.0	5	2.6	5	3.5	2	3.3	3	2.6	5	2.9	30	4
4-14	2.5	11	2.4	5	2.4	6	3.0	2	3.3	3	2.2	5	2.5	32	2
4-15	3.4	12	2.8	5	3.8	6	3.0	3	4.0	3	2.2	5	3.3	34	0
5-4	4.2	12	4.2	5	3.8	5	3.7	3	3.3	3	2.6	5	3.8	33	2
5-7	3.8	13	3.4	5	3.4	5	3.7	3	2.5	4	2.2	4	3.4	34	1
5-8	4.5	13	4.6	5	4.8	4	5.0	3	4.5	4	3.8	5	4.5	34	1
5-9	3.4	12	2.0	5	2.5	4	2.0	3	2.8	4	1.8	5	2.6	33	2
5-10	3.5	13	3.2	5	3.2	5	4.3	3	2.8	4	2.6	5	3.3	35	0
5-11	3.5	12	3.6	5	3.8	5	4.3	3	3.8	4	3.0	5	3.6	34	1
5-13	3.9	12	3.2	5	3.4	5	3.7	3	3.5	4	3.2	5	3.6	34	1
5-14	2.3	12	2.8	5	2.6	5	2.7	3	3.0	4	2.4	5	2.6	34	1
5-15	3.1	12	3.6	5	2.2	5	1.7	3	3.5	4	2.0	5	2.8	34	1
5-16	2.8	12	2.2	5	2.7	3	1.7	3	2.7	3	2.0	5	2.4	31	4
5-22	3.9	13	4.2	5	3.4	5	2.7	3	4.5	4	3.2	5	3.7	35	0
5-23	4.1	13	4.0	5	3.8	5	3.3	3	3.8	4	2.8	5	3.7	35	0
5-24	2.4	11	2.0	4	3.4	5	3.3	3	3.0	4	2.4	5	2.9	32	3
5-25	2.9	12	3.4	5	2.8	5	2.7	3	2.5	4	2.2	5	2.8	34	1
5-26	4.8	13	4.4	5	4.4	5	5.0	3	4.2	4	4.6	5	4.6	35	0
81-38	3.6	10	3.6	5	4.0	5	3.7	3	4.3	3	4.0	4	3.8	30	3
6-1	3.8	11	3.2	5	4.0	3	3.7	3	4.7	3	4.0	5	3.7	30	3
6-7	4.2	11	4.2	5	4.0	4	4.7	3	4.7	3	5.0	5	4.4	31	2
7-7	4.0	10	3.3	6	3.8	4	3.5	2	5.0	3	3.8	5	4.0	30	3
7-9	3.8	9	3.5	6	3.7	3	2.0	2	4.0	3	3.4	5	3.5	28	5
8-2	3.7	11	3.7	6	3.4	5	4.0	2	4.7	3	4.0	4	3.8	31	2
8-3	3.2	11	4.3	6	3.0	5	3.5	2	4.0	3	3.8	5	3.6	32	1
8-7	3.6	10	4.0	6	3.2	4	3.5	2	4.0	3	4.2	5	3.8	30	3

