CHAPTER II

AFFECTED ENVIRONMENT

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DATA SOURCES

HISTORICAL PERSPECTIVE

Information on historical (mid-1800s) through pre-CVP (early 1940s) biological resource conditions and trends was obtained from documents describing changes in the condition and extent of major habitats and species in California over the last two centuries. Parts of this section were adapted from Appendix X of the Sacramento River Service Area Water Contracting Program Draft Environmental Impact Statement (U.S. Bureau of Reclamation [Reclamation], 1988). Current status and historical trends for several species that illustrate overall trends in the Central Valley were summarized from a variety of published sources.

The approximate extent of common habitat types in the Central Valley immediately prior to the CVP was determined by planimetry of polygons within the Central Valley study area from Wieslander's (1945) map of California vegetation. This map is a highly generalized synthesis of more detailed maps prepared for U.S. Geological Survey (USGS) topographic quadrangles throughout the state. Results of the planimetry were rounded to the nearest 10,000 acres to indicate the approximate nature of these data. Classifications for the 1945 and existing habitat acreages were correlated where possible; however, direct comparison of 1945 and existing acreages for trend analysis is not possible for all habitats and should be attempted only with great caution, if at all. This problem results from the very generalized nature of statewide habitat mapping and differences in historical and modern habitat classifications (the wildlife habitat relationships [WHR] habitat classification system did not exist in 1945). Comparison of 1945 and existing habitat acreages could be improved by reinterpretation of Wieslander's detailed vegetation maps for each USGS quadrangle following the WHR habitat classification and possibly by inclusion of additional data sources. Detailed reinterpretation of historical vegetation mapping was beyond the scope of this PEIS.

RECENT CONDITIONS

Common Natural Terrestrial Communities

Descriptions of common natural communities were based on wildlife habitat descriptions published by the California Department of Forestry and Fire Protection (DFF) (Mayer and Laudenslayer, 1988), supplemented with information from California Department of Fish and Game (DFG) (Holland, 1986) and the California Native Plant Society (CNPS) (1993).

The distributions and acreages of common natural vegetation in the Central Valley study area regions (Shasta County to Kern County) were estimated from an unpublished, digitized habitat map of hardwood and other vegetation types prepared for DFF's California Forest and Rangeland Resources Assessment Program (FRRAP) (1988), modified and supplemented with data from

additional sources. The DFF map incorporates mapping from CALVEG and more recent hardwood mapping by DFF. Additional sources used to improve mapping detail in agricultural and urban areas of the Central Valley include a land use study of the Delta (California Department of Water Resources [DWR] 1993), various state maps showing city limits in large urban areas, and rectified Landsat Thematic Mapper imagery from August and September 1990 interpreted using GRASS image processing software from the U.S. Army Corps of Engineers (COE).

Information on wildlife commonly associated with major habitats was obtained from Mayer and Laudenslayer (1988), other available literature, and contacts with knowledgeable individuals at major reservoirs.

Riparian and Wetland Habitats

Information on the extent and types of riparian and wetland habitats in the study area were determined from existing published and unpublished data, including a land use study of the Delta (DWR, 1993), the U.S. Fish and Wildlife Service (Service) National Wetlands Inventory maps, Reclamation hydrographic data, DWR data (1987), and Natural Diversity Data Base (NDDB) information (1993).

Agricultural Habitats

Information on the extent of agricultural habitats in the Central Valley was obtained from county agricultural commission reports (see the Agricultural Economics and Land Use Technical Appendix). The value of these managed habitats to wildlife was described using existing literature.

Reservoirs

The extent of common habitat types at reservoirs was determined from an unpublished map of hardwood and other vegetation types prepared for FRRAP. Estimates of shoreline extent for various habitat types were based on estimates of the relative abundance of each common habitat type along the shoreline and data on shoreline mileage from Reclamation (1990a). Vegetation was not mapped in detail for the reservoir watersheds.

Rare Natural Communities

Descriptions and information on general distributions of rare natural communities were based on unpublished data from DFG (Holland, 1986; NDDB, 1993) and CNPS (1993).

