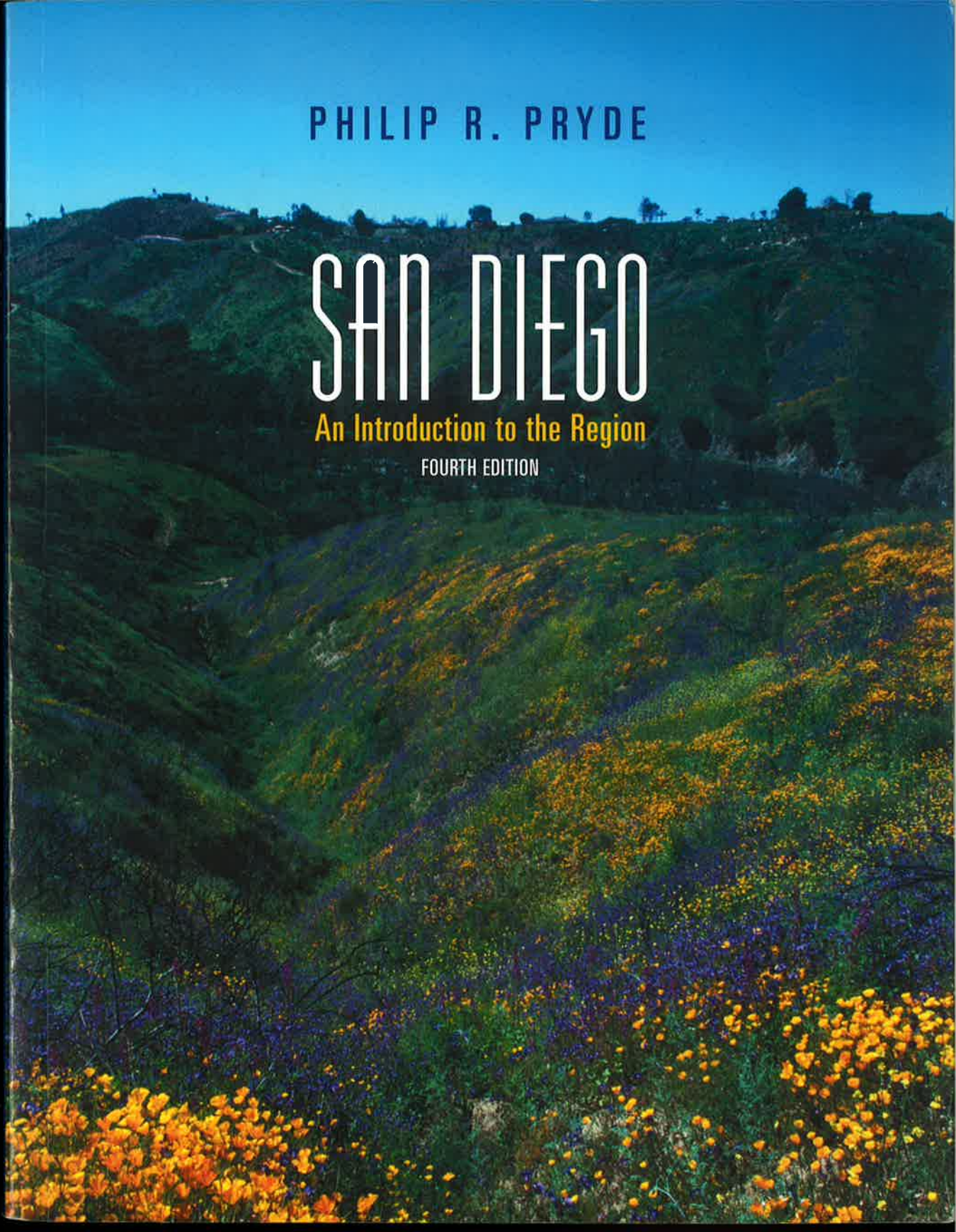
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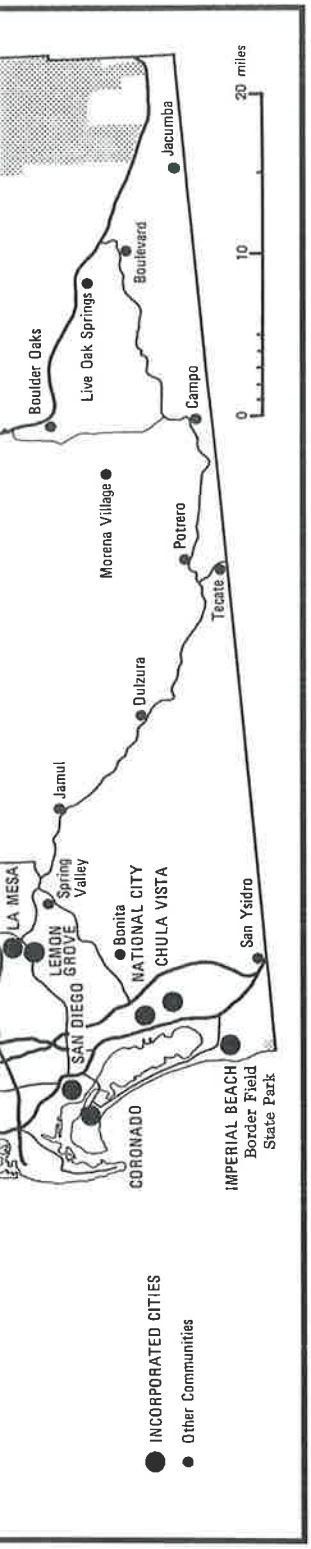

SAN DIEGO

An Introduction to the Region

FOURTH EDITION

Philip R. Pryde

A Historical Geography of the Natural Environments and Human Development of San Diego County

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County of San Diego: *www.co.san-diego.ca.us/*

San Diego Association of Geologists: *www.sandiegogeologists.org/index.html*

Chapter Three

Philip R. Pryde

The Nature of the County

San Diego's Climate, Soils, Vegetation, and Wildlife

The climate, soils, vegetation and wildlife of a region are closely related. Of these, climate usually provides the most popular concern and interest. It also tends to govern the other three, which are directly determined by climate. For example, natural vegetation is dependent upon the soils, rainfall, and average temperatures of any given locale, but at the same time vegetation helps to prevent soil erosion and modifies the local climate. Wildlife is highly dependent on local vegetation communities, but at the same time wild animals act both to transform and to propagate the plant life within these communities. Smaller organisms are an important part of the process of creating soils. These interdependencies are termed ecological relationships, and need to be well understood before any of their components are significantly or irreversibly disturbed.

Philip R. Pryde is a professor emeritus of environmental studies in the Department of Geography at San Diego State University.

The Climate of the County

If most county residents were asked to describe the local climate they would probably say, succinctly, that it is "very nice." By very nice they would mean that it is usually warm and sunny, and indeed the metropolitan area enjoys about 3,200 hours of sunshine

a year, or about 73 percent of the maximum possible. Why is it that sunshine and dry weather dominate in San Diego County?