Appendix C. (Continued

Problem	Public Prior.	No.	Private Prior.	No.	Gov't. Agency Prior.	No.	County Gov't. Prior.	No.	Conserva. Group Prior.	No.	Profess. Society Prior.	No.	All Prior.	No.	Individuals Not Rating
9-1	3.8	12	3.0	5	4.6	5	5.0	1	4.3	3	3.1	5	3.8	31	5
9-2	2.5	11	2.8	5	3.2	5	5.0	1	4.0	3	2.4	5	2.9	30	6
9-5	3.6	12	3.8	5	3.4	5	5.0	1	3.7	3	2.6	5	3.5	31	5
9-6	2.8	12	2.6	5	3.4	5	4.0	1	3.3	3	2.0	5	2.9	31	5
9-7	2.8	11	3.6	5	3.2	4	4.0	1	3.3	3	2.4	5	3.0	29	7
9-9	3.8	13	3.6	5	3.4	5	3.0	1	4.3	3	2.0	5	3.4	32	4
9-10	2.1	12	2.6	5	3.0	5	3.0	1	1.7	3	2.0	5	2.5	30	6
9-16	2.0	11	2.8	5	2.0	4	1.0	1	2.7	3	2.0	5	2.8	29	7
9-25	2.4	12	3.4	5	4.2	5	4.0	1	4.7	3	2.2	5	3.5	31	5
9-26	2.4	12	3.4	5	3.8	4	2.0	1	2.3	3	2.8	5	2.8	30	6
10-1	3.3	12	4.0	5	4.0	7	3.3	3	4.2	3	3.0	5	3.6	35	1
10-2	3.9	13	4.4	5	4.1	7	4.3	3	5.0	3	4.2	5	4.3	36	0
10-3	4.2	10	3.8	5	4.0	6	2.7	3	4.3	3	4.8	5	4.0	32	1
10-4	3.1	10	3.0	5	2.6	5	3.0	3	3.7	3	2.2	5	2.9	31	2
11-2	2.5	8	3.4	5	4.0	5	2.7	3	3.3	3	2.0	3	3.0	27	6
11-3	4.1	8	3.8	5	4.8	5	3.7	3	5.0	3	4.0	3	4.2	27	6
11-4	3.6	8	2.8	5	4.2	5	3.0	3	3.7	3	1.0	2	3.3	26	7
11-7	4.2	11	4.6	5	4.2	6	4.0	3	3.3	3	2.2	5	3.8	33	0
11-11	3.7	9	4.2	5	3.3	6	3.3	3	5.0	3	3.0	5	3.7	31	2
11-12	3.3	6	3.5	2	3.4	5	3.0	3	4.3	3	3.0	1	3.5	20	13
12-1	4.6	10	4.4	5	4.6	5	4.3	3	5.0	3	4.0	5	4.5	31	2
12-2	4.3	10	4.0	5	3.8	5	3.7	3	4.0	3	4.0	5	4.0	31	2
12-3	3.4	9	3.6	5	3.5	4	3.0	3	3.7	3	2.6	5	3.3	29	4
12-4	3.7	9	4.0	5	4.0	4	3.3	3	4.7	3	2.8	5	3.7	29	4
12-5	3.6	10	4.0	5	4.2	5	3.7	3	4.7	3	3.0	5	3.9	31	2
12-6	4.7	10	4.4	5	4.8	4	5.0	3	5.0	3	3.8	5	4.6	30	3

Appendix C. (Continued)

Problem	Public Prior.	Public No.	Private Prior.	Private No.	Gov't. Agency Prior.	Gov't. Agency No.	County Gov't. Prior.	County Gov't. No.	Conserva. Group Prior.	Conserva. Group No.	Profess. Society Prior.	Profess. Society No.	All Prior.	All No.	Individuals Not Rating
81-1	2.5	6	3.8	4	2.8	4	2.7	3	3.7	3	2.4	5	3.0	25	6
81-2	3.3	9	4.2	4	4.0	5	3.3	3	4.7	3	3.6	5	3.8	29	2
81-3	2.5	6	2.2	4	2.8	4	3.3	3	3.3	3	2.2	4	2.6	24	7
81-4	2.9	8	2.0	4	2.4	4	2.7	3	3.7	3	3.0	5	2.8	27	4
81-5	2.6	9	3.8	4	3.5	5	3.7	3	3.7	3	2.4	5	3.3	29	2
81-6	3.2	7	3.2	4	2.3	5	2.3	3	3.3	3	2.6	5	2.8	27	4
81-8	2.8	8	3.0	4	2.8	4	3.3	3	3.0	3	2.4	5	3.0	27	4
81-9	1.3	7	3.0	4	2.2	4	3.3	3	1.7	3	2.0	5	2.2	26	5
81-10	4.0	9	3.8	4	3.7	6	4.2	3	4.7	3	3.2	5	3.9	30	1
81-11	2.4	7	3.0	4	3.2	4	2.3	3	3.0	3	2.2	5	2.7	26	5
81-12	4.2	10	5.0	4	3.6	5	3.3	3	5.0	3	4.0	5	4.2	30	1
81-13	2.2	8	2.0	4	3.0	4	2.7	3	3.3	3	1.8	5	2.4	27	4
81-14	2.8	7	4.0	4	2.5	4	2.7	3	3.3	3	1.6	5	2.8	26	5
81-15	4.2	10	3.5	4	4.2	6	3.3	3	5.0	3	3.6	5	4.1	31	0
81-16	2.3	7	3.2	4	2.6	5	2.7	3	3.3	3	1.8	5	2.5	27	4
81-17	2.1	8	3.0	4	2.5	4	4.0	3	3.3	3	1.8	5	2.6	27	4

Appendix D
A Plan for Research, Development and Extension
Related to Shrublands in California

Goal: Provide to managers of California's shrublands the technology required to develop, use and protect the multiple resources related to these lands.

Target 1. Management of shrublands and vegetation resources

Subtarget 1.1 Determine whether composition of vegetational communities is shifted by various management practices, and determine causes and effects of observed shifts on key ecosystem processes. (Problems 10-1 & 2) (Yr. 1, $330,000; 10-yr., $2,640,000).