Special-Status Species

Special-status species are plants and animals that are legally protected under state and federal Endangered Species Acts (ESAs) or other regulations, and species that are considered sufficiently rare by the scientific community to qualify for such listing. For the purpose of this study, special-status plants are species in the following categories:

- plants listed or proposed for listing as threatened or endangered under the federal ESA (50 CFG 17.12 [listed plants] and various notices in the Federal Register [proposed species]);

- plants that are candidates for possible future listing as threatened or endangered under the federal ESA (61 Federal Register 40, February 28, 1996); and

- plants listed or proposed for listing by the State of California as threatened or endangered under the California ESA (14 CCR 670.5).

Special-status animals are species in the following categories:

- animals listed or proposed for listing as threatened or endangered under the federal ESA (50 CFR 17.11 [listed animals] and various notices in the Federal Register [proposed species]);

- animals that are candidates for possible future listing as threatened or endangered under the federal ESA (61 Federal Register 40, February 28, 1996); and

- animals listed or proposed for listing by the State of California as threatened or endangered under the California ESA (14 CCR 670.5).

Information on the status, habitats, and distribution of special-status plants in the project area (Attachment B) was obtained primarily from the printed and electronic (data base) versions of the CNPS Inventory of Rare and Endangered Vascular Plants of California (Skinner and Pavlik, 1994) and from proposed and final rules on species listings in the Federal Register. Information on some species was supplemented with data from DFG's NDDB (1993). Additional species of concern (former Candidate Category 2 and Category 3 species, species identified by the California Native Plant Society, and other species the Service believes are declining) were considered in the analysis. These species are included in Attachment J.

Special-status plants and wildlife were initially selected for inclusion in the project area lists using the categories listed above for counties in the Central Valley and the Central Coast and San Francisco Bay regions that would be affected by the CVPIA. The resulting list includes all special-status species from valley and coastal lowlands to lower mixed conifer forests on the west slope of the Sierra Nevada, the east side of the inner North Coast Ranges, the San Francisco Bay Area and Delta and the Central Coast Ranges, and the Transverse and Peninsular ranges of southern California. Summary lists of species occurrence by habitat were prepared for the Sacramento River, Delta, San Joaquin River, and Tulare Lake regions.

Species profiles for plants and wildlife in the Central Valley that are federally listed and proposed for listing were prepared using published information, mostly from DFG and the Service. Species profiles are also provided for plants that are candidates for federal listing in the Central Valley because most or all of these could be proposed for listing during the environmental review period for the CVPIA.

Significant Natural Areas

Significant natural areas (SNAs) have no legal status (unless they include designated critical habitat for endangered species); however, the areas have been designated by DFG to increase awareness about California's natural diversity and identify opportunities to conserve these resources. Information on SNAs was obtained from the Natural Heritage Division of DFG.

Waterfowl and Shorebirds

Information on the distribution and numbers of waterfowl was obtained from DFG mid-winter waterfowl surveys, managers of state and federal wildlife refuges, individual refuge management plans, and other available literature. Shorebird data collected through the Pacific Flyway Project and Point Reyes Bird Observatory (Page et al., 1992; Shuford et al., 1993) are the basis for discussion of the numbers and distribution of shorebirds in the Central Valley.

HISTORICAL PERSPECTIVE

Areas receiving CVP water deliveries and potential water transfer areas contain some of the most varied natural habitats and highest biodiversity anywhere in North America (Barbour et al., 1991, 1993). Many of these resources have been severely reduced or degraded by human settlement, population growth, and economic development since the mid 19th century, but they remain a prominent part of California's natural and cultural landscapes.

OVERVIEW OF HISTORICAL TRENDS

Changes in the natural landscape began soon after Spaniards first settled in California during the 1770s. Coastal grasslands changed with the introduction of European grasses and forbs to help feed cattle and sheep, first near the missions and later on more remote ranches.

