INTRODUCTION

Although much of the San Francisco Bay Region is densely populated and industrialized, many thousands of acres within its confines have been set aside as parks and preserves. Most of these tracts were not rescued until after they had been altered. The construction of roads, the modification of drainage patterns, grazing by livestock, and the introduction of aggressive species are just a few of the factors that have initiated irreversible changes in the region's plant and animal life. Yet on the slopes of Mount Diablo and Mount Tamalpais, in the redwood groves at Muir Woods, and in some of the regional parks one can find habitats that probably resemble those that were present two hundred years ago. Even tracts that are far from pristine have much that will bring pleasure to those who enjoy the study of nature.

Visitors to our region soon discover that the area is diverse in topography, geology, climate, and vegetation. Hills, valleys, wetlands, and the seacoast are just some of the situations that will have one or more well-defined assemblages of plants.

In this manual, the San Francisco Bay Region is defined as those counties that touch San Francisco Bay. Reading a map clockwise from Marin County, they are Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, and San Francisco. This book will also be useful in bordering counties, such as Mendocino, Lake, Santa Cruz, Monterey, and San Benito, because many of the plants dealt with occur farther north, east, and south. For example, this book includes about three-quarters of the plants found in Monterey County and about half of the Mendocino flora. Some species, in fact, are more common outside our region than within it. Nevertheless, it is important to keep in mind that the plants of the bordering counties are not comprehensively covered in this manual. In this edition, some species found in the San Francisco Bay Region, but not mentioned in previous editions, have been listed at the end of the appropriate group or family paragraph.

SCIENTIFIC NAMES, COMMON NAMES, AND GEOGRAPHIC RANGES OF PLANTS

The Jepson Manual (Baldwin et al. 2012) will be, for many years to come, the definitive reference on the flora of California. We have therefore followed its scheme of classification and its names for species, subspecies, and varieties.

Latin names in brackets are either those used in the first edition of *The Jepson Manual* (Hickman 1993) or in *Illustrated Flora of the Pacific States* (Abrams 1940). Unfortunately, common names for plants are not standardized as they are for birds and some other groups. We have attempted to provide one or two common names for each species.

Additional information that may be provided in connection with the Latin and common names of a plant consists of its region of origin (if the plant is not a native of California), its geographic range, and the extent to which it is rare or endangered. (See Abbreviations for an explanation of the symbols used.) A number in parentheses following a species denotes a color plate. The black-and-white drawings, except for those in "Illustrations of Plant Structures," are grouped at the beginning of the individual family keys and are referred to in the text as "(fig.)". An "(M)" after a family name indicates that it is a monocotyledon: those families are found in the latter part of the manual.

A few words should be said about geographic range. If the range is not mentioned, it may be assumed that the plant has a wide distribution, at least in California, although it is not necessarily plentiful everywhere. When the range is given, it is primarily concerned with the north-south distribution. For example, "Ma-s" means that Marin County is the northern limit of the species, and that the range extends well into southern California, perhaps to the state border or beyond it. The species could also occur, however, in the Sierra Nevada or the Sacramento Valley, but this book is not concerned with this portion of its geographic distribution. Similarly, although "SFBR" means that the species is found through much of the San Francisco Bay Region, its range may include other areas of the state.

Those already familiar with plants of the region will note that our scientific names reflect many changes that have been published since 1993. The changes are based on the reexamination of each species by specialists in the light of names that have been applied to it, and there are some striking departures from names that have been in use for a long time. Now with available techniques that can describe an organism's genetic make-up (DNA), biologists are discovering that some plants once thought to be closely related based on anatomical characters are not very genetically similar. Undoubtedly there will be many changes in how botanists group plants in the years to come.

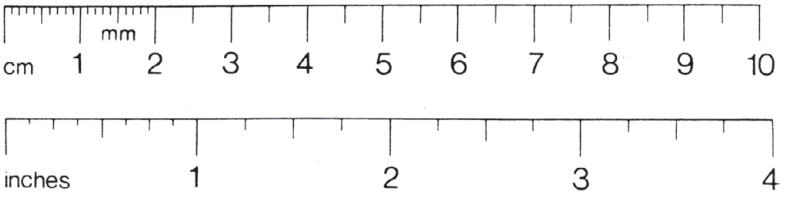
Some of the scientific names include the names of subspecies or varieties. The definitions for these entities have not been universally agreed upon by botanists. In general, the term "subspecies" (ssp.) should be applied to plants that differ rather clearly from those fitting the characteristics of the species, but not to the extent of warranting a separate species name. The term "variety" (var.) should perhaps be restricted to plants that differ from a spe-

cies or subspecies in relatively unimportant ways, such as the extent to which the leaves and stems are hairy.

MEASUREMENTS

In the keys, the height of plants and size of plant parts such as petals and leaves are given in metric units: meters (m), centimeters (cm), and millimeters (mm). These are routinely used in modern scientific work. Thus one can directly relate measurements in this book to those in *The Jepson Manual* and most other treatises. If you are not already familiar with the linear units of the metric system, a few comparisons with conventional units may be helpful. A meter, consisting of 100 centimeters, is slightly more than 39 inches. A centimeter, consisting of 10 millimeters, is about two-fifths of an inch, so 2.5 centimeters equal 1 inch, 5 centimeters equal 2 inches, and 25 centimeters equal 10 inches.

Temperatures are given on the Celsius scale, in which 0° equals 32° Fahrenheit and 100° equals 212° Fahrenheit. For altitude, long distances, and volumes, the conventional units—feet, miles, and gallons—are used.



Metric/English ruler

HOW TO USE A KEY TO IDENTIFY A PLANT

A key for plant identification takes advantage of contrasting characters, such as pink petals as opposed to blue petals, leaf blades with toothed margins as opposed to leaf blades with smooth margins, and so on. These characteristics are presented in a series of couplets. The two choices in the first couplet are 1a and 1b. If 1a is the better choice for the plant you are looking at, go to the next couplet—2a and 2b—under 1a. Don't wander into the territory under 1b! Similarly, if 1b happens to be the better choice, stick to the sequence of couplets under 1b.

The more you use keys of this type, the more quickly you will become familiar with the terms commonly used in plant classification. Experience, furthermore, will enable you to make judgments more quickly and to glide over choices that do not pertain to the specimen you are looking at.

