

# California's Brushlands

## Brushland management

Theodore E. Adams, Jr.

**B**rush is a major vegetation type in California. In pure stands, such as chaparral, and mixed with other types of vegetation, it covers more than 20 million acres in California—nearly one quarter of the state.

Our brushlands are a dynamic system which developed with the aid of fire over millions of years. The many life forms, plant and animal, that live in our brushlands are adapted to and dependent on recurring fire. Fire is a natural part of the environment and rejuvenates our vast brushlands. Evidence of recurrent fire has been recorded by nature.

In the past, concern with wildfire has provided the central focus for brushland-related research. Traditional views hold that our vast brushlands are a management problem, a wildfire hazard which threatens commodities and the environment.

Fire is now an effective management tool, used alone and in combination with other devices. Since 1945, more than 2 million acres of brushlands have been burned by ranchers in California for improvement of livestock grazing and wildlife habitat. It has been estimated that about 8.75 million acres of land with brush management problems are sufficiently productive to warrant brush control for purposes of range improvement. Where brush is the dominant vegetation, about 3.25 million acres could be converted to grass for livestock forage, improved wildlife habitat, and better fire and erosion control and watershed protection.

The impact of brush management on other values has been demonstrated. Reduction of woody vegetation (density exceeding 50 percent canopy) to a canopy cover of 20 to 25 percent can improve water yield on northern California watersheds. Quantitative hydrologic studies of the effect of these changes within the 18- to 45-inch rainfall range are impressive. Consistent increases in annual runoff—up to 50 percent or more (about 3 to 5 acre-inches per acre)—have taken place over long periods where deep-rooted plants and stream-edge vegetation together with adjacent brushed slopes have been managed.

Burning brushlands in a pattern and sequence has proved beneficial to wildlife. In brushlands of the northern coastal mountains, deer populations increased from 20 deer per square mile to 75 per square mile when brush was managed with fire. Other studies have revealed increases in the variety and number of animals present in managed over mature, aging brush.

Improving harvest of brush to utilize this storehouse of the sun's energy is a prospect. At the moment, goats show promise of grazing brush, producing meat and fiber (mohair from Angora goats) for human use. Animals may be used in brush management programs to help reduce wildfire hazard and provide for human needs in an energy-efficient program.

Methods to enhance and protect our brushlands resource are being investigated. Efforts are under way to develop better criteria on which to base management programs.

Research opportunities are developing in several California locations. There is a growing need for information on plant production and nutrient budgets in different brushland communities. Studies are being initiated to determine the response of brushland

communities and brushland soils to various management programs to produce multiple effects. Information from these efforts will help improve management techniques that protect and enhance brushlands.

In the following pages, summaries of past and present research are presented which suggest the wide spectrum of values and interests represented in California's brushlands.

---

*Theodore E. Adams, Jr., is Extension Wildlands Specialist, Davis, and is technical coordinator of this special section.*

## Responses of bird and mammal populations to fire in chaparral

William M. Longhurst

**M**any species of wildlife inhabit chaparral, depending on it for food and cover. To appraise the effects of chaparral fire on wildlife, it is useful to have some estimate of probable trends which can be expected in populations of birds and mammals.

UC's Hopland Field Station was selected for study because of the backlog of information on wildlife that has been collected there since 1951. Chaparral on the field station and adjoining Cow Mountain Recreational Area is composed of a mixture of species: chamise, chaparral pea, and knobcone pine, as well as various species of oaks, ceanothus and manzanita, plus a number of other minor brush species.

On the field station, 55 species of birds and 25 species of native terrestrial mammals inhabit chaparral to some extent. Because of their general distribution in the state, several other kinds of birds and mammals might be expected to occur in this area, but only the species that have actually been collected are included in this evaluation. The responses of individual species of birds and mammals to chaparral fire are determined by their respective habitat preferences and by their movement patterns, reproduction, and food habits. For example, relatively few species seem to be adapted to extensive stands of mature chaparral. However, many thrive in younger chaparral stands, particularly if there is an interspersed of age classes of brush, or if there are openings with grass and herbaceous plants present. As shown in tables 1 and 2, only two species of mammals and three species of birds are considered to be especially adapted to extensive stands of mature chaparral to the extent that their populations would increase. In contrast, 23 mammals and 50 kinds of birds are better adapted to younger aged stands of

TABLE 1. Chaparral Mammals—Their Habitats, Behavior, and Successional Relationships