Early reports from European explorers described the herds of grazing animals in the Central Valley as rivaling the bison of the central plains or the antelope of South Africa (McCullough, 1971); waterfowl were widely distributed and abundant (DFG, 1983).

Early settlement affected a limited number of California's wildlife resources. The effects of over-harvesting of sea otters by Spanish, Russian, and American trappers were noticed as early as 1820 (Skinner, 1962). By 1845, Hudson's Bay Company fur traders had nearly eliminated the once plentiful beaver and other fur-bearing mammals from the Central Valley (Skinner, 1962). But the effects of this overharvesting did not compare with the results of the discovery of gold in 1848.

The California Gold Rush brought rapid population growth during the 1850s, particularly in the San Francisco Bay Area, Stockton, Sacramento, and the Sierra Nevada foothills. This population growth prompted increased farming on the rich valley soils and commerce along the major rivers. Riparian forests were cut for building materials and fuel for steamboats, particularly along the Sacramento River. Hydraulic mining in the foothills clogged the river channels with enormous quantities of sediment that worsened floods, which, even under natural conditions, could be

extreme. Laws were passed that facilitated reclamation of wetlands for agriculture and levee construction for flood protection.

California's wildlife provided the meat that fed the mining camps in the foothills and burgeoning cities of Sacramento, Stockton, and San Francisco. Market hunters butchered the once extensive herds of deer, pronghorn antelope, and tule elk that occupied the Central Valley (Dasmann, 1964). Wild duck, goose, quail, dove, pigeon, and rail were featured in all of the markets and restaurants of California (Skinner, 1962).

After the Gold Rush, California's promise of economic opportunity, exploitable natural resources, and a comfortable climate persuaded many former miners to stay and new immigrants to join them. In addition, the droughts of the mid-1800s, combined with extensive grazing, hastened the conversion of native perennial grasslands to non-native annual grasslands (Thompson, 1961; Barbour et al., 1993) and reduced the herds of native herbivores, such as deer (Longhurst et al., 1952).

Floods and drought imposed some of the earliest and most lasting constraints on economic development in the state. In response, federal and state water projects and legislation came to the aid of farmers and riverside communities wanting to manipulate water supplies and protect their properties from the annual threat of floods.

The Arkansas Act of 1850 made federal lands available to farmers who would reclaim wetlands; the Green Act of 1868 reduced restrictions on reclamation activities, thereby facilitating riparian deforestation; COE dredging began about 1918 in Delta channels previously filled with hydraulic mining sediment; and the federal Flood Control Act was passed in 1930. These actions brought profound changes to habitats supported by natural sources and cycles of water, particularly in the Central Valley.

When Shasta Dam, the first large CVP facility, was constructed in 1944, many of California's natural habitats had been altered dramatically and irrevocably from their near-pristine conditions of 150 years earlier. Extensive herds of grazing animals and their associated predators had been eliminated from the Central Valley. Approximately 30 percent of all natural habitats in the Central Valley had been converted to urban and agricultural lands (Table II-1). Further changes were to come as direct and indirect results of the CVP and other factors, particularly in habitats at the land-water interface in the Central Valley.

Case studies are provided for three habitats: riparian, freshwater emergent wetlands, and grasslands. These habitats were selected because they have been affected substantially by development in the Central Valley. Each case study provides a description of changes in vegetation and changes in distribution or status of selected species of plants and wildlife associated with that habitat. This then provides an estimation of an overall trend for all associated plant and wildlife species within that habitat. Individual species were selected if they occurred in the Central Valley, they were associated with the habitats described previously, and historical data were available.