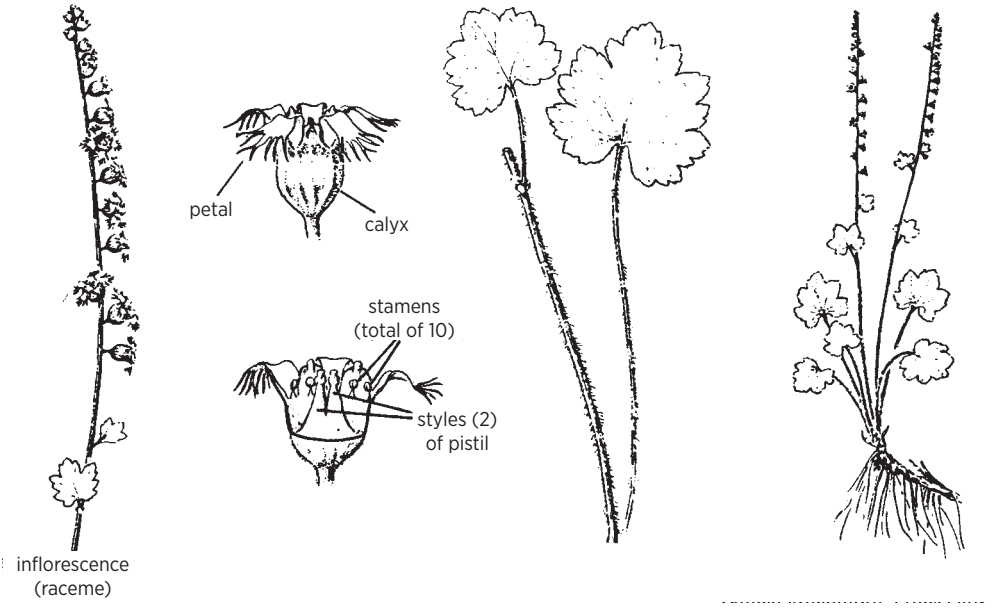
If you have not used a key before, the little exercise provided here will help you. An "unknown" is shown in the illustration. This plant belongs to the Saxifrage Family. Part of that family's key to species is reproduced below for you to use to "key out" the plant in the

drawing. If you are not familiar with some of the terms you encounter, look these up in the Glossary.

1a Stamens 3 or 5 (leaves lobed and toothed)
  2a Stamens 3; petals 4, 8–12 mm long; ovary superior (petals purple-brown, threadlike; leaves mainly basal, some of them sprouting plants that take root; moist banks) . . . . . *Tolmiea diplomenziesii* [*T. menziesii*] Piggy-back-plant; SFBR-n
  2b Stamens 5; petals 5, not more than 5 mm long; ovary half-inferior
    3a Leaves on stem, as well as basal (leaf blades up to 8 cm wide, lobed and toothed; inflorescence with more than 15 flowers; petals white; shady, wet areas) . . . . . *Boykinia occidentalis* Brookfoam
    3b Nearly all leaves basal, 1 or 2 along each stem if any
      4a Petals yellow-green, each with 4–7 hairlike lobes (leaf blades up to 5 cm wide; wet, shaded areas) . . . . . *Pectiantia ovalis* [*Mitella ovalis*] Mitrewort; Ma
      4b Petals white or pink, not lobed
        5a Calyx 1–3 mm long; styles 2–4 mm long, protruding well out of corolla; moist, rocky areas (widespread) . . . . . *Heuchera micrantha* (fig.) Small-flowered Alumroot; SLO-n
        5b Calyx 3–5 mm long; styles less than 2 mm long, scarcely protruding out of corolla if at all; coastal bluffs . . . . . *Heuchera pilosissima* Seaside Alumroot, Seaside Heuchera; SLO-n
1b Stamens 10 (petals 5; leaves mainly basal, stem leaves, if any, reduced)
  6a Styles 2 (moist, shaded areas)
    7a Petals pale green or nearly crimson, 3–7 mm long, each with 5–7 lobes; flowers in a raceme (ovary half-inferior; petals sometimes falling early) . . . . . *Tellima grandiflora* (fig.) Fringecups; SLO-n
    7b Petals white, 3–5 mm long, not lobed; flowers in a panicle

In certain choices, one or more characteristics, enclosed by parentheses, follow the basic features being contrasted. These characteristics give more information for that choice and all species under it. In choice 2a in the key example above, "(petals purple-brown, threadlike; leaves mainly basal, some of them sprouting plants that take root; moist banks)" applies to all the species under 2a. This information may be true for some of the species under 2b as well, but not all of them.

The plants in a particular family, being related to one another, share many characteristics. Usually there is not so much diversity in structure between the genera and species as there is between the numerous families. If you refer to the key to the families of herbaceous plants (p. 50), you can trace the path to get your unknown to the Saxifrage Family. First, you would determine that your plant belongs in Herbaceous Plants, Group 2 (p. 54) since it is not parasitic, grasslike, or aquatic. The early choices (1b, 2b, 4b, 6b, 7b, 9b, 13b, 14b, 15b, 16b, and 17b) would lead you to Group 2, Subkey 3 (p. 62) and subsequently (choosing 1b, 12b, 24b, 35b, 51b, 59b, 61b, 62b, 64b, and 65a) to Saxifragaceae (p. 68). That is when you would turn to the key for this family.



Tellima grandiflora
Fringecups

CONSERVATION

The best way to save our native plants and animals is to set aside large, undisturbed tracts where the flora and fauna are typical. The need for protection is especially urgent in areas to which rare or endangered species are restricted. Among private nonprofit organizations, The Nature Conservancy, the Trust for Public Land, the Peninsula Open Space Trust, and other organizations have been particularly effective in acquiring lands with a view to preserving natural communities of plants and animals. We also owe much to federal, state, and local agencies—including those that control the extensive acreages of watersheds—for protecting the fauna and flora in parks and other natural areas.

Botanical gardens, some of which are concerned entirely with the native flora, are doing a good job of displaying these species and providing educational programs about them, thereby increasing public awareness and appreciation of the California flora.

California, like many other states, has laws to prevent the digging or cutting of native plants on public lands. Historically, characters of roots and bulbs have been used to identify some plants. The keys in this book concentrate on the habits of growth and features of stems, leaves, flowers, and fruit that can be seen with a hand lens or without magnification, causing little if any damage to the whole plant. In the field, it is important to note the plant's natural setting. For example, what are the topography and soil like, what other plants grow nearby, does it grow in shade or sun? These types of observations often help in identification, and they may assist you in relating the plant to a particular ecological situation.