Species	Habitat*					Behavior†		Successional Relationships‡					
	Mature chaparral, 10 yrs. +	Recent burn, 1 yr.	Young chaparral, 2-3 yrs.	Intermediate chaparral, 4-9 yrs.	Grassland from type conversion	Ecotone chaparral/grassland	Home range	Food habits	Population trend in mature chaparral	Increase in young or intermediate chaparral	Increase in exten- sive grassland	Increase in chaparral interspersed	Increase in grassland interspersed
Vagrant shrew	FR		FR	FR	FR	FR	FR	S	I	D	YIn		X
Broad-handed mole			Fos	Fos	Fos	Fos	Fos	S	I	D	Y	X	X
Black-tailed jack rabbit			F	FR	FR	FR	FR	L	H	D	Y	X	X
Brush rabbit	R			FR			FR	S	H	D	In		X
California ground squirrel						FR P-Fos	FR P-Fos	S	HI	D		X	X
Townsend's chipmunk	FR			FR				S	HI	U			
Valley pocket gopher			Fos	Fos	Fos	Fos	Fos	S	H	D	Y	X	X
Heerman's kangaroo rat			P-Fos	P-Fos	P-Fos	P-Fos	P-Fos	S	H	D	Y		X
Western harvest mouse						FR	FR	S	HI	D		X	X
Deer mouse	FR	FR	FR	FR	FR	FR	FR	S	HI	D	YIn		X
Brush mouse	FR	FR	FR	FR	FR	FR	FR	S	HI	D	YIn		X
Pinyon mouse	FR	FR	FR	FR	FR	FR	FR	S	HI	D	YIn		X
Dusky-footed wood rat	FR			FR				S	HI	U			
California meadow mouse						P-Fos	P-Fos	S	H	D		X	X
Coyote	FR	FR	FR	FR	FR	F	FR	L	O	D	YIn		X
Grey fox	FR	F	FR	FR	FR	F	FR	L	O	D	YIn		X
Black bear	FR	F	F	FR	FR	F	F	L	O	D	YIn		X
Ring-tailed cat	FR	F	F	FR	FR		FR	L	O	D	YIn		X
Raccoon	FR	F	F	FR	FR	F	F	L	O	D	YIn		X
Badger		P-Fos	P-Fos	P-Fos	P-Fos	P-Fos	P-Fos	L	C	D	Y	X	X
Spotted skunk	FR	F	F	FR	FR	F	F	L	O	D	YIn		X
Striped skunk	FR	F	F	FR	FR	F	F	L	O	D	YIn		X
Mountain lion	FR	F	F	FR	FR	F	F	L	C	D	YIn		X
Bobcat	FR	F	F	FR	FR	F	F	L	C	D	YIn		X
Black-tailed deer	FR	F	FR	FR	FR	F	FR	L	H	D	YIn		X

SOURCE: Information drawn from personal observations and the following principal reference: Ingles, L. G. 1954. *Mammals of California and its coastal waters*. Stanford Univ. Press, Stanford, CA. 396 pp.

\*F = feeding  
R = resting  
Fos = fossorial  
P-Fos = partially fossorial

†Home range:  
L (large) = > 10 acres  
S (small) = < 10 acres

‡Food habits:  
I = insectivore  
H = herbivore  
O = omnivore  
C = carnivore

§Population trend in mature chaparral:  
U = up  
D = down

¶Increase in young or intermediate chaparral:  
Y = young  
In = intermediate

chaparral regrowth, or to such situations as clumps of chaparral interspersed with grassy openings.

At the Hopland Field Station and Cow Mountain Recreational Area, where precipitation averages between 35 and 50 inches annually, depending on elevation, chaparral grows back rapidly after it is burned: within ten years it is difficult to determine to what extent most plants were burned. To evaluate where the various kinds of birds and mammals fit into this pattern of regrowth, chaparral was arbitrarily divided into categories: new burn (less than one year old); young (two to three years old); intermediate (four to nine years old); and mature (over ten years old).

Many species of mammals and birds use brush for escape or resting cover but feed in nearby clearings. The boundary between brush and grassland or between different age classes of brush is

known as an ecotone or "edge," and the animals whose habitat it is are known as edge-adapted species. If the boundary is irregular or if clumps of brush are interspersed through grassland, the amount of edge increases, resulting in especially favorable conditions for the edge-adapted animals.

In dense stands of brush there is little undergrowth of grass or herbaceous plants because of the shade competition for moisture, and various allelopathic chemicals which certain brush plants produce that are toxic to grasses and herbaceous species. The openings, therefore, where grasses and the seed-bearing, broad-leaved, herbaceous plants can exist are the primary feeding areas for the mammals and birds that depend on these kinds of food.

