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 interspersion	
Savannah sparrow						FN				X	SI	D		FN	
Lark sparrow		F				F	FR	X		X	SI	D		X	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
Fr = fruits
S = seeds
I = insects
P = predator

§*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.

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An assessment of goat grazing in chaparral

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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

took place in a chaparral brush field in the Descanso Ranger District, Cleveland National Forest, San Diego County, in which a wild fire had occurred five years earlier. The dominant shrubs were scrub oak, chamise, cupleaf ceanothus, and eastwood manzanita. Less than two weeks before sampling, an unseasonably early and heavy rain contributed to the growth of herbaceous vegetation (grasses and forbs).

Shrub density, cover, and crown volume measurements were obtained from ten permanent transects. The diets and fecal matter of nine, 1- to 2-year-old (24 to 38 kg) Spanish goat wethers were measured over a two-week period. Before the daily morning collections of diet and fecal samples the goats were confined over night in a coyote-proof pen (supplied with drinking water and salt). After a 1- to 1½-hour collection period the animals foraged freely until sunset. Diet samples were frozen immediately with dry ice and kept frozen until their analysis at Davis. The intake was calculated from the average weights of fecal outputs and the percentage *in vitro* dry matter digestibility (DMD) of diet samples.

Results and discussion

The contribution of grass and forbs was reasonably constant at about 20 percent of the diet throughout the observational period except for higher intakes on the first and third day of sampling. For days 4 to 7 the dietary samples were predominantly composed of scrub oak and at times this was in excess of 80 percent. Chamise was also a major component of the diet and attained 70 percent on the last day of the study, when scrub oak and grass and forbs contribution decreased. Manzanita and ceanothus did not contribute significantly to the diet. Dead plant material, especially from a fallen liveoak tree inside the plot, contributed to a mean of 19 percent of the total dry matter intake. The decline in the contribution of grass and forbs during the period when scrub oak intake was predominant may indicate a change in preference of the goats to scrub oak over other forage components. During the last week of the study an increased contribution from grass and forbs possibly resulted from their increased availability due to growth while grazing pressure on the scrub oak was high. The amount of chamise in the diet was low when scrub oak and grass and forbs were major contributors to the diet. However, browsing on chamise increased when the scrub oak was depleted from the area. Chamise made its greatest contribution to the diet when the percentage intake of both dead material and grass and forbs declined. Manzanita and ceanothus were minor components of the diet and were eaten only when the scrub oak crowns were depleted of shoots.

The change in the total volume of the four shrub species during the sampling period is presented in figure 1. The total volume measurement is the index of the volume occupied by the shrubs but does not necessarily reflect the amount of forage available. Although manzanita and ceanothus had the highest total volume and were the most dominant shrub species in the plot, their contribution to the botanical composition of the dietary samples was very low. This indicates that eastwood manzanita and cupleaf ceanothus are not highly preferred by Spanish goats during the summer months.

The mean *in vitro* percentage dry matter digestibility was 51.6 for the 14-day period but varied in time with the species grazed (fig. 2). A highly significant positive association ($P < 0.01$) was found between dry matter digestibility and the percentage grass and forbs in the samples. Thus, new herbaceous growth when available could contribute significantly to the digestible energy intake of goats. No significant relationships were found between the *in vitro* digestibility and percentage of the other dietary constituents. However, the regression co-efficients for percentage scrub oak and chamise in the diet on *in vitro* digestibility were negative.

Recent comparative studies in Texas indicate that Angora goats have higher dietary requirements than Spanish goats. In our study the average total dry matter intake of five Spanish goats (30 kg body weight) was 61 $g/W^{3/4}$ which is comparable to the requirements cited in the Texas study. As there was only a slight change in the body weight of the goats over the two-week period, it indicates that the energy intake from browse was not grossly different from maintenance. This preliminary observation indicates that browse (scrub oak and chamise) can provide a maintenance diet for goats during the summer if it has an understory of grass and forbs.

The browsing preference of Spanish goats during a limited summer period in a 0.2 ha. plot of a five-year-old chaparral fuel break was highly directed—about 80 percent—toward scrub oak and chamise. Grasses and forbs contributed about 20 percent of the total diet, while eastwood manzanita and cupleaf ceanothus appear to have a negligible contribution. Further work into the effects of season and long-term grazing is needed for more comprehensive deductions.

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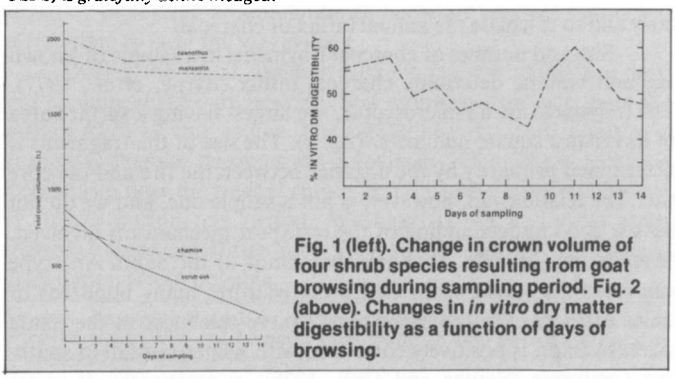

Fig. 1 (left). Change in crown volume of four shrub species resulting from goat browsing during sampling period. Fig. 2 (above). Changes in *in vitro* dry matter digestibility as a function of days of browsing.

Fossil record discloses wildfire history

Roger Byrne

When a wildfire runs through an area of chaparral not all of the plants are reduced to ashes: characteristically, a large number are simply charred. Fortunately for the paleoecologist, the charcoal produced often retains its cellular structure and, in some cases, can be identified (Komarek, *et al.*, 1973). Furthermore, charcoal is remarkably resistant to decay and as a result is commonly found in the sedimentary rocks that comprise the Coast Ranges.

On the northern slopes of the Santa Monica Mountains, for example, siltstones and shales of the Miocene Age (5 to 20 million years old) contain numerous charcoal fragments. Some of the fragments are derived from chaparral species and clearly indicate that chaparral-type vegetation was established in the area at this time (Weide, 1968). Macrobotanical evidence of this kind provides conclusive evidence that wildfires were an important part of the Cali-