GROWING NATIVE PLANTS

By 1850, numerous species of plants found in western North America, especially California, had been described and illustrated in botanical journals and grown in Europe. But the use of California plants as subjects for gardens and in the revegetation of disturbed areas has developed slowly. In 1965, the California Native Plant Society was founded by some professional botanists and many enthusiastic amateurs. Although this organization was, from the beginning, concerned with protecting the flora, it has also raised public appreciation of native plants as garden subjects, especially those species that are drought-resistant. Seasonal sales conducted by regional chapters of the Society and by botanical gardens are excellent sources of plants, bulbs, and seeds, as well as information and advice. Members of local chapters receive notices of sales, field trips, classes, and programs about the California flora. Commercial growers, impressed by the turnout at native plant sales, have begun offering California native plants, and some nurseries now specialize in these plants. Furthermore, some landscape architects and garden installers now use native plants to a considerable extent.

SAN FRANCISCO BAY REGION PLANT COMMUNITIES AND THEIR ENVIRONMENTS

Topography and Climate

Long before there was a San Francisco Bay, the westward flow from the large river system of the Central Valley, fed mostly by streams draining the Sierra Nevada, cut through two low points in the Coast Ranges, creating what are now Carquinez Strait and the Golden Gate. Smaller rivers from the Coast Ranges contributed to the scouring process. Later, at the close of the last Ice Age, when glaciers melted, the sea level began to rise. Over a period lasting several thousand years, water from the ocean gradually flooded much of the low-lying area behind the Golden Gate. Thus San Francisco Bay was formed.

The Coast Ranges of the region consist of hills and substantial mountains whose orientation is from northwest to southeast. Close to the ocean are the Santa Cruz Mountains, Marin Hills (in which Mount Tamalpais is the highest peak), and the Sonoma Mountains. Inland, the Mount Hamilton Range, Diablo Range, and Berkeley Hills are separated by Carquinez Strait and Suisun Bay from the Vaca Mountains and the Mayacamas Range. Western portions of the latter are scarcely distinct from the Sonoma Mountains.

The Coast Ranges of the region, as mountains go, are not high—the top of Mount Hamilton is 4261 feet above sea level, Mount Diablo has an altitude of 3849 feet, and Mount Tamalpais reaches only to 2610 feet—but they are nevertheless barriers that impede the mixing of the inland air mass with the one that lies over the ocean. In general, therefore, the climate at the coast, influenced by the relatively stable temperature of the ocean, is more moist than the climate east of the mountains. Furthermore, the coastal area is cooler in summer and warmer in winter. But the topography of the Coast Ranges is complex. The val-

leys and ridges run in all directions, and there are numerous low points besides the huge gap at the Golden Gate. The large estuarine water mass of San Francisco Bay is another factor that conspires to create an extremely variable pattern of weather and perhaps more different "microclimates" within the nine counties of this area than will be found in almost any other area of comparable size. For instance, on a particular summer day, residents of San Francisco may be shivering in temperatures of 50°–60° Fahrenheit, while people in Walnut Creek, 25 miles inland, are seeking refuge from the heat. Furthermore, annual rainfall in the region may vary between 14 and 35 inches.

One inescapable attribute of some parts of the region is fog. Most of our summer fogs originate when humid and relatively warm air from the Pacific approaches the coast. The coldness of the ocean water offshore causes the moisture in the air to condense into tiny airborne droplets. Some fogs over San Francisco Bay are caused partly by the daily tidal exchanges of water. After water has run out through the Golden Gate at low tide, the incoming rush of colder water at high tide may induce condensation of moisture in the overlying air. Shadows of clouds, which abruptly lower the temperature of the air, may bring about the same effect. Occasionally, fog develops when humid air from the ocean reaches the hills and is cooled as it is deflected upward. The result may be an extensive fog bank lying atop or against the hills, or perhaps just small patches of fog that float not far overhead.

The higher ridges of the Coast Ranges may prevent low-lying fog from reaching the valleys farther east. At the Golden Gate, however, nothing stands in the way of a fog bank being pushed inland. The amount of water that moves through the gap in the form of fog is sometimes enormous. It can be as much as a million gallons an hour. The fog is essentially a cloud lying close to the surface of the water of the Bay or of the ocean. If it rises, then it becomes a cloud of the conventional type.

In summer, when it is hot in the Central Valley, the rising of warm air causes cooler air and fog to be drawn in from the coast. Much of this eastward flow passes through the area, accounting for many of our summer fogs. After reaching the Central Valley, the daytime warmth and relative dryness usually quickly evaporates the fog. At night, the weather in the valley cools down a bit, and because there is less warm air to rise, the influx of air from the coast slows down or stops. The next day, however, the weather in the Central Valley heats up again, and the cycle is repeated. The result: more summer fog on the west side of the Coast Ranges.

In winter, air is cooler at higher elevations than in valleys. Cold air, being heavier than warm air, sinks down into the valleys. The Central Valley receives cold air from both the Sierra and the Coast Ranges. When this cold air comes in contact with moisture from warmer bodies of water in the valley, fog results. Unlike the summer fog on the west side of the Coast Ranges, which may soon dissipate, this Central Valley fog cannot escape and in winter may remain for days at a time.

Fogs contribute to the moisture requirements of the vegetation. One reason for this is that high humidity and the presence of mist reduce the extent to which plants lose water to the atmosphere by evaporation. Furthermore, as mist condenses on foliage, some of the

water drips down onto the soil, contributing to the moisture deposited by rain. In fact, a study in one area a few miles south of San Francisco showed that annual moisture added to the soil by drip from foliage was considerably more than the amount deposited by rain.

What about rain? Rain falls when the fine droplets of water in a cloud coalesce into larger drops. If this type of condensation takes place at a freezing temperature, there will be snow. If, on the other hand, an updraft causes raindrops to be carried upwards until they are frozen, the result will be hail. Rain that freezes as it falls becomes sleet.

As previously mentioned, the complex topography of the region produces vastly different microclimates, each of which typically receives different amounts of rainfall. For example, San Rafael has an average annual rainfall of about 35 inches, whereas San Mateo, about the same distance from the coast, has only 21 inches. Martinez' yearly total is about 14 inches, but Orinda, not far away, gets nearly twice that amount, and even more than Berkeley, which faces the Golden Gate. The disparity between the amount of rain falling on the western slopes of the mountains and hills near the coast and on some areas inland is even more striking. There are places in the Santa Cruz Mountains where the annual rainfall reaches 60 inches, yet in the Santa Clara Valley, just behind the mountains, the total rarely surpasses 15 inches.