A number of birds and mammals consume insects either as their primary food source or in combination with other kinds of

TABLE 2. Chaparral Birds—Their Habitats, Behavior, and Successional Relationships

Species	Habitat*					Behavior†			Successional Relationships‡						
	Mature chaparral, 10 yrs. +	Recent burn, 1 yr. -	Young chaparral, 2-3 yrs.	Intermediate chaparral, 4-9 yrs.	Grassland type conversion	Ecotone from chaparral	Wide-ranging	Brush nesting	Ground nesting	Food habits	Population trend in mature chaparral	Increase in young or intermediate chaparral	Increase in young or site grassland	Increase in exten- Chaparral intersper- sion	
Turkey vulture	F	F	F	F	F	F	F	X		X	Sc	D	Y	X	X
White-tailed kite						F		X			P	D		X	
Sharp-shinned hawk	F	F	F	F			F	X			P	D	YIn		X
Cooper's hawk	F	F	F	F			F	X			P	D	YIn		X
Red-tailed hawk	F	F	F	F		F	F	X			P	D	Y	X	X
Golden eagle	F	F	F	F		F	F	X			P	D	Y	X	X
Marsh hawk		F	F	F		F	F	X		X	P	D	Y	X	X
Pigeon hawk	F	F	F	F		F	F	X			P	D	Y	X	X
Sparrow hawk	F	F	F	F		F	F	X			PI	D	Y	X	X
California quail	R	F	F	R		F	F			X	VSI	D	Y		X
Mountain quail	FNR		F	FR			F			X	VSI	D			X
Band-tailed pigeon	F			F				X			VFrS	D			
Mourning dove		F	FN			FNR	FN	X	X	X	S	D	Y	X	X
Road runner		F	F			FNR	FNR	X		X	PI	D	Y	X	X
Barn owl		F	F			F	F	X			P	D	Y		X
Screech owl		F	F	F		F	F				PI	D	YIn		X
Great horned owl		F	F	F		F	F	X			P	D	YIn		X
Long-eared owl	FR	F	F	FR		F	F	X			P	D	YIn		X
Poorwill	F	F	FNR	FR		F	F			X	AI	D	YIn		X
Nighthawk	F	FNR	FNR	F		F	F	X		X	AI	D	Y	X	X
Anna's hummingbird	FNR		F	FNR			F		X		N	U	IN		X
Allen's hummingbird	FNR		F	FNR			F		X		N	U	IN		X
Violet-green swallow	F	F	F	F		F	F	X			AI	D	IN		X
Scrub jay	FNR	F	F	FR			F		X		SIP	D	YIn		X
Raven		F	F			F	F	X			SCI	D	YIn		X
Crow		F	F			F	F	X			SCI	D	YIn		X
Plain titmouse	FR			FR			F				I	D	IN		X
Common bushtit	FNR			FNR			F		X		FrI	D	IN		X
Wrentit	FNR			FNR			F		X		FrI	D	IN		X
Bewick's wren	FNR		F	FNR			FNR			X	I	D	IN		X
Mockingbird	FNR			FNR			FNR			X	FrI	D	IN		X
California thrasher	FNR			FNR			FNR			X	FrSI	D	IN		X
Robin	FR	F		FR		F	FR	X		X	FrI	D	IN	X	X
Western bluebird	FR	F	F	FR		F	FR				FrI	D	Y	X	X
Blue-grey gnatcatcher	FNR			FNR			F		X		I	D	IN		X
Cedar waxwing	FNR			FR			F	X	X		FrV	D	IN		
Loggerhead shrike		FR				FR	FR	X	X		IPSc	D		X	X
Starling						F	F	X			ISFr	D		X	X
Western meadow lark						FN	FR	X		X	SI	D		X	X
Brewer's blackbird							F	X			SI	D		X	X
Brown-headed cowbird							F	X			SI	D		X	X
Western tanager	FR			FR			F	X			VFI	U	IN		
Purple finch	R	F	F	R		F	FR	X			FS	D	Y	X	X
House finch	*R	F	F	R		F	FR	X			FS	D	Y	X	X
American goldfinch		F	F			F	FR	X			SI	D	Y	X	
Green-backed goldfinch		F	F			F	FR	X			SI	D	Y	X	
Lawrence's goldfinch		F	F			F	FR	X			SI	D	Y	X	
Rufous-sided towhee				FR			FR			X	FSI	D	YIn		
Brown towhee							FR			X	FSI	D	YIn		X

continued...