Activities

1.1.1 Summarize and disseminate existing information.
1.1.2 Determine ways in which community composition is shifted by management practices.
1.1.3 Determine effects of changes in vegetational composition on productivity, nutrient status, erosion, flammability, and other burning characteristics
1.1.4 Determine effects on ecosystem functioning of mosaics of various sizes.
1.1.5 Extend new technology to land owners and fire managers

Subtarget 1.2 Determine effects of frequency, season, and intensity of burning on survival of shrubs, seeds, and seedlings. (Problems 3-2, 3 & 6) (Yr. 1, $680,000; 10-yr., $8,150,000).

Activities

1.2.1 Summarize and distribute existing information.
1.2.2 Vary frequency, season, and intensity of burning and observe effects.
1.2.3 Evaluate effects of varying burning conditions on sensitive plants.
1.2.4 Determine optimal intervals between fires to maintain desired nutrient levels and composition and productivity of stands.
1.2.5 Conduct pilot studies and establish demonstrations.
1.2.6 Evaluate environmental and economic costs and benefits of alternative strategies for managing vegetation by burning.
1.2.7 Provide a monitoring procedure and standards for assessing vegetational status.

Subtarget 1.3 Compare current, historical, and precontact patterns of burning. (Problem 2-1) (Yr. 1, $120,000; 10-yr., $820,000).

Activities

1.3.1 Summarize and document existing and new information on patterns of burning for geographic parts of shrubland ecosystems.
1.3.2 Conduct cross-disciplinary research involving geography, archaeology, and botany.

Subtarget 1.4 Estimate the environmental and financial impacts of a fire-exclusion policy. (Problem 1-6) (Yr. 1, $60,000; 10-yr., $270,000)

Activities

1.4.1 Collect and analyze available information on changes in vegetation and associated fire hazard over long periods when fire is excluded.

1.4.2 Collect and analyze available information on frequency and cost of suppressing wildfires in different geographic areas and vegetational associations. (See also Subtarget 1.3)

1.4.3 Prepare sample environmental and financial impact statements for fire exclusion in selected geographic areas and shrub types.

1.4.4 Extend information on impacts of fire exclusion to landowners, fire managers, and vested interest groups.

Subtarget 1.5 Determine when and how to use herbicides safely and effectively to manage brush. (Problem 3-5) (Yr. 1, $780,000; 10-yr., $3,060,000)

Activities

1.5.1 Summarize and disseminate available information.

1.5.2 Determine efficacy of registered herbicides on new shrub associations.

1.5.3 Improve methods of application.

1.5.4 Screen new herbicides for efficacy (assume others will establish safety for use).

1.5.5 Conduct field experiments with promising new herbicides.

1.5.6 Analyze costs and benefits of using herbicides versus other alternatives.

1.5.7 Predict and ameliorate public reactions to use of herbicides.

1.5.8 Determine hazards in smoke from brown (with herbicide) and burn treatments.

Subtarget 1.6 Determine the biomass resource available for harvest, constraints on harvesting, and the economic and energy implications of harvesting shrubs for biomass. (Problems 81-1,2,10,11,12,13) (Yr. 1, $700,000; 10-yr., $4,710,000)

Activities

1.6.1 Determine current state of knowledge and methodology, success of operating projects, and plans for future projects; evaluate available feasibility studies; disseminate available information.

1.6.2 Estimate the shrubby biomass available to logical locations for energy generators considering transportation systems, operability of slopes and soils, and biomass productivity.

1.6.3 Analyze the potential biological and economic feasibility of supplying available biomass for generating energy at selected locations.

1.6.4 Determine financial and energy costs and environmental impacts of mechanical harvesting.

1.6.5 Determine mitigating procedures necessary to offset effects of mechanical harvesting.

1.6.6 Analyze the actual costs and benefits of using biomass for generating energy.

Subtarget 1.7 Determine long-term environmental implications, such as vegetational change and soil movement, from mechanical removal of shrubby biomass. (Problem 81-15) (Yr. 1, $420,000; 10-yr., $4,080,000)

Activities

1.7.1 Evaluate existing environmental impact assessments for utilizing shrubby biomass.

1.7.2 Determine implications of sustained yield of shrubby biomass on soils, yield and quality of water, wildlife, and productivity of vegetation.

1.7.3 Determine ways to ameliorate environmental effects.

1.7.4 Suggest practices for managing and harvesting shrubby biomass and related forest practice regulations, and extend information and technology to vested-interest groups.