About 90% of the total annual rainfall throughout the San Francisco Bay Region occurs from October to April. Within this period, however, there may be dry spells that last several weeks, and in some years the amount of rainfall is much less than normal. The droughts may adversely affect the germination of seeds, the survival of seedlings, and even the growth, flowering, and fruiting of well-established plants. As a rule, heavy rainfall in the winter leads to a good display of spring flowers, especially annuals.

Soils

In the region under consideration, we find rocks of several distinctly different categories, including granite and basalt, which are of igneous origin, as well as shales, sandstones, and conglomerates, which are of sedimentary origin. Thus, because soil is primarily derived from rock, one may expect a wide variety of soil types to exist in the region.

As every gardener and farmer knows, not all plants grow well on all soils. Some of the attributes of a particular soil are shown by its general texture, its coarseness or fineness, its degree of acidity or alkalinity, the amount of organic matter it contains, its ability to retain moisture, the extent to which it allows air and water to penetrate, its supply of mineral nutrients, and the possible presence of substances that inhibit the growth of plants.

The majority of soils are mixtures of sand (particles from 0.02 to 2 mm); silt (particles 0.002 to 0.02 mm), and clay (particles smaller than 0.002 mm). Fine particles have more surface area, in proportion to size, than large particles. Thus, the more clay in the soil, the more water the soil will retain. Furthermore, soil particles consisting largely of negatively charged compounds of aluminum, silicon, and oxygen attract positively charged mineral nutrients such as calcium and potassium. The nutrients are held so tightly to the particles that rainwater draining through the soil does not remove them, but they are available to plants.

One particular situation common in the area deserves special mention. This is the presence of a type of rock called "serpentine," which consists to a large extent of magnesium silicate. It is typically somewhat shiny and slightly greenish, although after being weathered for a long time it becomes reddish brown and the soil into which it eventually breaks down is usually reddish. Serpentine is abundant in California, and an act of the legislature named it the State Rock. Outcrops of serpentine can be found on Mount Tamalpais, Mount Diablo, and Mount Hamilton, in the hills directly east of Oakland and Berkeley, and in Edgewood Park in San Mateo County.

Soils in which serpentine is an important component are, as might be expected, rich in magnesium. Plants need this metal in order to synthesize chlorophyll, as well as for other processes. When magnesium is present in large quantities, however, it interferes with the uptake of calcium, which plants also require, and which is scarce in serpentine soils. Inadequate supplies of other nutrients, including nitrogen, make life difficult for plants on serpentine soils, and the toxic effect of nickel and chromium, sometimes present in unusually high concentrations, is still another problem. These features prevent many plants from growing on serpentine soils. Species that tolerate serpentine flourish in the absence of competition from other plants, and some are found only where it is present. Notable serpentine lovers include the following:

TREES

Hespercyparis sargentii (Sargent's Cypress)

SHRUBS

Quercus durata (Leather Oak)

HERBS

Allium fimbriatum (Fringed Onion)

Allium lacunosum (Wild Onion)

Aquilegia eximia (Serpentine Columbine)

Aspidotis densa (Dense Lace Fern)

Calystegia collina (Woolly Morning-glory)

Carex serratodens (Saw-toothed Sedge)

Eriophyllum jepsonii (Jepson's Woolly Sunflower)

Hesperolinon micranthum (Small-flowered Western Flax)

Monardella villosa ssp. *franciscana* (Coyotemint)

Muilla maritima (Common Muilla)

Polygonum douglasii (Douglas' Knotweed)

Sedella pentandra (Little Stonecrop)

Streptanthus breweri (Brewer's Jewelflower)

Streptanthus glandulosus ssp. *secundus* (One-sided Jewelflower)

Toxicoscordion fontanum (Serpentine Star Lily)

Viola ocellata (Western Heart's-ease)

Principal Plant Communities

A "plant community," in the minds of most botanists, ecologists, and naturalists, is a relatively constant association of several to many species, certain of which predominate. A forest of Coast Redwoods is a good example, for *Notholithocarpus densiflorus* (Tanbark Oak), *Polystichum munitum* (Western Sword Fern), *Oxalis oregana* (Redwood Sorrel), and some other plants are commonly associated with this coniferous tree over much of its north-south range. Thus the entire assemblage may be called a "community."

In classifying vegetational assemblages, even in a rather restricted geographic area, it is best to maintain a flexible attitude. One community may intergrade with another, and an association of plants that seems to fit a particular type of community in a general way may deviate from that type in certain respects. For instance, a Douglas-fir Forest in Humboldt County, or farther north, will have several species of plants that are not present in a Douglas-fir Forest in Marin County. Nevertheless, it is convenient to be able to deal with the Douglas-fir Forest as an entity, so long as we are prepared to accept some variation in its composition.

Valley and Foothill Woodland

In the San Francisco Bay Region, Valley and Foothill Woodland occurs at elevations of about 300 to 3500 feet and includes much of the area occupied by the Mount Diablo and Mount Hamilton ranges and the hills in Napa and Solano counties. These inland habitats receive about 20 inches of rain each year and are rarely touched by fog except in the winter. The summer weather is warm, with daytime temperatures often exceeding 90° F.

The trees are generally somewhat scattered, so there is a well-lighted understory, with a few shrubs and a wide variety of herbaceous plants. Some of the more common and conspicuous plants of this woodland community are listed below.

TREES

Aesculus californica (California Buckeye)
Pinus coulteri (Coulter's Pine)
Pinus sabiniana (Foothill Pine)
Quercus agrifolia (Coast Live Oak)
Quercus chrysolepis (Canyon Live Oak)
Quercus douglasii (Blue Oak)
Quercus lobata (Valley Oak)
Quercus wislizeni var. *wislizeni* (Interior Live Oak)
Umbellularia californica (California Bay)

SHRUBS

Ceanothus cuneatus var. cuneatus (White Buckbrush)
Eriodictyon californicum (Yerba-santa)
Frangula californica ssp. *californica* (California Coffeeberry)
Heteromeles arbutifolia (Toyon)
Symphoricarpos albus var. *laevigatus* (Common Snowberry)
Toxicodendron diversilobum (Western Poison-oak)

HERBS

Cardamine californica (Milkmaids)

Collinsia heterophylla (Chinese-houses)

Dodecatheon hendersonii (Mosquito-bills)

Lithophragma heterophyllum (Hill Starflower)

Micranthes californica (California Saxifrage)

Nemophila menziesii var. *menziesii* (Baby-blue-eyes)

Pentagramma triangularis (Goldback Fern)

Phoradendron serotinum ssp. *tomentosum* (Oak Mistletoe)

Ranunculus occidentalis (Western Buttercup)

Riparian Woodland

The complex of trees, shrubs, and herbaceous plants usually found along streams and rivers form the Riparian Woodland community. The vegetation consists mostly of species that require more soil moisture than do the oaks and other constituents of Valley and Foothill Woodland. A few of the especially common plants of a Riparian Woodland in the region are listed below.