TABLE 2. Chaparral Birds—Their Habitats, Behavior, and Successional Relationships (continued)

Species	Habitat*					Behavior†			Successional Relationships‡					
	Mature chaparral, 10 yrs. +	Recent burn, 1 yr. -	Young chaparral, 2-3 yrs.	Intermediate chaparral, 4-9 yrs.	Grassland from type conversion	Ecotone grassland chaparral	Wide-ranging	Brush nesting	Ground nesting	Food habits	Population trend in mature chaparral	Increase in young or intermediate chaparral	Increase in extensive grassland	Increase in grassland chaparral interspersed
Savannah sparrow						FN				X	SI	D		FN
Lark sparrow		F				F	FR	X		X	SI	D		X
Sage sparrow				F		FNR	FN				SI	D		
Oregon junco							FR				SI	D		X
White-crowned sparrow				F			FR				VSI	D		X
Golden-crowned sparrow				F				FR			VSI	D		X

SOURCE: Information drawn from personal observations and the following principal references:  
 Bent, A.D. 1932-1968. *Life histories of North American birds*. Smithsonian Institution, U.S. National Museum Bulletin Nos. 162, 167, 170, 174, 176, 179, 191, 195, 196, 197, 203, 211, 237.  
 Smith, D. R.(Tech. Coordinator). 1975. *Proceedings of the symposium on management of forest and range habitats for nongame birds*. USDA Forest Service, Gen. Tech. Report WO-1, 343 pp.

\*F = feeding  
 R = resting  
 N = nesting

†Food habits:  
 V = vegetation I = insects  
 Fr = fruits P = predator  
 S = seeds

‡Population trend in mature chaparral:  
 U = up  
 D = down

Increase in young or intermediate chaparral:  
 Y = young  
 In = intermediate

food such as seeds or vegetation. The diet of some of these insectivores may be restricted to only a few kinds of insects, whereas others may consume a large variety. Insects in turn are adapted to certain environmental conditions: various age classes of chaparral favor different groups of insects. In general, however, in brush of diverse age classes, especially if grass is mixed in, a greater variety of insects will be supported providing food for more kinds of insectivorous birds and mammals.

When a fire occurs in a stand of chaparral, most of the vegetation above the ground level is usually consumed or killed. Depending on the intensity of the fire and the atmospheric conditions at the time, islands of brush are often left unburned. If the fire follows an irregular course, the margin between the burned and unburned brush will be more complex, the amount of edge will increase, and the habitat for a number of mammals and birds will improve.

Most chaparral brush species are replaced after a fire either by seedlings or sprouts that grow from any surviving subterranean root crowns. The heat of the fire seems to aid in breaking the dormancy of seeds that have accumulated in the soil since the last fire without germinating. This abundant crop of seedlings and sprouts, together with numerous kinds of grasses and herbaceous plants which grow in burned areas, furnish a new and abundant supply of food for deer, rodents, and a number of birds. Also, the new growth is significantly more nutritious than the old-growth brush. The increase in carrying capacity for deer is especially dramatic: in the Hopland area, census data indicate that deer numbers will increase from about 20 per square mile in mature chaparral to 50 to 60 per square mile in chaparral that has been opened up by fire.

In some cases chaparral has been completely converted to grassland either by repeated burning over a few years, or by following up an initial burn with herbicidal chemical treatments to kill the brush sprouts and seedlings. If an extensive area of grassland is created in this way, birds and mammals that are adapted to grassland will thrive. However, extensive, unbroken areas of grassland will not be favorable for the edge-adapted animals except around the margins where ecotones exist.

Chaparral cannot be studied in isolation. The important relationships which exist between chaparral and grassland, either natural grassland or grassland produced from type conversion from chaparral, have been pointed out. Likewise, in many situations chaparral and oak woodland are also contiguous or interspersed cover types. A large array of wildlife finds its habitat niche in oak woodland, many overlapping into both chaparral and grassland. A breakdown of the range of habitats that individual species utilize is given in tables 1 and 2.

Another important factor to consider in these relationships is the mobility of wildlife. Species that have limited home ranges, restricted to a few acres, are more apt to be affected significantly when fire occurs in chaparral. In contrast, the wider ranging animals have the ability to move about to seek the habitat conditions they require.

William M. Longhurst is Professor, Department of Agronomy and Range Science, UC, Davis.

## An assessment of goat grazing in chaparral

A.E. Sidahmed □ S.R. Radosevich

J.G. Morris □ W.L. Graves

Goats may be the all-purpose machine, the biological, ecologically acceptable alternative to mechanical, chemical, or prescribed burning methods of managing brushland. They produce minimal pollution, are self-perpetuating, provide animal protein for human consumption, and from the Angora goat, fiber for clothing.

In the summer of 1977 a study was initiated to assess the browsing preference, intake, and shrub suppression of Spanish goats, and the digestibility of certain shrubs by goats. The study