The reason is that our local climate is influenced most of the year by the proximity of the subtropical high pressure systems. Although these systems occasionally weaken or strengthen or shift location, they are generally found somewhere near southern California, usually displaced a little to the north in summer and to the south in winter. In high pressure systems such as this, dry air moves earthward from higher altitudes and spreads out in a mild, clockwise wind pattern when it reaches the surface. This dry, subsiding air is what keeps southern California in sunshine most of the time.

From time to time, the high pressure is centered farther inland, perhaps over Nevada. This produces periods of two or three days of very dry, subsiding winds from the east, which are locally known as a *Santa Ana.* Santa Ana wind conditions often produce the coastal cities' annual high temperatures in August or September (over 100°)[1], and can spread wildfire through the dry brush very rapidly.

Our climate is generally described as warm, of course, because of our relatively low latitude location. Yet areas of the county inland from the coast (El Cajon, Ramona, Escondido, Fallbrook) have warmer summers and cooler winters than does the city of San Diego, because they lack the moderating effects of breezes off the ocean (caused by the water warming and cooling more slowly than the land). This moderating effect of the ocean is easily seen on a typical August day, when the high temperature for the day may be 70° at Ocean Beach, 80° in East San Diego and 90° in the El Cajon Valley (Figure 3.1). The reverse effect occurs with regard to low temperatures in winter, but the difference is not as great, and is dependent on other variables such as wind speed and local topography (Figure 3.2).

The proximity of the ocean has two other effects. One is a frequent afternoon "sea breeze," a gentle wind off the ocean that has the beneficial effect of cleansing the downtown air. It is most pronounced during the summer months. The other effect is a frequent occurrence of coastal "fog", especially in late spring and summer. The relatively cool ocean waters cause a low, thin layer of stratus clouds (sometimes called a "fog bank") to form offshore, which extends inland at night almost every day during spring and summer, and generally "burns off" the next day sometime between 9 A.M. and noon, as the land heats up. Sometimes, though, it may linger all day, especially near the coastal areas. Indeed, some coastal communities receive more hours of sunshine in the winter than they do in the summer.

San Diego's infrequent and highly seasonal rainstorms generally occur between the months of October and April. During these winter months the high pressure system occasionally weakens or moves further south, thus allowing major storms from the Pacific to reach southern California. Some of these originate in the Gulf of Alaska, while others (often the wettest ones) originate in the warmer tropical waters near Hawaii. On the average, between ten and twenty such storms reach San Diego County each winter, with the heaviest ones dropping one to two inches of rain in the metropolitan area. Once in a great while a major tropical cyclone may reach us from the south but this is quite rare (although two occurred in the consecutive years of 1976 and 1977).

In the summer, the sparse rainfall in coastal areas usually comes from an occasional thunderstorm, but some summers are completely without measurable precipitation. The key terms to describe the county's rainfall are "highly seasonal" and "highly variable." A further discussion of San Diego's rainfall characteristics can be found in Chapter 8.

Mountains are another important control on climate. As you gain elevation by driving eastward into the mountains of San Diego County, average temperatures decrease and average annual precipitation increases. This creates differing vegetation belts on mountains as one increases in elevation, a phenomenon known as *vertical zonation.* Although there can be exceptions, on an average annual basis, the higher you go into the hills the cooler and wetter it becomes. Thus Palomar Mountain is the wettest location in the county, receiving over forty inches of precipitation a year, and usually the most snow in winter; the Laguna and Cuyamaca mountains are the next coolest and wettest areas (Figure 3.3). The mountainous areas are more apt to get beneficial thundershowers in the summer than are low-lying areas, and one huge thunderstorm in 1891 reportedly dropped 11.5 inches of rain on Campo in just 80 minutes. Palomar Mountain is also the coolest spot in the county,

[1]All temperature figures are expressed in degrees Fahrenheit.

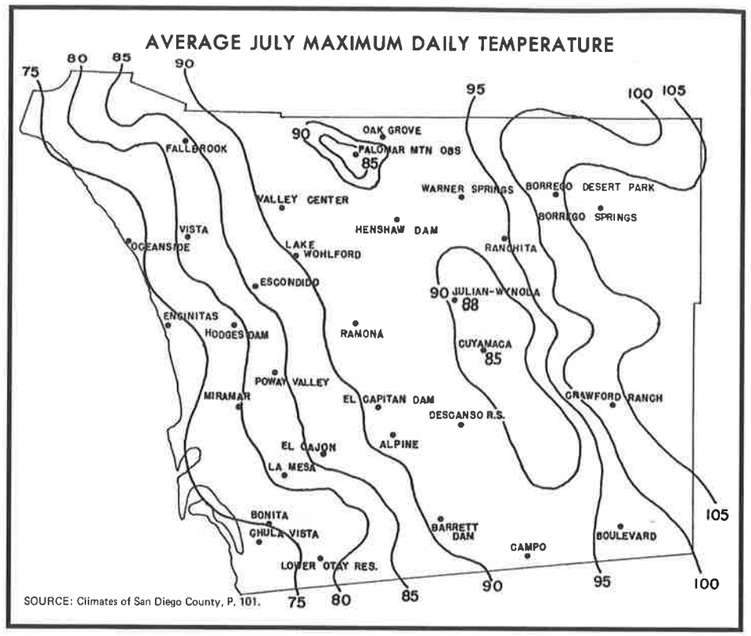

Figure 3.1.

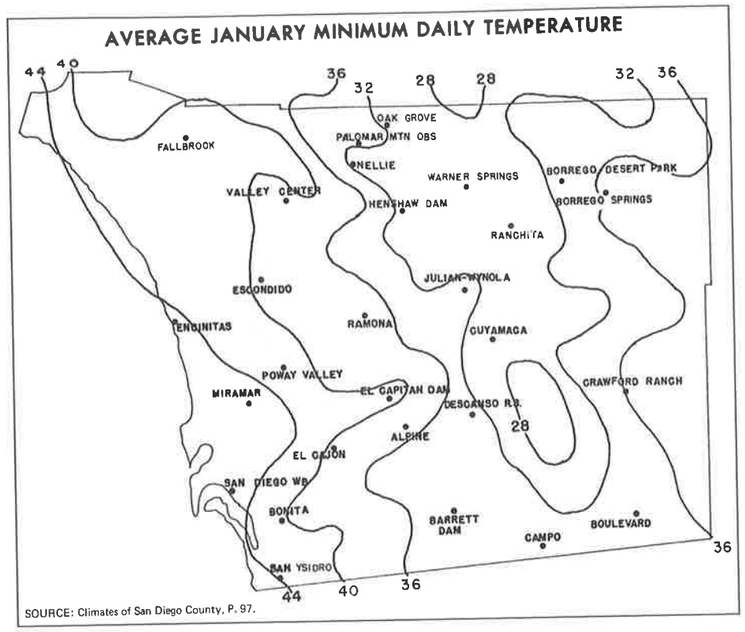

Figure 3.2.

with an average annual temperature of about 53°. Mountain areas tend to experience a greater range of temperatures, both daily and annual, than do coastal areas. The only subzero temperatures ever recorded in the county were a –4 and –1 at Cuyamaca State Park (Table 3.1).