1.7.5 Recommend methods and standards for monitoring projects to utilize shrubby biomass for energy.

Target 2. Management of soil resources

Subtarget 2.1 Determine the soil properties to predict susceptibility to soil erosion and destabilization of slopes after burning. (Problems 4-2, 3 & 7) (Yr. 1, $540,000; 10-yr., $3,960,000)

Activities

2.1.2 Determine upslope erosion processes that occur during fire and postfire events.

2.1.2 Determine channel erosional processes that occur after upslope materials are deposited in streams.

2.1.3 Extend information on erosional processes to vested-interest groups.

Subtarget 2.2 Determine effects of management, especially burning, on structure, organic matter, and biological properties of soils. (Problems 4-2, 6, 12 & 13) (Yr. 1, $600,000; 10-yr. $6,000,000)

Activities

2.2.1 Relate organic matter, biological components, and stability of soils to aggregation of soil, and relate effects of soil aggregation to erosion, water runoff, and biomass production.

2.2.2 Establish interrelations between atmospheric deposition and shrubland productivity, microbial transformations, and groundwater pollution.

Subtarget 2.3 Devise a system for rating site index of shrublands. (Problems 4-9 & 15) (Yr. 1, $840,000; 10-yr. $5,640,000)

Activities

2.3.1 Complete the soil and vegetation survey for shrublands and incorporate in a site index system to serve needs of management.

2.3.2 Develop a computer-based inventory and overlay system to handle data and predict shrub biomass productivity.

Subtarget 2.4 Determine effects of management, especially burning, on storage capacity and budgets of soil water. (Problem 4-11) (Yr. 1, $240,000; 10-yr. $1,320,000)

Activities

2.4.1 Compile and relate information on water yield to soil surveys.
2.4.2 Compile information on soil water storage capacity and relate to site index information.

Target 3. Management of water resources

Subtarget 3.1 Develop models to predict yields of water and sediment and changes in stream channels from managed and unmanaged shrublands around the state. (Problems 5-4,7,11 & 26) (Yr. 1, $450,000; 10-yr. $6,810,000)

Activities

3.1.1 Adapt predictive models currently available.
3.1.2 Collect data from several calibrated watersheds, and adjust or replace existing models.
3.1.3 Provide manuals and computer programs to use predictive models.
3.1.4 Determine effects of various burning conditions on sediment balance and placement in stream channels.
3.1.5 Determine effects of sequential burns on yields and placement of sediment stored in channels.

Subtarget 3.2 Determine how conditions of burning influence subsequent yields and quality of water. (Problems 5-4,8,9,10,16 & 23) (Yr. 1, $440,000; 10-yr., $4,400,000)

Activities

3.2.1 Define changes over time after burning in yields of surface water and sediment and in water chemistry.
3.2.2 Define changes over time after burning in volume and timing of base flows of ground water and in soil water.
3.2.3 Define changes over time after burning in stream channel profiles and in riparian vegetation.

Subtarget 3.3 Determine the long-term impacts on yields of water and sediment of converting from shrubs to forest or grassland. (Problem 5-22) (Yr. 1, no cost; 10-yr., $2,050,000)

Activities

3.3.1 Establish base flows of water and sediment prior to treatment.
3.3.2 Convert shrubs to trees or to grasses.
3.3.3 Determine net changes in yields of water and sediment after type conversion.

Subtarget 3.4 Understand processes involved in erosion and mass wasting on steep land. (Problem 81-38) (See Subtarget 2.1)

Target 4. Management of fish, wildlife, and grazing resources.

Subtarget 4.1 Determine effects of shrubland management on instream resources. (Problems 6-1 & 7) (Yr. 1, $360,000; 10-yr., $3,780,000)

Activities

4.1.1 Provide a site classification for shrubland streams based on aquatic biota.

4.1.2 Develop a model to predict changes in aquatic biota with height of stream flow after management of upstream vegetation.

4.1.3 Develop a monitoring system with standards for aquatic resources.

Subtarget 4.2 Determine effects of shrubland management alternatives on wildlife resources. (Problem 7-7) (Yr. 1, $720,000; 10-yr., $7,200,000)

Activities

4.2.1 Provide a terrestrial habitat classification for shrublands.

4.2.2 Develop models to predict changes in populations of vertebrates after management of vegetations communities.

4.2.3 Develop a monitoring system with standards for vertebrate wildlife populations.

Subtarget 4.3 Quantify social demands for and benefits from changes in populations of species of game associated with management of shrublands. (Problem 7-9) (Yr. 1, $120,000; 10-yr., $600,000)

Activities

4.3.1 Build an econometric model to help landowners develop managerial strategies for optimizing returns from paid recreational hunting.