TREES

Acer macrophyllum (Big-leaved Maple)

Alnus rhombifolia (White Alder)

Platanus racemosa (Western Sycamore)

Populus fremontii (Fremont's Cottonwood)

Salix lasiolepis (Arroyo Willow)

Salix lasiandra (Pacific Willow)

Umbellularia californica (California Bay)

SHRUBS

Cornus sericea ssp. *occidentalis* (American Dogwood)

Lonicera involucrata var. *ledebourii* (Black Twinberry)

Oemleria cerasiformis (Osoberry)

Rhododendron occidentale (Western Azalea)

Rhus aromatica (Skunkbush)

Ribes sanguineum var. *glutinosum* (Pink-flowering Currant)

Rosa californica (California Rose)

Toxicodendron diversilobum (Western Poison-oak)

Vitis californica (California Wild Grape)

HERBS

Aralia californica (Elk-clover)

Claytonia perfoliata ssp. *perfoliata* (Miner's-lettuce)

Cyperus eragrostis (Tall Cyperus)

Mimulus cardinalis (Scarlet Monkeyflower)

Thalictrum fendleri var. *polycarpum* (Many-fruited Meadowrue)

Woodwardia fimbriata (Giant Chain Fern)

Redwood Forest

Natural forests of *Sequoia sempervirens* (Coast Redwood) are found from Monterey County to southern Oregon. The best known and perhaps most nearly pristine grove in our area is the one in Muir Woods, Marin County, but there are a few other good examples. Furthermore, some of the groves that had been cut down for lumber have made a fairly good recovery and will be found to have many of the plants that are characteristically associated with the Coast Redwood, including two trees, *Notholithocarpus densiflorus* (Tanbark Oak) and *Umbellularia californica* (California Bay). As often happens when an area is disturbed, however, the balance of species changes. Some become rare or disappear entirely, others become proportionately more or less common, and opportunists not previously present may add themselves to the mix.

Natural groves are found in areas that receive considerable annual rainfall—at least 35 inches—and that have frequent heavy fogs during the dry season. There are substantial plantations of redwoods in some places where they were not native, but these are not likely to have the usual associates. Many of the other plants typically found in Redwood Forests are listed below.

SHRUBS

Ceanothus thyrsiflorus var. *thyrsiflorus* (Blue-blossom)

Corylus cornuta ssp. *californica* (California Hazelnut)

Gaultheria shallon (Salal)

Rhododendron macrophyllum (Rosebay)

Rosa gymnocarpa (Wood Rose)

Rubus parviflorus (Thimbleberry)

Vaccinium ovatum (Evergreen Huckleberry)

HERBS

Adenocaulon bicolor (Trailplant)

Anemone oregana (Western Wood Anemone)

Asarum caudatum (Wild-ginger)

Athyrium filix-femina var. *cyclosorum* (Western Lady Fern)

Clintonia andrewsiana (Red Bead Lily)

Oxalis oregana (Redwood Sorrel)

Polystichum munitum (Western Sword Fern)

Prosartes smithii (Large-flowered Fairybells)

Scoliopus bigelovii (Fetid Adder's-tongue)

Trillium ovatum (Western Trillium)

Vancouveria planipetala (Inside-out-flower)

Viola ocellata (Western Heart's-ease)

Viola sempervirens (Evergreen Violet)

Closed-cone Pine Forest

A closed-cone pine is one whose cones do not simply open up as soon as the seeds are mature. The scales of the cones are held tightly together by pitch, and they are not likely to separate for several years unless the pitch is melted by fire or exceptionally warm sunshine.

Within our area, the only species forming significant natural stands of a closed-cone pine is *Pinus muricata* (Bishop's Pine). Its range, extending from Humboldt County to Baja California, overlaps that of *P. contorta* (Shore Pine) and *P. radiata* (Monterey Pine) (Santa Cruz, Monterey, and San Luis Obispo counties). Like these last two species, *P. muricata* is not found far from the coast. In Marin County, an extensive grove of this tree can be seen at Inverness Ridge, and there are specimens mixed with chaparral shrubs in the Carson Ridge area, northwest of Fairfax and San Anselmo. Other stands not too far away will be found in Sonoma, San Mateo, and Santa Cruz counties. Some common associates of the Bishop Pine include the following.

TREES

Quercus agrifolia (Coast Live Oak)

SHRUBS

Arctostaphylos (manzanitas; various species)

Baccharis pilularis (Coyotebrush)

Frangula californica ssp. *californica* (California Coffeeberry)

Toxicodendron diversilobum (Western Poison-oak)

Vaccinium ovatum (Evergreen Huckleberry)

Douglas-fir Forest

From southern Alaska to northern Sonoma County, there are dense forests in which *Pseudotsuga menziesii* (Douglas-fir), *Abies grandis* (Grand Fir), and *Tsuga heterophylla* (Western Hemlock) are the characteristic coniferous trees. Farther south—on Mount Tamalpais, on the Inverness Ridge, and in some other portions of our region—forests of Douglas-fir include some other plants not typical of this community farther north. Characteristic members of our region's Douglas-fir Forest in our region are listed below.

TREES

Abies grandis (Grand Fir)

Arbutus menziesii (Pacific Madrone)

Notholithocarpus densiflorus (Tanbark Oak)

Pseudotsuga menziesii (Douglas-fir)

Tsuga heterophylla (Western Hemlock)

Umbellularia californica (California Bay)

SHRUBS

Ceanothus thyrsiflorus var. *thyrsiflorus* (Blue-blossom)

Frangula californica ssp. *californica* (California Coffeeberry)

Toxicodendron diversilobum (Western Poison-oak)

HERBS

Polystichum munitum (Western Sword Fern)

Chaparral

Chaparral is a type of vegetation in which most of the obvious components are tough-leaved evergreen shrubs that are adapted for life in a relatively dry habitat. The word comes from Spain, where it has been used to refer to brushy places dominated by the chaparro, a kind of scrub oak. Although our chaparral does include a similar oak, it is not dominant and a variety of other shrubs and herbs are common. Some of these plants follow.