TABLE II-1

HABITAT AREAS MAPPED BY WIESLANDER IN CENTRAL VALLEY

Habitat Type	Area by Subregion (Acres)							
	Delta	Sacramento River West	Sacramento River East	San Joaquin River West	San Joaquin River East	Tulare Lake West	Tulare Lake East	Total
Mixed conifer forest	0	540,000	2,910,000	0	850,000	10,000	270,000	4,580,000
Juniper	0	0	40,000	10,000	0	80,000	80,000	190,000
Valley foothill hardwood	0	1,260,000	1,710,000	280,000	1,440,000	80,000	870,000	5,650,000
Grassland	50,000	500,000	700,000	1,060,000	1,340,000	1,330,000	810,000	5,790,000
Chaparral	0	710,000	500,000	140,000	310,000	0	340,000	2,000,000
Desert scrub and alkali desert scrub	0	0	0	10,000	0	530,000	120,000	660,000
Coastal scrub	0	0	0	60,000	0	30,000	0	90,000
Freshwater emergent wetland	10,000	120,000	30,000	0	0	70,000	0	230,000
Agricultural and urban	670,000	1,620,000	1,340,000	810,000	2,040,000	750,000	780,000	8,020,000

NOTES:

Areas planimetered from Wieslander (1945) map of California vegetation and rounded to nearest 10,000 acres (apparent inaccuracies are due to rounding error).

Uncertainties of total habitat acreages are estimated to be ±15 percent. Uncertainties of most individual habitat acreages are variable (estimated at ±10-20 percent) and are caused by minor errors in planimetry and habitat mapping. Wetland acreages are least accurate because only a few large wetland sites were included in Wieslander's statewide map.

Mixed conifer forest includes Wieslander's "Pine", "Fir", "Pine-Douglas Fir-Fir", and "Lodgepole Pine-Whitebark Pine" categories.

Juniper includes Wieslander's "Pinyon Pine" and "Juniper" categories.

Valley foothill hardwood includes Wieslander's "Woodland (hardwoods)" and "Woodland-Grass" categories.

Fresh emergent wetland includes Wieslander's "Marsh" and "Lakes" categories (Tulare and Buena Vista lakes and the Delta). Numerous other wetlands were not mapped by Wieslander. Therefore, these values are conservative and data from Frayer et al., 1989, were used in the Draft PEIS analysis.

Wildlife Habitat Relationship (WHR) habitat types in the Central Valley, not distinguished by Wieslander (1945), include montane hardwood, valley foothill riparian, montane riparian, inland dunes, and some freshwater emergent wetlands.