4.3.2 Provide guidelines for analyzing demands for and setting up paid hunting programs.

4.3.3 Validate and adjust model and guidelines based on observed experiences.

Subtarget 4.4 Develop optimum livestock management strategies for utilizing grazing resources of managed shrublands. (Problems 8-2 & 3) (Yr. 1, $240,000; 10-yr., $1,680,000)

Activities

4.4.1 Determine potentials for use by livestock of vegetation regrowing after treatment of shrublands.

4.4.2 Monitor use by livestock of vegetation regrowing after treatment of shrublands.

4.4.3 Provide guidelines or new systems for utilization by livestock of regrowing vegetation.

Subtarget 4.5 Determine interactions between wildlife and livestock following manipulation of shrubland vegetation. (Problem 8-7) (Yr. 1, $480,000; 10-yr., $4,800,000)

Activities

4.5.1 Determine impacts on population of game animals of combined treatments of vegetation and utilization by livestock of regrowing vegetation.

4.5.2 Provide guidelines for managing livestock to maximize combined output of livestock products and major game species.

Target 5. Management of air resources

Subtarget 5.1 Develop tools for predicting smoke resulting from burning. (Problem 9-1) (Yr. 1, $120,000; 10-yr. $460,000)

Activities

5.1.1 Develop tools for planning.

5.1.2 Test tools for planning.

5.1.3 Provide guidelines for practical use by fire managers.

Subtarget 5.2 Provide models for predicting dispersion over complex terrain of smoke resulting from burning shrublands. (Problem 9-9) (Yr. 1, $120,000; 10-yr., $540,000)

Activities

5.2.1 Develop mathematical models.

5.2.2 Test and revise models under real conditions.

5.2.3 Provide guidelines for practical use of the predictive models.

Subtarget 5.3 Determine how characteristics of fuel beds and fire behavior in shrublands influence emissions of particulates and gases and release of heat. (Problem 9-5) (Yr. 1, $60,000; 10-yr., $480,000)

Activities

5.3.1 Review and analyze available technology.

5.3.2 Investigate relationships.

5.3.3 Utilize findings to improve guidelines for practical use by fire managers. (See 5.1.3)

Subtarget 5.4 Develop inexpensive instruments and field methods for collecting and analyzing meteorological data to support planning and managing of prescribed burning. (Problem 9-25) (Yr. 1, $120,000; 10-yr., $420,000)

Activities

5.4.1 Review and analyze currently available instruments and methodology.

5.4.2 Adapt available instruments and methodology to meet needs of fire managers.

5.4.3 Provide guidelines for use by fire managers.

Subtarget 5.5 Develop a public information program to explain technology and options for management of smoke from shrublands. (Problem 9-27) (Yr. 1, $120,000; 10-yr., $480,000)

Activities

5.5.1 Determine the public's understanding and attitude toward smoke from prescribed burning.

5.5.2 Develop information programs to inform the public about prescribed burning of shrublands.

5.5.3 Provide guidelines for local use by practitioners of public information programs.

Target 6. Economics and policy of shrubland management

Subtarget 6.1 Determine the status of shrubland resources. (Problem 11-3) (Yr. 1, $250,000; 10-yr., $710,000)

Activities

6.1.1 Inventory shrublands as to status of land use, and condition and trend of biomass resources.

6.1.2 Determine major categories of owners of shrublands and their intentions for management and use of their land and resources.

6.1.3 Analyze laws, regulations, and policies of governing groups affecting owners and managers of shrublands.

Subtarget 6.2 Develop methods for improving social and economic considerations of shrubland management. (Problems 11-2, 4 & 7) (Yr. 1, $230,00; 10-yr., $3,400,000)

Activities

6.2.1 Identify influences of ownership, jurisdiction and policies on management of shrublands.

6.2.2 Propose and observe effects of alternative cooperative arrangements for management of shrublands among various ownership and units of government.

6.2.3 Recommend cooperative management strategies to alleviate problems.

6.2.4 Assess with respect to shrublands the existing methods for determining values of market and nonmarket resources.

6.2.5 Provide economic analyses for options identified from other shrubland research, such as biomass production, livestock grazing, or paid hunting.

6.2.6 Develop models to facilitate decisions about managerial alternatives, including associated risks, for shrublands.

6.2.7 Analyze impacts of managerial constraints and incentives, such as land and commodity prices, taxes, insurance and zoning.

Target 7. Management of prescribed burning

Subtarget 7.1 Develop prescriptions for burning and methods of using fire to accomplish specific objectives for various conditions and locations of fuels. (Problems 12-1, 4 & 6) (Yr. 1, $420,000; 10-yr., $2,580,000)

Activities

7.1.1 Develop prescriptions and methodology for burning shrublands to

achieve precise objectives.

7.1.2 Determine critical upper and lower conditions for flammability, based on vegetation and terrain.

7.1.3 Evaluate prescriptions and methodology for burning.

7.1.4 Provide guidelines for managing prescribed burning of shrublands.

Subtarget 7.2 Develop methods for documenting effects of fires on shrubland ecosystems. (Problems 12-2 & 3) (Yr. 1, $360,000; 10-yr., $3,060,000.