Another common consequence of mountain ranges is to produce what is termed a *rain shadow* on the downwind side of the range. Thus, east of the Laguna crest, the average annual precipitation drops off very rapidly, and the community of Borrego Springs averages less than four inches of rain a year. The valley areas of Anza-Borrego Desert State Park form the westernmost portion of the great Sonoran Desert, and are one of the driest parts of the United States. In summer, they are also one of the hottest, with the daily high temperature from mid-June to mid-September averaging between 105° and 115°. Yet in winter, near-freezing temperatures are not uncommon. This great range in temperatures in inland locations is termed *continentality,* and illustrates how completely the mountains of the county block off the moderating influence of the ocean (Table 3.2). The average range of temperature for any one day in downtown San Diego is only about 16°, but in Borrego Springs it is over 30°.

Figure 3.3. Heavy snow in the Cuyamaca Mountains, illustrating decreased temperatures at higher elevations. Photo by P. R. Pryde.

The desert is not always the hottest part of the county, however. Under the influence of subsiding Santa Ana winds, Spring Valley or Fallbrook (or even Point Loma!) may record the highest temperature in the county, and all stations in the county have registered temperatures of over 100°. Except under Santa Ana conditions, though, the daily high temperature in Borrego Springs will be anywhere from 10° to 30° higher than in San Diego.

It is clear that the coastal belt, the mountains, and the deserts all have significantly different climates. Based on considerations of average temperatures and precipitation, the world can be divided into several different natural climatic zones, and four or five of these can be found in San Diego County. The four most common locally are (1) cool Mediterranean, (2) warm Mediterranean, (3) semiarid (or steppe), and (4) arid (or desert). The semiarid classification is sometimes divided into cool and hot subcategories, but the hot steppe region of San Diego county is found only in a relatively narrow belt as one descends the steep east face of the Laguna, Volcan, and San Ysidro (Hot Springs) mountain ranges, and thus is of lesser importance (Figure 3.4).

If almost any Californian were asked what climatic zone the city of San Diego lies in, they would probably respond "Mediterranean." But in fact, it does not! The entire coastal area of the county is properly classified as a semiarid

TABLE 3.1. Temperature and Precipitation Summary, Selected Stations

Weather Station	Elevation (feet)	Average Annual Precipitation (inches) (1971–2000)	Average Annual Temp. (F) (1971–2000)	Average July or August (a) High T (F)	Average January Low T (F)	Difference between All-time High and All-time Low T (F)
Alpine	1,700	18.7	63.8	90.3	38.0	94 (112:18)
Borrego Springs	625	6.9	72.8	106.0	36.5	106 (121:15)
Campo	2,630"	15.4	58.7	94.3	32.4	96 (108:12)
Cuyamaca	4,650	35.7	53.1	85.2	28.1	104 (100:-4)
El Cajon	525	12.8	65.1	88.2	36.7	93 (113:20)
Escondido	660	15.7	62.5	87.9	36.7	91 (108:17)
Julian/Wynola	3,655	27.5	57.4	88.4	32.5	95 (105:10)
Oceanside	60	11.2	60.6	72.9	42.6	78 (103:25)
Palomar Mtn./ Observatory	5,350	29.8	55.7	83.9	31.0	91 (100:9)
Ramona	848	17.1	61.7	91.4	36.5	85 (106:21)
San Diego/Lindbergh	13	9.9	63.2	78.0	45.4	77 (106:29)
Warner Springs	3,180	12.9	56.5	93.4	30.0	98 (109:11)

(a) Whichever is higher.

Sources: U.S. Weather Bureau, NOAA.

steppe climate. The reason for this is that the coastal strip, which receives only about ten inches of rain a year on the average, is too dry to be termed a Mediterranean climate. Most of the Mediterranean-type vegetation with which we have landscaped the metropolitan area could not survive the dry climate here if it were not regularly watered, as the average homeowner well knows. The sparse, brown vegetation seen on undeveloped mesas, such as the area around Miramar N.A.S., gives a hint as to our true climate. Only when one has gone inland far enough to receive about fourteen inches of rain a year (Alpine, Escondido) can the climate be accurately termed Mediterranean. In most inland valley and foothill areas, where the average temperature of the warmest month is above 71.6°, the climate is termed warm-summer Mediterranean, and in the higher elevations (Julian, etc.) it is a cool-summer Mediterranean. East of Julian, as noted above, the traveler quickly passes through a hot steppe transition belt, and then drops into the and or desert zone as soon as they are below about 3,000 feet elevation (Table 3.2).

These natural zones are useful ways of viewing the county, because of their close relationship to soils and vegetation belts. For example, the cool Mediterranean climate zone of the mountains corresponds quite closely to the areas of coniferous forests in the county. The rest of the chapter will examine the principal features of the soils and vegetation zones that are most common in San Diego County, and the wildlife found within them.

TABLE 3.2. Climatic Data for Representative San Diego County Locations

Station		J	F	M	A	M	J	J	A	S	O	N	D	Year
San Diego	High	64.6	65.4	67.7	69.2	70.9	72.6	76.8	78.0	77.6	74.4	72.1	67.0	71.4
	Low	45.4	46.9	50.2	53.8	57.0	59.8	63.4	65.5	62.2	57.8	51.4	47.2	55.1
	Average [c]	2.01	2.15	1.57	.79	.15	.05	.01	.08	.15	.49	.90	2.05	10.40
	Most [d]	6.26	5.31	5.89	3.58	.88	.28	.16	.87	2.58	2.90	5.82	7.60	24.93
El Cajon	High [a]	67.0	68.0	70.2	73.5	76.7	81.0	88.0	88.2	87.5	81.4	76.5	70.5	77.4
	Low [b]	36.7	38.8	40.9	46.1	49.9	53.6	57.6	58.4	55.6	48.9	40.2	37.5	47.0
	Average [c]	2.41	2.57	2.23	1.19	.46	.07	.04	.15	.23	.58	.93	2.22	13.08
	Most [d]	7.13	7.68	8.08	6.10	3.69	.88	.20	1.92	5.03	3.13	4.02	7.59	28.14
Palomar Mountain (West slopes)	High [a]	47.0	48.8	51.7	59.2	65.2	80.4	83.8	83.9	77.5	66.9	57.6	49.5	64.3
	Low [b]	31.0	31.5	34.9	37.6	40.6	51.3	57.4	57.3	51.4	44.7	37.8	32.0	42.3
	Average [c]	10.83	8.65	10.67	2.57	2.24	.18	.55	.60	.53	1.91	3.30	5.94	47.97
	Most [d]	44.41	16.78	36.88	9.94	7.21	1.14	3.75	1.70	4.40	6.79	9.99	26.90	82.21
Borrego Springs (airport)	High [a]	68.8	73.7	76.8	85.6	91.7	100.6	106.0	104.3	100.8	90.5	77.3	70.4	87.2
	Low [b]	36.5	40.6	44.6	51.4	56.0	62.6	70.3	69.4	63.6	54.2	42.9	37.4	52.5
	Average [c]	.51	.27	.34	.14	.01	.01	.12	.58	.16	.29	.38	.56	3.37
	Most [d]	2.17	1.44	1.35	.74	.13	.22	.46	5.51	1.10	2.64	2.56	3.05	10.75

[a] Average daily high temperature during the month.
[b] Average daily low temperature during the month.
[c] Average precipitation for the month, in inches.
[d] Greatest monthly precipitation ever recorded for that month, or (last column) for one year.
Source: *Climates of San Diego County: Agricultural Relationships*, pp. 38–42 and 60–65.