RIPARIAN HABITAT

Vegetation

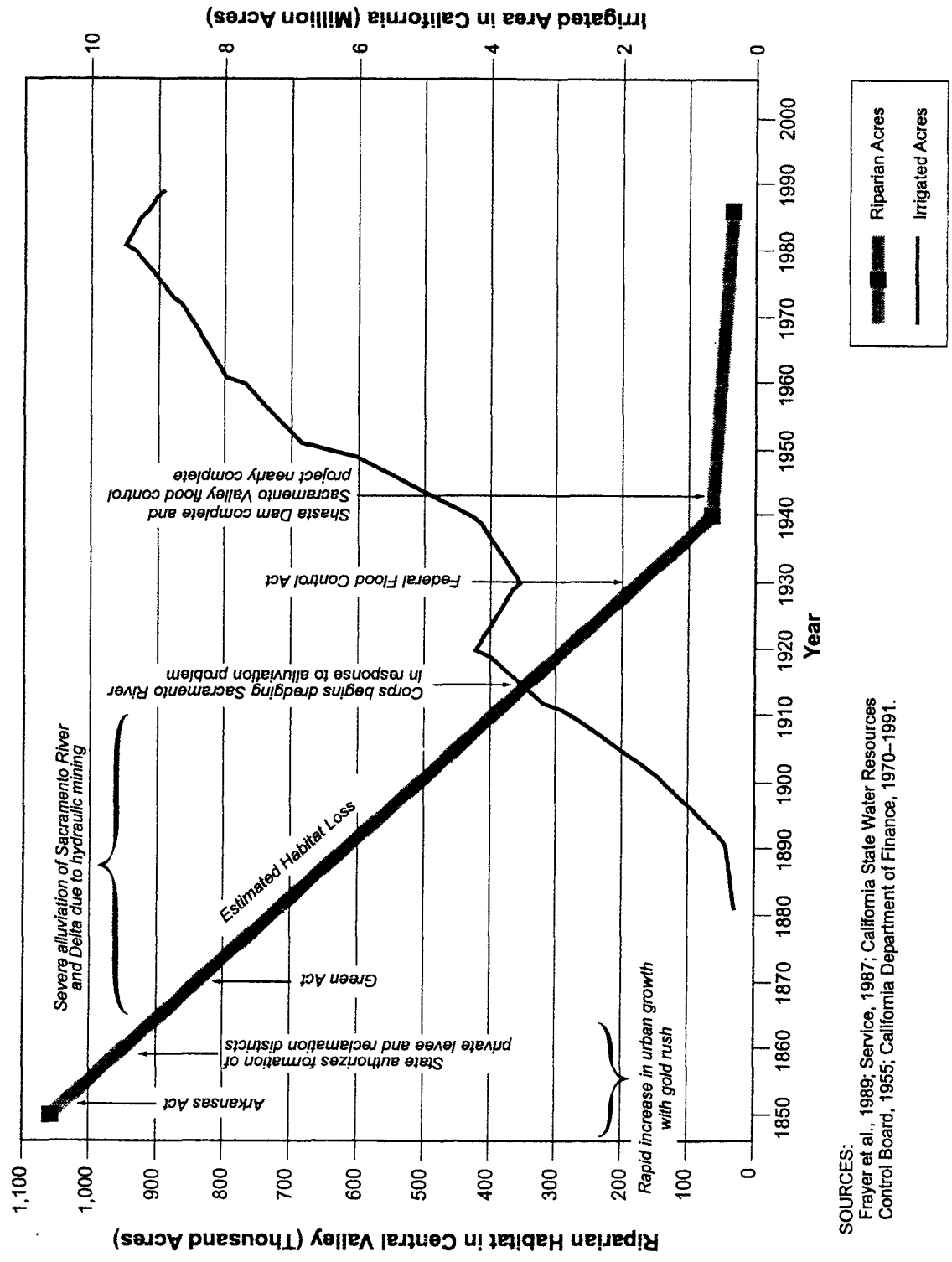
Presettlement Conditions and Extent. The Sacramento and San Joaquin valley floodplains originally supported vast riparian woodlands along their major rivers. Historical maps and accounts indicate the existence of continuous forests up to 5 miles wide along the Sacramento River, plus extensive forests on high terraces even farther from the river. The riparian forests were diverse in composition and structure and were often dominated in size and number by valley oaks (Thompson, 1961).

Estimates of the presettlement extent of riparian vegetation along the Sacramento River range from 800,000 (Roberts et al., 1977; Katibah, 1984) to 1,000,000 acres (Thompson, 1961; Service, 1984d, 1987), not including the extensive forests along some tributaries. Katibah (1984) estimated that another 50,000 acres of riparian habitat occurred in the San Joaquin Valley.

Changes Before CVP. At least 90 percent of the Central Valley's original riparian forest was lost before the CVP began operations (Figure II-1). On the Sacramento River, riparian forests were extensively cleared within a few decades of the discovery of gold. Trees were cut to fuel boats; build and heat towns; and make way for levees, farms, and harbors. Massive erosion from hydraulic mines in the Sierra Nevada filled the rivers and Delta with sediment; when the rivers were dredged to permit navigation, the spoils were deposited as levees in the riparian zone. During the first half of this century, more forests were lost to large-scale placer mining usingdredges (Katibah, 1984; Thompson, 1961). Levee building was nearly continuous in the Central Valley, except during the Great Depression of the 1930s. By 1939, the amount of woody riparian habitat in the Central Valley had been reduced to less than 100,000 acres (Frayer et al., 1989). By 1944, the Sacramento Valley Flood Control Project was nearly complete, with 980 miles of levees, 438 miles of channels and canals, and 95 miles of bypasses (Kahrl, 1979).

Changes Since CVP. In the mid-1980s, the area of mature riparian forest in the entire Central Valley was estimated to total about 34,600 acres (Frayer et al., 1989). Along the Sacramento River, an estimated 2 percent of the estimated historical riparian forest remained (McGill, 1979; McCarten and Patterson, 1987). Today, the cumulative loss of historical Central Valley riparian habitat may exceed 90 percent.