SHRUBS

Adenostoma fasciculatum (Chamise)

Arctostaphylos crustacea (Brittle-leaved Manzanita)

Arctostaphylos glandulosa ssp. *glandulosa* (Eastwood's Manzanita)

Arctostaphylos glauca (Big-berried Manzanita)

Arctostaphylos manzanita ssp. *manzanita* (Parry's Manzanita)

Arctostaphylos stanfordiana ssp. *stanfordiana* (Stanford Manzanita)

Ceanothus cuneatus var. *cuneatus* (White Buckbrush)

Ceanothus foliosus var. *foliosus* (Wavy-leaved Ceanothus)

Ceanothus oliganthus var. *sorediatus* (Jimbrush)

Cercocarpus betuloides (Birch-leaved Mountain-mahogany)

Eriodictyon californicum (Yerba-santa)

Heteromeles arbutifolia (Toyon)

Pickeringia montana (Chaparral Pea)

Quercus berberidifolia (Scrub Oak)

Ribes malvaceum (Chaparral Currant)

Salvia mellifera (Black Sage)

Toxicodendron diversilobum (Western Poison-oak)

HERBS

Castilleja affinis ssp. *affinis* (Common Paintbrush)

Pedicularis densiflora (Indian-warrior)

Salvia columbariae (Chia)

Chaparral is characteristic of hilly areas in which the soil, being gravelly or sandy, is well drained and does not hold water effectively. The vegetation is usually dense and often difficult to slog through. The shrubs are not often more than 2.5 m tall, but the foliage of most of them rubs us rather harshly. One of the few soft-leaved species in the list above is *Toxicodendron diversilobum* (Western Poison-oak), not to be contacted either.

During the dry season, chaparral is extremely vulnerable to fire, partly because of the density of the vegetation and partly because the foliage is not "juicy." A chaparral fire can be a very hot one; temperatures of over 1000° F have been recorded at ground level, and even 3

cm below the surface the temperature may exceed 300° F. Nevertheless, chaparral is capable of rather quick recovery. One reason for this is that certain shrubs, after being burned to the ground, sprout new shoots from the crown. Others come back only if seeds have survived the fire, or if seeds have been carried in from another area.

If there is ample rainfall during the growing season that follows a chaparral fire, there is likely to be a fine show of wildflowers, some of which may have been uncommon for several years preceding the fire. Among the plants that grow luxuriantly in fire-ravaged chaparral are the following.

SHRUBS

Adenostoma fasciculatum (Chamise)

HERBS

Ehrendorferia chrysantha (Golden Eardrops)

Emmenanthe penduliflora var. *penduliflora* (Whispering-bells)

Papaver californicum (Fire Poppy)

An interesting feature of chaparral in our region is that some of the shrubs begin to bloom in November or December. In the case of certain manzanitas, the opening of flowers is soon followed by production of new foliage; by late spring or early summer, the plants already have the buds of flowers that will not open until the arrival of the rainy season, several months later. Other shrubs of the chaparral, such as Chamise, flower in the spring, after they have produced new foliage.

Hill and Valley Grassland

Grassland is a treeless, shrubless vegetational assemblage that occupies large areas of California. Toward the end of the nineteenth century, three factors had begun to bring about an irreversible change in this kind of habitat. One of these was the conversion of grasslands into cultivated fields. Another was the sharp increase in over-grazing by livestock first introduced by the Spanish in the 1700s. Still another was the introduction of plants native to other parts of the world, especially annual grasses. Most of the native grasses were clump-forming perennials of the type called "bunchgrasses." They were literally grazed to death, and their demise was hastened by a lack of sufficient rain in certain years, which prevented them from generating enough new growth to compensate for the grazing they suffered. The aggressive introduced species—their seeds arriving on the hair of domestic animals, on clothing, and by other means—joined a few native grasses in filling up the space that was opened up for them. The introduced grasses die by summer, giving California's grasslands a "golden" appearance. It is likely that before the flora was significantly altered, there would have been a substantial green or gray-green component during the dry season.

It is now nearly impossible to find examples of pristine grassland. Nevertheless, there

are many localities where bunchgrasses and their natural associates have persisted, even though they have been diluted by introduced species. And it is our grasslands that provide the most spectacular displays of native wildflowers, most of which have survived change better than the native bunchgrasses.

The following list of herbaceous grassland plants is far from complete, but many of the common native and introduced species are included.

Achyrachaena mollis (Blow-wives)

Amsinckia intermedia (Common Fiddleneck)

Avena fatua (Wild Oat)

Briza minor (Little Quaking Grass)

Brodiaea elegans (Elegant Brodiaea)

Bromus diandrus (Ripgut Grass)

Bromus hordeaceus (Soft Cheat Grass)

Calandrinia ciliata (Redmaids)

Castilleja densiflora (Common Owl's-clover)

Cirsium quercetorum (Brownie Thistle)

Cynosurus echinatus (Hedgehog Dogtail)

Dichelostemma capitatum (Bluedicks)

Elymus multisetus (Big Squirreltail)

Erodium botrys (Broad-leaved Filaree)

Eschscholzia californica (California Poppy)

Hemizonia congesta ssp. *congesta* (Pale-yellow Hayfield Tarplant)

Hordeum jubatum (Foxtail Barley)

Lasthenia californica ssp. *californica* (California Goldfields)

Lepidium nitidum (Common Peppergrass)

Leptosiphon parviflorus (Common Whiskerbrush)

Logfia filaginoides (California Fluffweed)

Lupinus bicolor (Miniature Lupine)

Micropus californicus (Q-tips)

Microseris douglasii ssp. *douglasii* (Douglas' Microseris)

Nemophila menziesii var. *menziesii* (Baby-blue-eyes)

Plagiobothrys nothofulvus (Common Popcornflower)

Plantago erecta (California Plantain)

Platystemon californicus (Creamcups)

Ranunculus californicus var. *californicus* (California Buttercup)

Sanicula bipinnatifida (Purple Sanicle)

Sidalcea malviflora ssp. *malviflora* (Common Checkerbloom)

Sisyrinchium bellum (Western Blue-eyed-grass)

Viola pedunculata (Johnny-jump-up)

Coastal Prairie

Above cliffs along the coast, landward from the backshores of sandy beaches, and sometimes in other situations, are areas in which perennial grasses, a fern, *Pteridium aquilinum* var. *pubescens* (Western Bracken), and several other types of herbaceous plants predominate. Typically there are neither trees nor large shrubs. Such coastal prairies nearly fit our definition of grassland, and the distinction between the two types of plant communities is not sharp. Common members of this community are listed below.