Activities

7.2.1 Provide guidelines for use of available methodology to document effects of prescribed burning.

7.2.2 Investigate mechanisms by which fire brings about observed effects.

7.2.3 Develop and apply improved methodology for documenting effects of prescribed burning.

Subtarget 7.3 Improve inventories and modeling of fuels on shrublands. (Problem 12-4) (Yr. 1, $360,000; 10-yr., $2,100,000)

Activities

7.3.1 Adapt procedures for inventorying fuels used in Southern California to shrublands in other regions.

7.3.2 Inventory fuels on all shrublands.

7.3.3 Improve and apply dynamic fuel modeling to inventories.

Subtarget 7.4 Disseminate information to landowners, fire managers, and the public on fire effects, prescribed burning, and fire management. (Problem 12-5) (Yr. 1, $240,000; 10-yr., $2,400,000)

7.4.1 Gather and repackage available information.

7.4.2 Extend information to a variety of audiences.

Appendix E.
Estimated costs for a research, development and extension program
to solve shrubland problems in 10 years

Targets / Subtargets / Activities	Problems	Years 1	2	3-4	5-6	7-8	9-10	1-10
Target 1	Management of shrublands and vegetation	3,090	2,840	5,105	4,640	3,855	4,200	23,730
Subtarget 1.1	Shifts in vegetational composition	* 330	240	480	530	530	530	26,640
1.1.1	Existing and new information	90	--	--	50	50	50	240
1.1.2	Changes in composition	(included in 1.2.2)						
1.1.3	Causes and effects of change	120	120	240	240	240	240	1,200
1.1.4	Size of mosaics	120	120	240	240	240	240	1,200
Subtarget 1.2	Effects of burning on plants	680	590	1,420	1,780	1,780	1,900	8,150
1.2.1	Existing and new information	* 120	35	70	70	70	70	440
1.2.2	Effects of burning conditions	* 480	480	960	960	960	960	4,800
1.2.3	Effects on sensitive species	20	15	30	30	30	30	150
1.2.4	Intervals between fires	60	60	120	120	120	120	600
1.2.5	Pilot studies and demonstrations	--	--	240	480	480	480	1,680
1.2.6	Cost and benefit evaluations		--	--	120	120	120	360
1.2.7	Monitoring and standards	--	--	--	--	--	120	120
Subtarget 1.3	Historical patterns of burning	120	120	265	290	25	--	820
1.3.1	Existing and new information	120	--	25	50	25	--	220
1.3.2	Cross-disciplinary research	--	120	240	240	--	--	600
Subtarget 1.4	Impacts of fire exclusion	60	60	60	60	30	--	270
1.4 1	Changes in vegetation and hazard	60	60	--	--	--	--	120
1.4.2	Frequency and cost of wildfires	--	--	60	--	--	--	60
1.4.3	Sample impact statements	--	--	--	60	--	--	60
1.4.4	Extend information	--	--	--	--	30	--	30

Appendix E. (Continued)

		1	2	3-4	5-6	7-8	9-10	1-10
Subtarget 1.5	Use of herbicides	780	810	1,200	270	--	--	3,060
1.5.1	Existing and new information	60	30	60	30	--	--	180
1.5.2	Efficacy of registered compounds	120	120	120	--	--	--	360
1.5.3	Methods of application	120	120	120	--	--	--	360
1.5.4	Efficacy of new compounds	120	120	120	--	--	--	360
1.5.5	Validate efficacy in field	240	240	480	120	--	--	1,080
1.5.6	Costs/benefits of alternatives	60	60	120	60	--	--	300
1.5.7	Public reactions	--	60	120	60	--	--	240
1.5.8	Smoke from brown and burn	60	60	60	--	--	--	180
	Date of application							
Subtarget 1.6	Biomass potentials for energy	700	600	1,080	870	650	810	4,710
1.6.1	Current status and extension	100	--	--	40	--	40	180
1.6.2	Biomass inventory	300	300	600	600	600	600	3,000
1.6.3	Biological and economic feasibility	120	120	120	--	--	120	480
1.6.4	Costs and impacts of harvesting	120	120	240	120	--	--	600
1.6.5	Mitigation for harvesting	60	60	120	60	--	--	300
1.6.6	Actual costs and benefits	--	--	---	50	50	50	150
Subtarget 1.7	Long-term effects of harvesting	420	420	600	840	840	960	4,080
1.7.1	Existing impact assessments	120	120	--	--	--	--	240
1.7.2	Sustained yield implications	300	300	600	420	--	--	1,620
1.7.3	Ameliorate long-term effects	--	--	--	180	600	600	1,380
1.7.4	Suggest practices and regulations	--	--	--	240	240	240	720
1.7.5	Monitoring and standards	--	--	--	--	--	120	120