Factors contributing to this loss include continued conversion of nonirrigated land to irrigated agricultural land, levee construction and maintenance, bank erosion, bank protection, groundwater extraction, and flow regulation. Dams have flooded riparian vegetation in their impoundments and degraded it downstream by altering flows and geomorphic processes. Flood control has interfered with natural processes that affect forest regeneration. Because of the many factors involved, the specific contribution of the CVP to riparian habitat loss cannot be quantified.



SOURCES:
Frayer et al., 1989; Service, 1987; California State Water Resources Control Board, 1955; California Department of Finance, 1970–1991.

FIGURE II-1

RIPARIAN HABITAT TRENDS IN THE CENTRAL VALLEY

Yellow-Billed Cuckoo

Presettlement Conditions and Extent. The yellow-billed cuckoo nests in large (greater than 80-acre) stands of dense willow-cottonwood forests along the edges of rivers, sloughs, and lakes (Laymon and Halterman, 1989). Records indicate that yellow-billed cuckoos once nested in the riparian forests of the larger coastal valleys from San Diego County to Sonoma County; the length of the Central Valley; the Owens Valley; the south coastal wetlands in Ventura, Los Angeles, Orange, and San Diego counties and along the Santa Ana and Mojave rivers in San Bernardino County; along the Colorado River in Imperial County; and sporadically in Siskiyou, Modoc, and Lassen counties (Grinnell and Miller, 1944).

Changes Before CVP. Historically, high breeding densities of yellow-billed cuckoos occurred in Surprise Valley in Modoc County, in the Sacramento Valley, locally in the San Joaquin Valley, in south coastal wetlands, and along the Colorado River. Estimates of high breeding densities may be conservative, however, because much of the riparian forests had been removed (Figure II-1) prior to publication of early ornithological records, such as Dawson's (1923) description of California birds (Gaines, 1974a; Gaines and Laymon, 1984).

Changes Since CVP. Surveys conducted in 1977 determined that the statewide population of yellow-billed cuckoos had substantially declined (Gaines and Laymon, 1984). This decline was attributed to a loss of riparian habitat and widespread spraying of DDT and other chlorinated hydrocarbons that killed insects serving as prey for cuckoos (Gaines and Laymon, 1984).

Another statewide survey conducted in 1986 and 1987 estimated that there were 31 to 42 nesting pairs of yellow-billed cuckoos in California. This estimate represented a 66 to 88 percent decline in nesting pairs since the 1977 surveys (DFG, 1992). The continued decline resulted in the California Fish and Game Commission's listing of the yellow-billed cuckoo as endangered in 1987.

EMERGENT WETLANDS

Vegetation

Presettlement Conditions and Extent. In normal rainfall years, vast portions of the Central Valley flooded as winter and spring runoff collected in the low areas. Extensive wetlands formed behind natural river levees, especially in the Butte Creek sink, Colusa basin, the Delta, and the Tulare Lake basin. The Sacramento and San Joaquin rivers merged in an inland Delta containing more than 60 islands and more than 700 miles of waterways. Most of the Delta islands were marshy and some had a shrub overstory (DFG and Service, 1980). Numerous other types of wetlands also existed in the CVP service area. Seasonal wetlands, such as vernal pools, alkali meadows, and valley sink scrub, developed in the Sacramento and San Joaquin valleys. Montane meadows were common in canyon bottoms along rivers and creeks.

Estimates of the original extent of California's wetland and open-water habitats range from 2 to 5 million acres (Dennis and Marcus, 1982; DFG, 1983; Frayer et al., 1989). The Central Valley contained an estimated 4 million acres of permanent, seasonal, and tidal wetlands (Frayer et al., 1989; Dennis and Marcus, 1984). Marsh occupied approximately 500,000 acres, 60 percent of

this in the Delta (Kahrl, 1979; DFG, 1983). These estimates do not include areas of vernal pool, alkali meadow, alkali sink scrub, and montane meadow habitat.