Calamagrostis nutkaensis (Pacific Reed Grass)

Calochortus luteus (Yellow Mariposa Lily)

Danthonia californica (California Oat Grass)

Deschampsia cespitosa ssp. *holciformis* (Pacific Hair Grass)

Dichelostemma capitatum (Bluedicks)

Dichelostemma congestum (Ookow)

Festuca californica (California Fescue)

Festuca idahoensis (Idaho Fescue)

Grindelia hirsutula (Hairy Gumplant)

Heterotheca sessiliflora ssp. *bolanderi* (Bolander's Golden-aster)

Iris douglasiana (Douglas' Iris)

Lupinus formosus (Summer Lupine)

Lupinus variicolor (Varied Lupine)

Pteridium aquilinum var. *pubescens* (Western Bracken)

Ranunculus californicus var. *californicus* (California Buttercup)

Sanicula arctopoides (Footsteps-of-spring)

Sisyrinchium bellum (Western Blue-eyed-grass)

As for other plant communities, not all of the plants in the list will necessarily be found at a particular site that qualifies as Coastal Prairie. Furthermore, some habitats that may seem to fit into this category are not genuine. They have developed in places that once were brushy or forested, and that were cleared to promote the growth of native and introduced grasses that would provide favorable food for livestock.

Coastal Scrub and Coastal Forest

Close to the coast, from Monterey County to the Oregon border, is a type of vegetation called Coastal Scrub. It consists of a mixture of grassland plants and low shrubs. Coastal Scrub does not form a continuous north-south band; it is interrupted by Closed-cone Pine Forest, Coastal Prairie, and other plant communities.

A few good examples of Coastal Scrub are found in San Mateo, Marin, and Sonoma counties. An introduced shrub, *Cytisus scoparius* (Scotch Broom), is widespread at these localities. Other plants common in this community include the following.

SHRUBS

Artemisia californica (California Sagebrush)

Baccharis pilularis (Coyotebrush)

Heteromeles arbutifolia (Toyon)

Mimulus aurantiacus (Bush Monkeyflower)

HERBS

Anaphalis margaritacea (Pearly Everlasting)

Erigeron glaucus (Seaside Daisy)

Eriophyllum lanatum var. *achilleodes* (Common Woolly Sunflower)

Scrophularia californica (Beeplant)

Sisyrinchium bellum (Western Blue-eyed-grass)

Toxicoscordion fremontii (Common Star Lily)

Triteleia laxa (Ithuriel's-spear)

Close to the shores of San Francisco Bay (in Oakland and Berkeley, for example) oak woodland mixes with the open Coastal Scrub described above. In both of these areas the climate is much more temperate than the Valley and Foothill Woodland. Some of the components of Coastal Forest are listed below.

TREES

Corylus cornuta ssp. *californica* (California Hazelnut)

Sambucus nigra ssp. *caerula* (Blue Elderberry)

Quercus agrifolia (Coast Live Oak)

SHRUBS

Frangula californica ssp. *californica* (California Coffeeberry)

Toxicodendron diversilobum (Western Poison-oak)

Rubus ursinus (California Blackberry)

HERBS

Claytonia perfoliata ssp. *perfoliata* (Miner's-lettuce)

Stachys bullata (California Hedgenettle)

Vernal Pools

A vernal pool is a low spot in a meadow that fills with water during the rainy season, then dries out by the beginning of summer. This type of habitat almost always has an interesting community of herbaceous plants, some of which do not occur anywhere else. A few of the more common species found in vernal pools are listed.

Downingia concolor (Maroon-spotted Downingia)

Lasthenia glabrata (Yellow-rayed Goldfields)

Downingia pulchella (Flat-faced Downingia)

Limnanthes douglasii ssp. *douglasii* (Douglas' Meadowfoam)

Freshwater Marsh

The vegetation of marshy areas around ponds, lakes, and slow-moving, shallow streams consists primarily of cattails, bulrushes, and sedges. There are, however, other types of aquatic or semi-aquatic herbaceous plants in this habitat, and the more commonly encountered species are listed here.

Carex obnupta (Slough Sedge)

Cyperus eragrostis (Tall Cyperus)

Juncus balticus ssp. *ater* (Baltic Rush)

Juncus lescurii (San Francisco Rush)

Mimulus guttatus (Common Monkeyflower)

Oenanthe sarmentosa (Pacific Oenanthe)

Potentilla anserina ssp. *pacifica* (Pacific Cinquefoil)

Schoenoplectus acutus var. *occidentalis* (Common Tule)

Scirpus microcarpus (Small-fruited Bulrush)

Sparganium eurycarpum (Giant Bur-reed)

Typha latifolia (Broad-leaved Cattail)

Veronica americana (American Brooklime)

The water and muck in a freshwater marsh are typically slightly acid, and the availability of certain mineral nutrients that plants need—including phosphorus, nitrogen, and molybdenum—is often low. When this is the case, plant productivity is also low. The density of the vegetation is deceptive; it has been achieved slowly. Most of the common plants, incidentally, are perennials that are adept at vegetative propagation.

Our freshwater marshes are not as prevalent or as large as they once were. To a considerable extent, the decrease has been caused by the draining of marshes in order to make more land available for agricultural use and development, by diverting water needed for irrigation, and by building dams to create lakes.