Appendix E. (Continued)

		1	2	3-4	5-6	7-8	9-10	1-10
Target 2	Management of soil resources	2,220	2,020	4,040	3,320	2,720	2,600	16,920
Subtarget 2.1	Erosion and slope failure	*540	540	1,080	600	600	600	3,960
2.1.1	Upslope erosion process	240	240	480	480	480	480	2,400
2.1.2	Channel erosional processes	240	240	480	--	--	--	960
2.1.3	Extend information	60	60	120	120	120	120	600
Subtarget 2.2	Soil organics and biology	600	600	1,200	1,200	1,200	1,200	6,000
2.2.1	Soil aggregation and effects	360	360	720	710	720	720	3,600
2.2.2	Atmospheric deposition and fate	240	240	480	480	480	480	2,400
Subtarget 2.3	Site index for shrublands	840	640	1.280	1,280	800	800	5,640
2.3.1	Soil and vegetation survey	400	400	800	800	800	800	4,000
2.3.2	Soils and site quality	440	240	480	480	--	--	1,640
Subtarget 2.4	Soils and water	240	240	480	240	120	--	1,320
2.4.1	Soils and water yield	240	240	240	--	--	--	720
2.4.2	Soil water storage and site index	--	--	240	240	120	--	600
Target 3	Management of water resources	890	2,020	2,690	2,690	2,690	2,280	13,260
Subtarget 3.1	Yields of water and sediment	*450	1,170	1,400	1,400	1,400	990	6,810
3.1.1	Adapt available models	120	60	--	--	--	--	180
3.1.2	New calibrated watersheds	160	820	820	820	820	410	3,850
3.1.3	Provide for use of models	120	240	480	480	480	480	2,280
3.1.4	Sediment and stream channels	20	20	40	40	40	40	200
3.1.5	Effects of sequential burns	30	30	60	60	60	60	300
Subtarget 3.2	Burning conditions vs. water	*440	440	880	880	880	880	4,400
3.2.1	Changes in surface water	290	290	580	580	580	580	2,900
3.2.2	Changes in ground water	120	120	240	240	240	240	1,200
3.2.3	Changes in stream channels	30	30	60	60	60	60	300

Appendix E. (Continued)

		1	2	3-4	5-6	7-8	9-10	1-10
Subtarget 3.3	Convert to forest or grass	--	410	410	410	410	410	2,050
3.3.1	Base flows before conversion	--	410	410	200	--	--	1,020
3.3.2	Type conversion	--		(contributed by others)			--	--
3.3.3	Net changes after conversion	--	--	--	210	410	410	1,030
Target 4	Management of wildlife, fish and grazing	1,920	1,920	3,840	3,720	3,420	3,240	18,060
Subtarget 4.1	Effects on in-stream resources	*360	360	720	720	780	840	3,780
4.1.1	Site classifications for streams	120	120	240	240	240	240	1,200
4.1.2	Changes in aquatic biota	240	240	480	480	480	480	2,400
4.1.3	Monitoring and standards	--	--	--	--	60	120	180
Subtarget 4.2	Effects on wildlife resources	720	720	1,440	1,440	1,440	1,440	7,200
4.2.1	Terrestrial habitat classification	120	120	120	--	--	--	360
4.2.2	Changes in vertebrates	600	600	1,260	1,320	1,320	1,320	6,420
4.2.3	Monitoring and standards	--	--	60	120	120	120	420
Subtarget 4.3	Economic benefits from game	120	120	240	120	--	--	600
4.3.1	Econometric model for decisions	120	120	150	--	--	--	390
4.3.2	Guidelines for paid hunting	--	--	60	90	--	--	150
4.3.3	Validate model and guidelines	--	--	30	30	--	--	60
Subtarget 4.4	Utilize grazing resources	240	240	480	480	240	--	1,680
4.4.1	Determine forage values	120	120	180	120	--	--	540
4.4.2	Monitor use by livestock	120	120	240	240	120	--	840
4.4.3	Provide guidelines for use	--	--	60	120	120	--	300
Subtarget 4.5	Wildlife-livestock interactions	480	480	960	960	960	960	4,800
4.5.1	Impacts of livestock on wildlife	480	480	960	480	480	--	2,880
4.5.2	Guidelines for managing livestock	--	--	--	480	480	960	1,920

Appendix E. (Continued)