Changes Before CVP. By 1939, Central Valley freshwater wetlands had declined from about 4 million to approximately 483,000 acres (Frayer et al., 1989), an 88 percent loss (Figure II-2). Statewide, the highest rate of wetland loss occurred between 1906 and 1922 (Dennis and Marcus, 1982). The many reasons for these declines parallel those described earlier for riparian habitats. The largest declines occurred early in this century, when reclamation and flood control combined to accelerate conversion of wetlands to irrigated agricultural land.

Changes Since CVP. The area of freshwater emergent wetlands in the Central Valley declined from about 483,000 acres in 1939 to about 243,000 acres in 1985 (Frayer et al., 1989), a 50 percent decline since shortly before the CVP began. In the San Joaquin Valley, an estimated 92 percent of the historical permanent and seasonal wetlands have been drained and reclaimed for agriculture; only 85,000 to 91,000 acres of managed wetlands remain. The most dramatic decline has been in the Tulare Lake Region, where only 4 percent of historical wetlands remain (San Joaquin Valley Drainage Program, 1990). The cumulative loss in the Central Valley now exceeds 90 percent. In addition, Holland (1978) estimated that 70 to 95 percent of historical vernal pool wetlands have been lost.

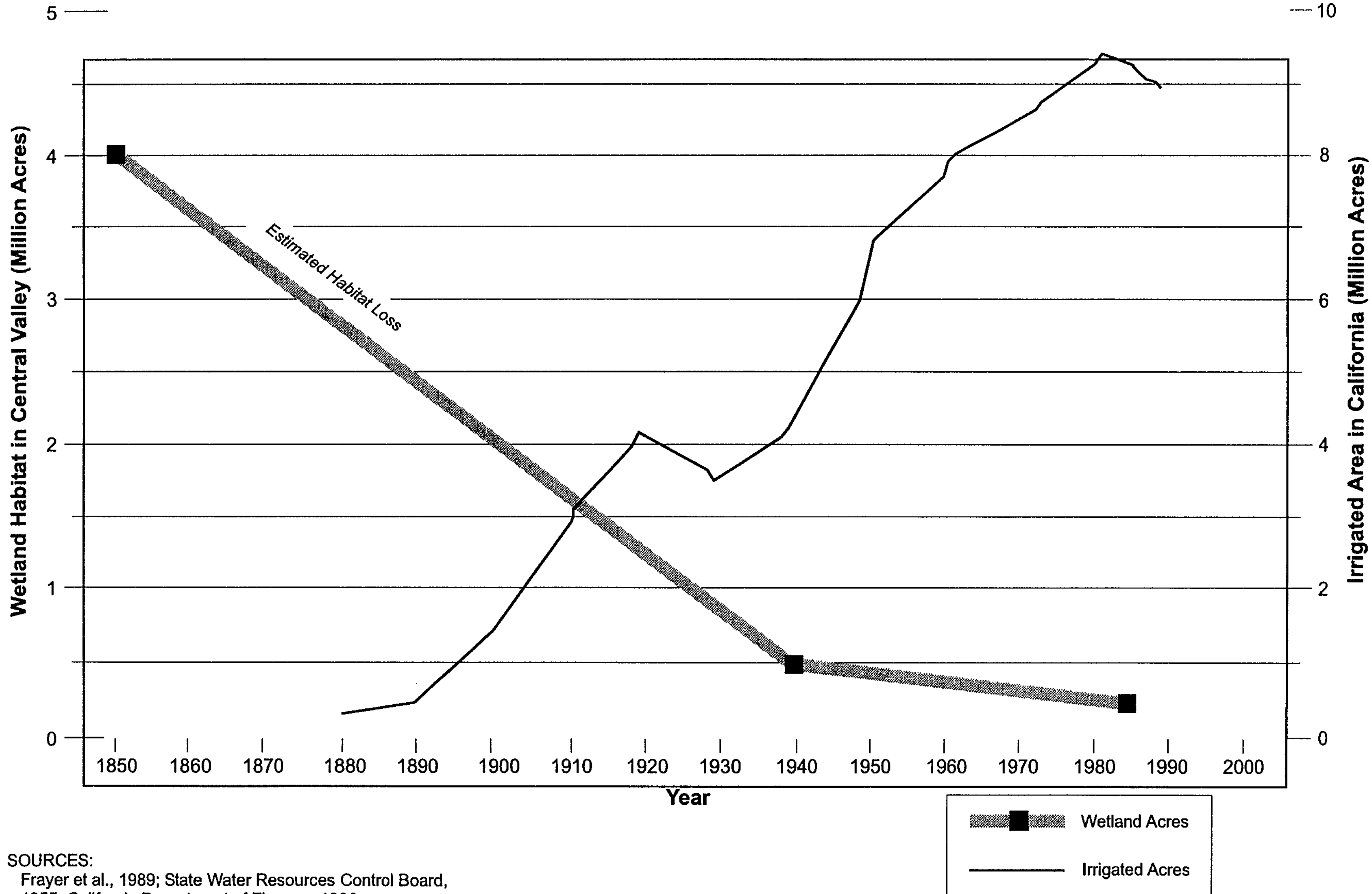
Many factors and many water projects contributed to post-CVP wetland declines. Some of the loss can be attributed to agricultural and urban conversions facilitated by CVP water deliveries and flood protection.