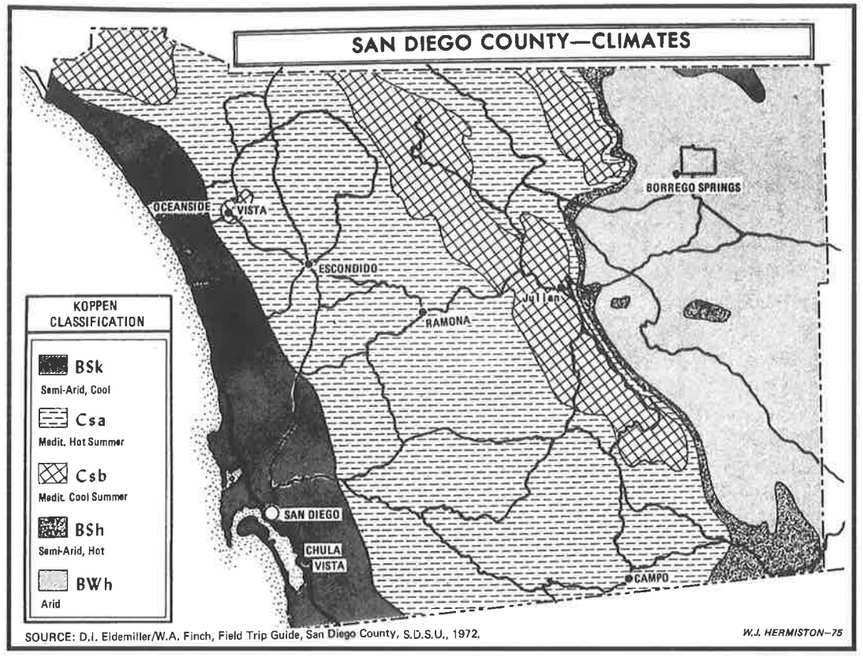

Figure 3.4. San Diego County's five main climate zones.

San Diego County Soils

Soils are an easily overlooked but extremely important component of the physical environment of any region. They not only support the area's natural vegetation, as well as the agriculture with which we replace this vegetation, but they are also the foundation for our homes and all the other structures of our neighborhoods and cities. Used with care, they provide the physical foundation of our civilization; abused, they can become an agent of its destruction, as the preceding chapter pointed out.

All soils contain varying amounts of organic and inorganic (mineral) matter, as well as water and air. They are a product of the weathered bedrock beneath them, and the decomposed organic (plant and animal) material on top of them. Climate and surface waters together with the various living agents of decomposition (worms, etc.) slowly transform these parent materials into soils. Depending on the area's climate and bedrock, thousands or even millions of years may be required for this process.

The majority of San Diego County, except for Anza-Borrego and Cuyamaca State Parks, has been well mapped in terms of its soils (see the "Soil Survey" reference at the end of the chapter). Soils that are similar are grouped together into what is known as a *soil series.* There are 53 of these series in San Diego County. Each has been studied to determine its suitability or limitations for certain types of uses, such as agriculture or construction. The Soil Survey rates their suitability for these uses as good, fair, or poor; their limitations (such as erodibility) are designated as slight, moderate or severe.

As an example, a commonly occurring soil in San Diego County is Diablo clay. Diablo clays have high shrink-swell characteristics, which means that moisture causes them to expand. Thus, they can cause cracks in buildings, and must be dealt with carefully in the course of urban construction. Further, these clays can precipitate landslides under adverse developmental conditions, as was observed in Chapter 2. On the other hand, Diablo clays are moderately fertile, and are a very good soil for growing certain truck crops, such as tomatoes.

Thus, it is a wise policy to learn about local soil characteristics before buying land for any purpose. It is particularly important to understand basic soil properties, and to hire a soils engineer, before committing land to any economic use involving significant capital expenditures or permanent structures.

On the coastal terraces, most of the soil series are comprised of sandy loams, clay loams, and clays. These range from poor to good for agriculture, depending on their depth and permeability. As noted above, clay soils pose problems for urban development, and are also underlain by an iron-silica hardpan, making either gardening or landscaping difficult. They are frequently poorly drained, causing numerous back-yard ponds during the wet season. On the other hand, some of the best soils in the region are found in the coastal river floodplains, and unless waterlogged or salinized are generally quite fertile.

In the foothills on the western slopes of the mountains, the soils are generally well-drained sandy loams or silt loams over decomposed granitic or metavolcanic rock. They are fairly fertile though often rocky, and support much of the county's extensive avocado acreage. As in the coastal province, the most fertile soils are generally found in the valley areas, such as around Lakeside, Ramona, and the San Pasqual and San Luis Rey valleys. Conversely, other areas are mostly rocky outcrops having almost no soil at all.

The higher mountain areas are characterized for the most part by usually well drained sandy loams over granitic bedrock. Due to rocky outcrops and generally steep slopes, these have limited agricultural potential, with the famous orchards around Julian representing a notable exception. Other agriculture in the mountains occurs mainly on relatively flat alluvial sandy loams, such as around Campo and Warner Springs, or on natural meadows as occur in the Laguna Mountains.

In the desert, the soils range from virtually none on the steep mountain slopes, to coarse sandy alluvial soils on the gentler slopes. If these latter are irrigated, as they are in the area north of Borrego Springs, they can support a variety of agricultural activities. Since in this area evaporation exceeds precipitation, these desert soils are often alkaline, and in low lying areas saline basins can develop, such as Borrego Sink and Clark Dry Lake. In easily erodible areas of moderate local relief, steep mazelike canyons called badlands may form, such as the scenic Borrego Badlands at Font's Point.

Vegetation Communities

Probably most San Diegans are unaware that California contains more plant and animal

species—6,717 according to The Nature Conservancy—than any other state. Even fewer may realize that San Diego is the most biologically diverse county in the state, and quite possibly in the country. This is because we have such a variety of natural climatic regions within the county.

Plant species are closely related to the type of climatic zone in which they are found, and animal life in turn corresponds to the plant composition. There are five major vegetation communities (also called biotic zones) within San Diego County: coastal sage scrub, chaparral, oak-pine woodlands, pinyon-juniper, and desert scrub. The areal expanse of these biotic zones exhibits a high correlation with the five basic climatic zones illustrated in Figure 3.4, and this correlation is further illustrated in the schematic cross-section of the county depicted in Figure 3.5. Within most of these five basic vegetation communities may be found two or three distinct types of subzones, or localized biotic communities, some of which are fairly limited in size though not necessarily in importance (Table 3.3).

The placing of the county's vegetation into five broad biotic zones necessarily involves a certain amount of generalization. There is no visible line in the natural world that precisely delimits these zones. Rather, their boundaries are usually wide transition zones. Neighboring plant communities tend to mutually "invade" one another, since similar soils and microclimates usually exist for some distance on either side of the generalized biotic zone boundary.