		1	2	3-4	5-6	7-8	9-10	1-10
Target 5	Management of air resources	540	600	1,120	120	--	--	2,380
Subtarget 5.1	Predict production of smoke	120	120	220	--	--	--	460
5.1.1	Develop tools	120	120	--	--	--	--	240
5.1.2	Test tools	--	--	120	--	--	--	120
5.1.3	Guidelines for fire managers	--	--	100	--	--	--	100
Subtarget 5.2	Predict dispersion of smoke	120	120	240	60	--	--	540
5.2.1	Develop mathematical models	120	60	--	--	--	--	180
5.2.2	Test and revise models	--	60	240	--	--	--	300
5.2.3	Guidelines for use of models	--	--	--	60	--	--	60
Subtarget 5.3	Fire characteristics vs. emissions	60	120	240	60	--	--	480
5.3.1	Analyze available technology	60	--	--	--	--	--	60
5.3.2	Investigate relationships	--	120	240	--	--	--	360
5.3.3	Provide guidelines for managers	--	--	--	60	--	--	60
Subtarget 5.4	Inexpensive meteorological data	120	120	180	--	--	--	420
5.4.1	Analyze available technology	60	--	--	--	--	--	60
5.4.2	Adapt available methodology	60	120	120	--	--	--	300
5.4.3	Provide guidelines for managers	--	--	60	--	--	--	60
Subtarget 5.5	Inform public about smoke	120	120	240	--	--	--	480
5.5.1	Determine public's attitudes	120	60	--	--	--	--	180
5.5.2	Build information programs	--	60	180	--	--	--	240
5.5.3	Guidelines for informing public	--	--	60	--	--	--	60

Appendix E. (Continued)

		1	2	3-4	5-6	7-8	9-10	1-10
Target 6	Economics and policy of management	480	490	950	910	780	500	4,110
Subtarget 6.1	Status of land and resources	250	230	230	--	--	--	710
6.1.1	Inventory use, condition, and trend	150	150	150	--	--	--	450
6.1.2	Intentions of owners	60	60	60	--	--	--	180
6.1.3	Policies, rules, and regulations	40	20	20	--	--	--	80
Subtarget 6.2	Socioeconomics of management	230	260	720	910	780	500	3,400
6.2.1	Ownership, jurisdiction and politics	--	40	80	80	--	--	200
6.2.2	Alternatives for cooperation	120	120	300	220	80	--	840
6.2.3	Cooperative management strategies	--	--	250	550	520	320	1,640
6.2.4	Market and nonmarket values	20	10	--	--	--	--	30
6.2.5	Economics of outputs	30	30	60	60	60	60	300
6.2.6	Models to facilitate decisions	--	--	--	--	120	120	240
6.2.7	Managerial constraints and incentives	60	60	30	--	--	--	150
Target 7	Management of prescribed burning	1,380	1,260	2,280	1,980	1,620	1,620	10,140
Subtarget 7.1	Prescriptions and methods for burning	*420	420	720	420	300	300	2,580
7.1.1	Develop prescriptions and methods	240	240	480	240	120	120	1,440
7.1.2	Conditions for flammability	120	120	60	--	--	--	300
7.1.3	Evaluate prescriptions and methods	60	60	120	120	120	120	600
7.1.4	Guidelines for prescribed burning	--	--	60	60	60	60	240
Subtarget 7.2	Document effects of fires	360	300	600	600	600	600	3,060
7.2.1	Use of available methodology	120	60	--	--	--	--	180
7.2.2	Causes and effects	240	240	480	480	480	480	2,400
7.2.3	Improved methodology	--	--	120	120	120	120	480

Appendix E. (Continued)

		1	2	3-4	5-6	7-8	9-10	1-10
Subtarget 7.3	Inventory and model fuels	360	300	480	480	240	240	2,100
7.3.1	Develop procedures	120	60	--	--	--	--	180
7.3.2	Inventory fuels	120	120	240	240	240	240	1,200
7.3.3	Improve dynamic fuels modeling	120	120	240	240	--	--	720
Subtarget 7.4	Inform vested-interest groups	240	240	480	480	480	480	2,400
7.4.1	Repackage available information	120	--	--	--	--	--	120
7.4.2	Extend information	120	240	480	480	480	480	2,280
Target 1	Management of shrubland and vegetation	3,090	2,840	5,105	4,640	3,855	4,200	23,730
2	Management of soil resources	2,220	2,020	4,040	3,320	2,720	2,600	16,920
3	Management of water resources	890	2,020	2,690	2,690	2,690	2,280	13,260
4	Management of wildlife, fish, and grazing	1,920	1,920	3,840	3,720	3,420	3,240	18,060
5	Management of air resources	540	600	1,120	120	--	--	2,380
6	Economics and policy of management	480	490	950	910	780	500	4,110
7	Management of prescribed burning	1,380	1,260	2,280	1,980	1,620	1,620	10,140
		10,520	11,150	20,025	17,380	15,085	14,440	88,620

*Costs for solutions to only the problems rated by users as critical