Backshores of Sandy Beaches

Landward from the line reached by high tides on wave-swept sandy beaches, and also around certain bays, is an area on which loose sand is deposited by wind. This strip, ranging in width from a few meters to hundreds of meters, is called the "backshore." The stability of the sand depends on plants that are rooted in it and on the amount of organic matter and clay that it contains. Much of the organic matter will consist of the remains of previous generations of plants. Strong winds, especially when the tides are high, carry salt-laden droplets landward. Furthermore, the sand does not hold water very well and is generally poor in mineral nutrients that plants require. Its surface layer, on warm days, may absorb considerable heat from the sun. Being light in color, the sand also reflects heat back at the plants. The grayish or whitish hairiness of the foliage of certain species is probably protective, since it should help to reflect heat away from them. Some of the backshore plants are moderately to very succulent, storing up water that enables them to withstand extended periods during which there may be neither rain nor fog. As sand is blown about, it may accumulate in dunes, whose stability is constantly challenged. Even if a dune has been fairly thoroughly colonized by plants, a strong wind may uproot enough of the sand-binding plants to cause a breakdown of the whole dune. The vegetation of backshores includes certain grasses, many other herbaceous species, and a few shrubs. There are no trees, for the substratum is not conducive to the success of tall plants that are frequently exposed to strong winds.

An introduced plant, *Ammophila arenaria* (European Beachgrass), has been found to be an effective sand-binder, stabilizing dunes. It is more aggressive than the native *Elymus mollis* (American Dune Grass). Other efficient sand-binders are *Juncus lescurii* (San Francisco Rush), *Elymus pacificus* (Pacific Wildrye), and *Poa douglasii* (Sand Dune Blue Grass).

Some plants found on the dunes often form tight low mats and thus stabilize the substratum. A plant that may be a California native, *Carpobrotus chilensis* (Iceplant), was widely planted for this purpose, but is now being removed in some areas to encourage other native species. A few of these herbaceous species are listed below.

Abronia latifolia (Yellow Sand-verbena)

Abronia umbellata var. *umbellata* (Coastal Sand-verbena)

Acmispon maritimus (Hooked-beak Lotus)

Agoseris apargioides var. *eastwoodiae* (Coast Dandelion)

Ambrosia chamissonis (Silvery Beachweed)

Atriplex californica (California Orach)

Atriplex leucophylla (Beach Saltbush)

Calystegia soldanella (Beach Morning-glory)

Camissoniopsis cheiranthifolia (Beach Evening-primrose)

Erigeron glaucus (Seaside Daisy)

Eschscholzia californica (California Poppy)

Fragaria chiloensis (Beach Strawberry)

Heliotropium curassavicum var. *oculatum* (Seaside Heliotrope)

Lathyrus littoralis (Silky Beach Pea)

Plantago maritima (Sea Plantain)

Polygonum paronychia (Beach Knotweed)

Tanacetum bipinnatum (Dune Tansy)

The most conspicuous shrubby plant of the backshore habitat is *Lupinus arboreus* (Yellow Bush Lupine), native in our area but naturalized farther north. Its flowers are usually yellow, but there are forms with pale blue or pale lilac flowers. A little farther inland, where sand gives way to dirt, one may expect to see *Lupinus chamissonis* (Chamisso's Bush Lupine), whose flowers are always bluish. Some other common shrubs are *Artemisia pycnocephala* (Coastal Sagewort), *Baccharis pilularis* (Coyotebrush), and *Ericameria ericoides* (Mock-heather).

Coastal Salt Marsh

Salt marshes are typically found around the edges of bays and river mouths, where there is little wave action but where fine sediment—silt and clay—can gradually accumulate. The deposition of sediment is followed by an invasion of plants, arriving as seeds or fragments that can take root. Successful colonization leads to expansion of the plant community. The plants stabilize the substratum and trap more fine sediment.

The salt marsh is at a level that is submerged only during highest tides. The salinity varies according to the extent of tidal flooding, rainfall, freshwater runoff, and evaporation. Unless the rate of evaporation cancels out rainfall, and unless there is very little freshwater draining toward the salt marsh, the salinity of the marsh will probably be greater on

the seaward side than on the landward side. This accounts, in part, for the differences in vegetation.

The slope of an extensive salt marsh is usually so gradual that the surface of the marsh is nearly level. It is likely, however, to have shallow pools as well as a system of tidal creeks formed by the erosive action of tidal flow into and out of the marsh.

The pressures of civilization have led to destruction of salt marshes in many parts of the world. In San Francisco Bay, large tracts of cheap acreage were needed for airports, industrial sites, housing developments, farmland, race tracks, and dumps. Today not more than 25% of the area once occupied by salt marshes remains in a nearly natural state. A cursory look at the shoreline in populated areas will reveal the presence of industries whose wastes affect surviving marshes as well as ecological aspects of the rest of the Bay.

Most of the flowering plants characteristic of salt marshes are found nowhere else. In the salt marshes of San Francisco Bay, and those of Tomales Bay, Bodega Bay, and some other estuarine habitats within the region for which this book is written, the following species are especially common and widespread.

SHRUBS

Frankenia salina (Alkali-heath)

HERBS

Atriplex gmelinii (Gmelin's Saltbush)

Cuscuta pacifica (Salt Marsh Dodder)

Distichlis spicata (Salt Grass)

Jaumea carnosa (Fleshy Jaumea)

Limonium californicum (California Sea-lavender)

Plantago maritima (Sea Plantain)

Puccinellia nutkaensis (Alaskan Alkali Grass)

Salicornia perennis (Perennial Pickleweed)

Triglochin maritima (Common Arrow-grass)

Castilleja ambigua (Johnny-nip), *Glaux maritima* (Sea-milkwort), and *Salicornia depressa* (Slender Glasswort) are less common, or at least not widespread in salt marshes.

On the seaward side of the salt marsh, there will often be *Spartina foliosa* (California Cord Grass). It is submerged by tides lower than those required to inundate plants of the salt marsh proper. *Spartina alterniflora* (Salt-water Cord Grass), recently introduced from the Atlantic coast, is spreading aggressively in some places in San Francisco Bay.

On slightly drier and less saline soil landward of the salt marsh, members of the following characteristic assemblage of plants, including the introduced *Tetragonia tetragonioides* (New Zealand Spinach), may be encountered.

SHRUBS

Baccharis pilularis (Coyotebrush)

HERBS

Atriplex patula (Spear Orach)

Grindelia stricta var. *platyphylla* (Dune Gumplant)

Rumex fueginus (Golden Dock)

Spergularia macrotheca var. *macrotheca* (Sticky Sand-spurrey)

In mucky areas rarely if ever touched by high tides, the water is fresh or at most very slightly brackish. Here one will find *Schoenoplectus acutus* var. *occidentalis* (Common Tule), *Bolboschoenus robustus* (Seacoast Bulrush), and *Typha latifolia* (Broad-leaved Cattail)

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