Coastal Sage Scrub

The Coastal Sage Scrub zone extends from the ocean inland to approximately the 1,500 foot elevation contour. The eastern boundary is necessarily very general, as chaparral species widely invade into the coastal zone, especially in canyons and on cooler north-facing slopes.

The Coastal Sage Scrub zone is characterized by a semi-open appearance, with most of the typical vegetation species not exceeding 3–4 feet in height. The dominant species include California sagebrush *(Artemisia californica),* flat-top (or California) buckwheat *(Eriogonum fasciculatum),* laurel sumac *(Rhus laurina),* and white and black sage (*Salvia apiana* and *S. mellifera*). This zone is also characterized by a large number of forbs (forbs are broad-leafed herbaceous plants, and include most small spring wildflowers), as well as many woody-stemmed flowering plants such as the attractive mimulus, also known as monkey-flowers. The zone also contains a large variety of both natural and introduced grasses, introduced varieties of mustard, and certain species of cacti such as prickly pear *(Opuntia littoralis).*

Within the coastal province, two other very familiar natural zones occur, the intertidal and coastal marsh-lagoon communities. Both of these are very fragile, and their intricate ecological relationships are easily disturbed (see Chapter Seven). The lagoons in particular are repeatedly threatened by development proposals and siltation, and for this reason, much effort has gone into their preservation.

Much of San Diego county's original Coastal Sage Scrub zone (over 70%) has been transformed by urban development (Table 3.4). Locations where it may still be found include undisturbed areas near Lake Hodges and the Otay lakes, Miramar Marine Air Station, and Point Loma. Two convenient places to study Coastal Sage vegetation are the nature trails in Florida Canyon in Balboa Park, and in the Bernardo Bay area of the San Dieguito River Park.

Chaparral

The Chaparral plant community is characteristic of inland hillsides, most commonly within

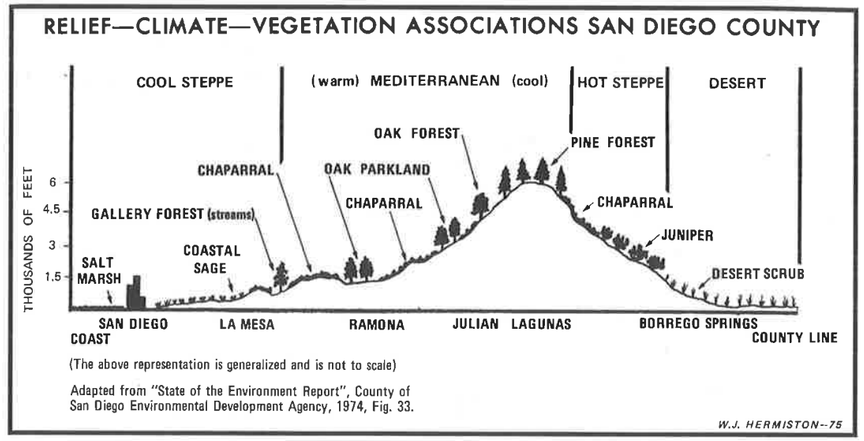

Figure 3.5.

an elevation range of from 1,000 to 5,000 feet. In terms of acreage, it is the most extensive biotic zone in the county (Table 3.4). On its western margins, it mixes freely with the coastal sage scrub, with several species, such as the laurel sumac and black sage, found in both zones. Here, the plants rarely exceed 5–10 feet in height. Further inland, at the zone's eastern margins where it mixes with pine-oak woodlands, typical mountain chaparral species such as manzanita *(Arctostaphylos spp.),* redshank *(Adenostoma sparsifolium),* and various oaks *(Quercus spp.),* may grow to fifteen feet or more. Other common chaparral species include chamise *(Adenostoma fasciculatum)* and several varieties of California lilac *(Ceanothus spp.).*

Chaparral is a remarkable plant community. First, chaparral plants must be able to survive the prolonged summer drought season. To do this, they have adapted both their root structure, which is extensive and deep, and their leaves, which are often waxy and curl easily to minimize evaporation losses. Second, they have developed the ability to recover readily from wildfire, which is a natural part of chaparral ecology and which is rapidly spread by these dense, tinder-dry woody plants in the summer and fall dry season.

Spring is a particularly attractive season in the chaparral, with the ceanothus and other shrubs and forbs displaying a profusion of wildflowers. Resident mammals, which generally prefer the more open edges and margins to the dense interior of the chaparral, include mule deer, fox, racoon, coyote, bobcat, skunks, and rabbits. Most of these common species, as well as others less often seen such as ringtail cat and mountain lion, are nocturnal, using the cover of darkness both for protection and to avoid the summer heat. Many species of birds and rodents have adapted themselves to the denser interior of the chaparral zone.

TABLE 3.3. Correspondency Table of Climatic and Biotic Zones in San Diego County

Biotic Zone/Subzone	Climatic Zone	Elevation Range	Some Typical Species of the Zone
1. Coastal Sage Scrub	Cool Steppe (BSK)	0–1500*	Flattop buckwheat, Calif. sage, Laurel sumac
1a. Intertidal		−5– +5	Mollusks, Anemones, Crustaceans, loose kelp
1b. Coastal Marsh/Lagoon		0– 20	Salicornia, Saltbush, Sea fig, grasses
2. Chaparral	Warm Mediterranean (Csa)	1000*–5500	Scrub Oak, Chamise, Ceanothus, Manzanita
2a. Riparian Woodland		50–5000	Cottonwood, Sycamore, Willow
2b. Oak Parkland ("Savanna")		3000–4500	California live oak, grasses
3. Oak and Pine/Oak Woodlands	Cool Mediterranean (Csb)	3500–6500	Black oak, Var. pines, Live Oak, Incense Cedar
3a. Southern Oak Woodland		3500–6000	Black oak, Coulter pine, chaparral sp.
3b. Coniferous Forest		4500[a]–6500	Jeffrey pine, Incense cedar, other pines
3c. Mountain Grassland		3500–6000	Grasses, Forbs
4. Pinyon/Juniper association (Chaparral is common in this zone, in which the main indicator species tend to be very very intermittent)	Hot Steppe (BSh)	5000–2000	Juniper, Yucca, Pinyon, Cacti, chaparral
5. Desert (or Creosote Bush) Scrub	Desert (BW)	3000– 0	Cresote Bush, Brittlebush, Ocotillo, Cacti
5a. Desert Riparian		2000–500	Mesquite, Ironwood, Smoke tree
5b. Palm Oasis		2000–500	Fan Palm

*The boundary between the Coastal sage scrub and chaparral communities is very imprecise as the two blend together over a wide elevation range. Chaparral can be found on north-facing canyon slopes at any elevation in the coastal province.
[a]3500 feet in Pine Valley

Two other major biotic communities can be identified within the chaparral zone. These are the riparian woodland and the oak parkland (or "savanna"). The riparian woodland is the familiar canopy of cottonwood *(Populus fremontii)*, willows *(Salix spp.)* and sycamores *(Platanus racemosa)* that are found along most of the larger streams in the county. This community has high aesthetic and wildlife habitat values, but is also highly depleted (Table 3.4). The oak parkland consists of widely spaced California live oaks *(Quercus agrifolia)* growing in natural grasslands, usually with various chaparral species attempting to invade from the edges. Easily seen oak parklands exist along I-8 and Highway 94 in the Boulder Oaks and Potrero areas, and around Ramona.

An excellent natural area in which to study chaparral vegetation is the Silverwood Wildlife Sanctuary on Wildcat Canyon Road. Although heavily burned in the 2003 "Cedar" fire, the chaparral here will recover.

Oak and Pine-Oak Woodlands

The oak and pine-oak woodlands are characteristic of the higher mountain areas, and are generally encountered above about 3,500 feet, corresponding to the cool mediterranean climatic belt. The dominant community in this biotic zone is the southern oak woodland, in which black and live oak *(Quercus kelloggii* and *Q. agrifolia)* dominate. There are commonly many chaparral species mixed in, especially on the margins and in recently burned areas. Above 5,000 feet, pines and oaks often occur in about equal proportion.

At elevations above 6,000 feet, the forest may become predominantly, or totally, coniferous. In

TABLE 3.4. Vegetation Communities in San Diego County

Community Type	Original Acreage	1990 Acreage	Percent Change
Chaparral (all types)	1,120,970	937,192	−16.4
Creosote bush and mesquite scrub	536,900	504,429	−6.1
Coastal sage scrub	480,260	135,370	−71.8
Desert transition	143,680	143,680	0
Native grassland and mountain meadow	142,160	23,730	−83.3
Oak woodland	109,400	105,680	−3.4
Coniferous forest (a)	79,010	79,010	0
Riparian woodland	34,580	13,570	−60.8
Desert wash and desert wash complex	26,080	26,080	0
Pinyon—juniper woodland	20,420	20,420	0
Coastal salt marsh	6,530	810	−87.6
Cypress woodland (a)	4,440	4,229	−4.8
Coastal strand	1,940	0	−100
Dry lake sink	1,580	1,580	0
Freshwater marsh	1,090	100	−90.8
Torrey pine woodland	310	250	−19.4
Urban-agricultural complex	0	339,030	
Disturbed grassland	0	203,760	
Agriculture	0	159,640	
Lakes and reservoirs	0	10,800	

Source: Adapted from T. Oberbauer, "Rare Plants and Habitats in San Diego County", 1990.
(a) The area of conifer forests was probably permanently reduced by the 2003 fires.

addition to Jeffrey and Coulter pine, incense cedar *(Libocedrus decurrens)* and white fir *(Abies concolor)* are locally common. In the more open areas, spring wildflowers, such as various species of penstamon and lupine, can be spectacular. Good examples of both the southern oak woodland and coniferous forests can be found in Palomar State Park, and along the Sunrise Highway (S-1) in the Laguna recreation area in Cleveland National Forest.

The third zone within the mountain province comprises areas of grasslands, the smaller of which are often called meadows. By far the largest mountain grassland in the county is around Lake Henshaw and Warner Ranch, which has long been used for cattle grazing. Unfortunately, most natural grasslands in the county have been taken over by introduced species (Table 3.4). Some, such as the Laguna meadows, may contain seasonal lakes.

Pinyon-Juniper Associations

The pinyon-juniper communities are found within the hot (arid) steppe belt on the eastern slopes of the county's Peninsular Ranges, but are not completely conterminous with it (Figure 3.6). Due to fires, topography, and unsuitable soils, these communities are localized to just a few regions within, or near, the hot steppe belt.

The community is named for two of the larger tree species found within it, California juniper *(Juniperus californica)* and pinyon pine *(Pinus monophylla)*. Also common within this community are several species of cacti and yucca, various chaparral plants, as well as a few desert species that can tolerate rocky slopes and slightly moister conditions.

The pinyon pine is now uncommon within the county. It was formerly more widespread, but was burned out in many areas due to a wildfire-inducing build-up of chaparral species within the pinyon-juniper community. This build-up was in part abetted by the policy of attempting to suppress all fires, which resulted eventually in such a fuel accumulation that the larger and hotter wildfires were able to decimate the community. Today, the policy of the Forest Service and other similar agencies is to manage undergrowth in conifer forests by various techniques, including deliberate controlled burns. Controlled burns, if done properly, can produce the combined results of protecting developed property, preventing dangerous levels of fuel build-up, and preserving the natural values of the conifer forests.

Because it is relatively small, there are no major sub-zones within the pinyon-juniper community. A good place to study this biotic association is along Highway 78 east of the base of the Banner Grade, and in the Box Canyon area along S-2. A huge pinyon pine, slightly out of place, is at the top of the hill on the Wooded Hill nature trail.

Desert (or Creosote Bush) Scrub

The desert scrub plant community is generally conterminous with the Sonoran desert climatic zone within the county. It is also sometimes referred to as the creosote bush scrub community after its dominant (or "indicator") species *(Larrea tridentata)*, also called (improperly) greasewood. Other common plants in this sparse but highly diverse community include ocotillo *(Fouquiera splendens)*, bursage *(Franseria dumosa)*, a large number of cacti *(Opuntia, Echinocereus,* and *Mammillaria spp.)*, and an even larger number of perennial and seasonal forbs and annual grasses.

The Sonoran desert is famous for its annual profusion of wildflowers. Their magnitude depends on the particular year's rainfall characteristics, but in wet years the blooming season usually extends from January to mid May, with the peak generally in March or early April.

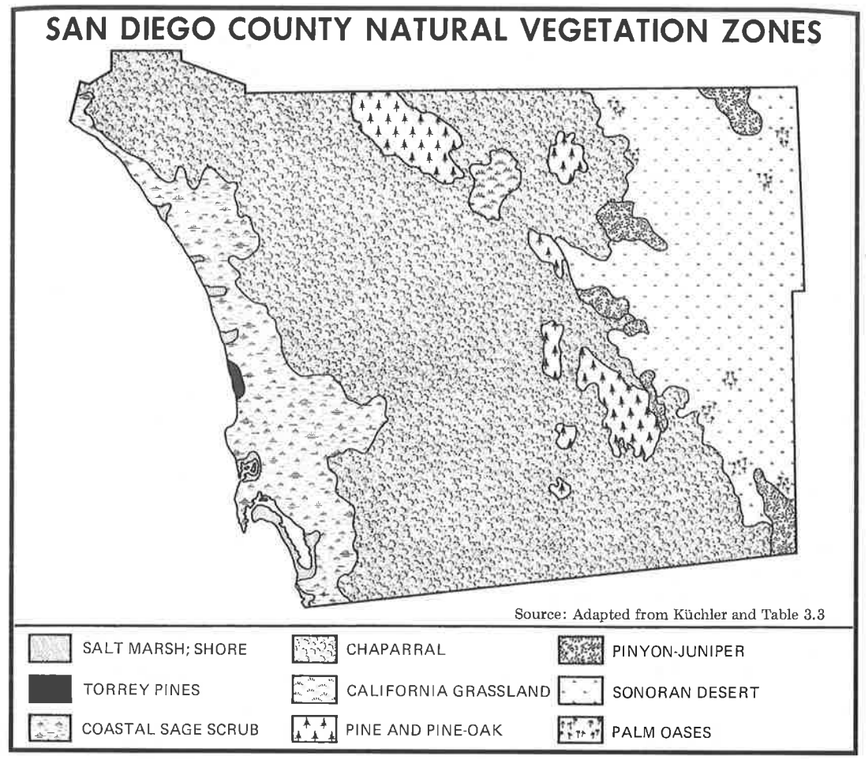

Figure 3.6. The major natural vegetation zones of the county.

In addition to the ocotillo and cacti, other colorful blooms include chuparosa *(Beloperone californica)*, brittle-bush *(Encelia farinosa)*, desert lavender *(Hyptis emoryi)*, desert primrose *(Oenothera deltoides)*, and sand verbena *(Abronia villosa)*. There are dozens of other less common flowers, one of the most looked-for being the desert lily *(Hesperocallis undulata)*, which usually blossoms right around Easter. The nature trail at the end of the road in Borrego Palm Canyon provides a good introduction to the profusion of desert species.

Within the desert zone are two important sub-communities, the desert riparian and the palm oasis. The desert riparian, like its chaparral counterpart, occurs along stream courses where somewhat more abundant sub-surface moisture allows larger and different types of

vegetation to exist. Two common species found here are mesquite *(Prosopis juliflora)* and ironwood. *(Olneya tesota)*. The spectacular palm oasis, most likely remnants of much larger palm forests that existed in an earlier and wetter era, are generally found near streams or springs that can supply their greater moisture requirements. They are comprised of the only native California palm, the fan palm *(Washingtonia filifera)*. The half-mile hike to the first grove in Borrego Palm Canyon is well worth the effort, especially during the winter and spring wildflower season.

In all of the county's biotic zones except the desert, wildfire is a significant annual threat. Summer and fall are the major fire seasons, but devastating brush fires can occur in any month (Table 3.5). Fire is a naturally occurring phenomenon in many semi-arid regions such as San Diego County, and the seeds of many plants in such biomes as chaparral and oak woodland will germinate only following wildfires. Under dry, Santa Ana wind conditions, brush fires can occasionally rage out of control and consume vast acreages and hundreds or even thousands of dwellings. The disastrous, fast-moving Cedar fire of October, 2003 was the largest in California's history, and destroyed over 2,200 homes and took at least 14 lives. It burned for over a week and extended from Miramar Air Station in San Diego to beyond Julian (Figure 3.7). It is incumbent upon those who live near canyons and in the backcountry to take all necessary measures to protect their property from wildfires.

Rare and Unusual Vegetation

There are many rare, endangered, unique, and introduced species of vegetation in San Diego County. The California Native Plant Society lists a total of 154 rare or endangered species of flora in the region, many of which are not found in any other county or state.

One of the best known is the familiar Torrey pine *(Pinus torreyana)*, restricted within the county to the coastal bluffs immediately north and south of Peñasquitos Lagoon. These trees depend on the frequent coastal fog for much of their moisture. Many of these trees are preserved in Torrey Pines State Reserve. Besides San Diego County, the only other place in the world they occur is on Santa Rosa Island in the Santa Barbara channel. Also in the coastal zone is found the endangered coast barrel cactus *(Ferocactus viridescens)*, as well as the unusual flora found in seasonal vernal pools.

TABLE 3.5. Some Major San Diego County Wildfires

Year	Name	Significance
1913, September	Barone	65,470 acres burned
1928, September	Witch Creek	33,240 acres burned
1956, November	Inaja (Santa Ysabel)	11 firefighters perished
1970, September	Kitchen Creek (Laguna)	180,000 acres burned
1985, July	Normal Heights (San Diego)	76 homes destroyed
1987, October	Palomar Mountain	16,100 acres burned
1989, August	Vail (Agua-Tibia area)	15,600 acres burned
1993, October	Guejito	20,720 acres burned
1996, July	Harmony Grove	8,600 acres and 110 homes burned
2001, January	Viejas (Alpine)	10,350 acres burned
2002, July	Pines (Banner, Ranchita)	62,000 acres and 37 homes burned
2003, July	Coyote (Chihuahua Valley)	19,000 acres burned
2003, October	Paradise (Valley Center)	56,700 acres and 221 homes burned
2003, October	Cedar (I-15 east to Julian)	273,000 acres and 2,230 homes burned

Unusual chaparral plants include the coast spice bush *(Cneoridium dumosum)*, which is actually in the citrus family, and a native species of orchid, the rein orchid *(Habenaria unalascensis)*. Also in the chaparral zone is the rare Tecate cypress *(Cupressus forbesii)*, found primarily on Otay Mountain where it is frequently subjected to fire losses, as it was in 2003.

The desert region is predictably rich in unusual vegetation. In addition to the fan palm and numerous annual flowers, another species of interest is the elephant tree *(Bursera microphylla)*. Elephant trees are common in Mexico, but in the United States occur only in Anza-Borrego Desert State Park.

In the foothill and mountain provinces there occur occasional small meadows called *cienegas*, These usually form in low-lying areas where the soil is sufficiently wet to prevent the development of chaparral species. They are comprised of a rich variety of grasses and forbs that are a favorite food of foraging animals.

Among what is now our county flora are almost 200 species of plants that were introduced from other parts of the United States or the world. Many of the grasses and forbs that are found in the coastal sage and chaparral zones may have been brought in by the early Spaniards, mixed in with hay or crop seeds. Numerous others have been more recently introduced into the urban areas. The most visible and best known non-native species are the many groves of towering eucalyptus trees, brought here from climatically analogous parts of Australia. In urban areas, practically all decorative plants, flowers, and trees have been introduced. This makes the naturally rich flora of San Diego County even more varied.

With the advent of the twenty-first century, one of the most insidious environmental threats most everywhere on earth are introduced ("alien") plant and animal species that disperse rapidly and overrun beneficial native species. This is most definitely true in San Diego County, especially as regards plants. Among the worst of the local invasive plants are various tamarisk species, giant reed (*Arundo donax*), castor bean (*Ricinus communis*), pampas grass (*Cortaderia jubata*), fennel (*Foeniculum vulgare*), star thistle (*Centaurea solstitialis*), perennial peppergrass (*Lepidium latifolium*), and a large selection of other introduced plants. Various public agencies in the county must spend millions of dollars annually, and enlist countless volunteer citizens to provide manual labor, in order to try to control these non-native invasives. Unfortunately, the task is only expected to get worse in the future.

Wildlife Resources

Although the wildlife resources of San Diego County are rich enough to merit a detailed treatment, it will be possible only to summarize them here. There are probably three main points that should be made concerning our native wildlife. First, the wildlife resources of the county are richer and more varied than the average urban dweller may realize. Second, urbanization has made significant changes in the composition and numbers of our wildlife. And third, many unusual or endangered species may be found in the county, and deserve our special consideration.

Many of the mammals of San Diego County, as elsewhere, are secretive and try to avoid contact with people, and many are nocturnal in their habits. The fact that we seldom see them, however, does not mean that they are not around. Mule deer are still plentiful in the county, as are the easily seen cottontails, jackrabbits, skunks, and a large variety of rodents. Less often seen, but nevertheless widespread, are opossum, raccoons, and twenty-one species of bats. Carnivores include bobcat, coyotes, ringtails, two kinds of foxes, and an increasing number of

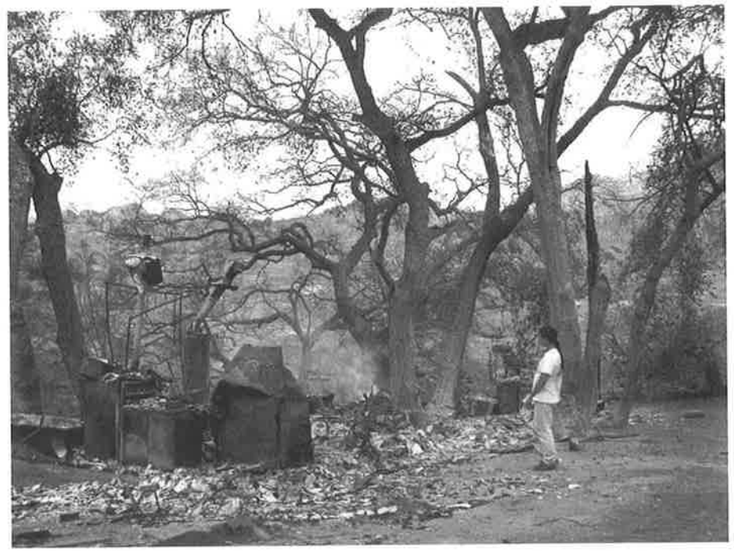

Figure 3.7. Remains of one of the residences as San Diego Audubon's Silverwood Wildlife Sanctuary following the vast 2003 "Cedar" fire. Photo taken by Pete Nelson on October 27, 2003.

mountain lions. The California grizzly bear has been extinct in the county since about 1901, although a mother black bear with cub was reported at Camp Pendleton in 1973, and several sightings were reported in 1999.

Reptiles include the common fence lizard, alligator lizard, and others; also several species of snakes, most of which are beneficial, including the three poisonous species. Among marine mammals, the sea lion, harbor seal, and of course the California grey whale are the most often seen. Other species of whales and dolphins may be encountered further offshore.

It is in terms of bird life that the county is truly outstanding. The annual Audubon Society Christmas bird census regularly turns up one of the highest counts recorded anywhere in the nation. The reasons for this outstanding selection of bird life are, first, the wide variety of natural zones and habitats in the county (Table 3.3), and second, our strategic location on the Pacific Flyway (the spring-fall migration route). The county is also an important wintering area for many species of birds, especially waterfowl and shorebirds which use our coastal lagoons and estuaries. In all, about 490 species of birds have been recorded in the county, of which about 170 breed here.

Urbanization inevitably brings changes to the wildlife populations that formerly inhabited an area. Some species, such as deer, quail, rodents, and some species of songbirds and waterfowl are capable of adapting to the human presence, perhaps even thriving because of the increased water and vegetation. Others, however, are less adaptable, and are usually eliminated as land is converted from a rural to an urban status. We have tried to compensate for the inevitable changes by protecting or improving the habitat of some of the remaining species. Numerous wildlife preserves have been established, artificial feeding and watering stations have been installed, and important breeding areas are posted and protected.

Many species have been so reduced in numbers that they have been given "endangered" or "threatened" status. Indeed, because of the uniqueness of San Diego's natural environment and the extent of local urbanization, San Diego County has more endangered species than any other county in the United States. Habitat destruction has been the most common cause of this.

The county's best known endangered mammal is probably the desert bighorn sheep. Several endangered or threatened species of birds nest in the county, of which the brown pelican, Bell's vireo, and least tern are probably the most familiar. Several others (including the symbol of our country, the bald eagle) are regularly seen here. There are also several endangered species of amphibians and invertebrates (butterflies, etc.) in the county. A complete list is given in Table 3.6.

Local governments are working to identify the most important wildlife habitats in the county, as a first step towards preserving the wildlife that utilize them. It is desirable to do this not just for aesthetic and educational reasons, but also to reap psychological and even economic benefits. The natural environment, like the built environment, is an important part of San Diego's heritage, and neither should be thoughtlessly destroyed.

To this end an extensive network of preserved lands and open space reserves has been created in the county (see Chapter 17). These are owned and managed by a variety of public and private entities, and virtually all are accessible to the public. Numerous excellent nature centers exist in the county, from the Tijuana Estuary Visitors Center in Imperial Beach to the unique underground state park visitors' center in Borrego Springs. These present marvelous opportunities for families and individuals to further acquaint themselves with San Diego's impressive natural environment.

TABLE 3.6. San Diego County: Endangered and Threatened Fauna

	Extir-pated?	Federal Endan.	Federal Threat.	Calif. Endan.	Calif. Threat.
Invertabrates					
Riverside fairy shrimp		X			
San Diego fairy shrimp		X			
Laguna Mountain skipper		X			
Quino checkerspot butterfly		X			
Fish					
Desert pupfish (introduced in ABDSP)		X		X	
Tidewater goby		X			
Unarmored three-spine stickleback (introduced)		X		X	
Southern steelhead trout		X			
Amphibians and Reptiles					
Desert slender salamander	?	X		X	
Arroyo toad		X			
California red-legged frog (extirpated)	X		X		
Mountain yellow legged frog	?	X			
Barefoot banded gecko			X		
Mammals					
Pacific pocket mouse		X			
Stephen's kangaroo rat		X			X
Peninsular bighorn sheep					X
Birds					
California brown pelican		X		X	
California condor (extirpated)	X	X		X	
Bald eagle (winter migrant)		X		X	
Swainson's hawk (winter migrant)					X
American peregrine falcon		X		X	
California black rail (extirpated)	X				X
Light-footed clapper rail		X		X	
Western snowy plover			X		
California least tern		X		X	
Marbled murrelet (only found offshore)			X	X	
California spotted owl					X
Yellow-billed cuckoo (extirpated)	X				X
Southwestern willow flycatcher		X		X	
Least Bell's vireo		X		X	
California gnatcatcher			X		
Bank swallow (formerly bred)	?				X
Belding's savannah sparrow		X			

* Species that are listed have some protection at the Federal or State level. Other species of concern that are not yet listed include: White abalone, Orange-throated whiptail, Flat-tailed horned lizard, Southwestern pond turtle, Golden eagle, Burrowing owl, San Diego cactus wren, Grasshopper sparrow, and many others.
There are also 32 species of plants on the federal or state lists.

Sources: San Diego County DPLU and San Diego Museum of Natural History.

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Internet Connections:

California Native Plant Society: *www.cnps.org*
San Diego Audubon Society: *www.sandiegoaudubon.org*
San Diego Natural History Museum: *www.sdnhm.org*
U.S. Weather Bureau: *www.nws.noaa.gov*