Rose-Mallow (California Hibiscus)

Presettlement Conditions and Extent. Rose-mallow (also known as California hibiscus) is a bushy perennial herb in the mallow family. It grows among dense freshwater marsh vegetation, on wet riverbanks along the Sacramento and lower San Joaquin rivers, and on low peat islands in the Delta. It grows up to 10 feet tall and has large leaves, but surrounding vegetation often conceals the hibiscus until its large, white flowers appear in August (EDAW and WESCO, 1981).

Changes Before CVP. The historical range of rose-mallow included the banks and backwaters of the Sacramento River as far north as Red Bluff, the Delta region westward to about Antioch, and the lower San Joaquin River as far south as Lathrop.

Changes Since CVP. Current distribution of the rose-mallow is primarily in the central and eastern Delta, and a few scattered disjunct populations remain in Glenn and Butte counties. Within its current range, the numbers and sizes of populations appear to be much less than in the last century (EDAW and WESCO, 1981). This decline is attributed to habitat loss, which is a frequent result of flood control, levee protection, bank protection, and erosion control projects and agricultural, urban, and recreational development (EDAW and WESCO, 1981; Skinner and Pavlik, 1994). Rose-mallow appears to be intolerant of brackish water; therefore, some of its decline may also be due to saltwater intrusion into the Delta that results in part from water diversions. Altogether, about 94 percent of freshwater emergent marsh has been eliminated from



SOURCES:
Frayer et al., 1989; State Water Resources Control Board, 1955; California Department of Finance, 1990.

FIGURE II-2

FRESHWATER EMERGENT WETLAND TRENDS IN THE CENTRAL VALLEY

May 1997

the Sacramento River and Delta since the 1840s (see "Overview of Historical Trends"), and this is probably a reasonable estimate for the cumulative amount of rose-mallow loss also.

Giant Garter Snake

Presettlement Conditions and Extent. The giant garter snake is endemic to the freshwater emergent wetlands of the Central Valley. These snakes hunt and seek cover in cattails or bulrushes along the edges of open, calm water. Exposed banks covered with grass are used for basking in the sun, and uplands dotted with rodent burrows are used for cover and refuge from flood waters (Hansen and Brode, 1980). They do not occur in large rivers because of predatory fish or in riparian woodlands because excessive shade reduces basking habitat.

Changes Before CVP. Historically, the giant garter snake inhabited the estimated 4.1 million acres of flood basins, freshwater marshes, and small tributary streams along the length of the Central Valley. The drainage of wetlands and reclamation for agriculture produced substantial losses of habitat. Drainage of Tulare and Buena Vista lakes between 1940 and 1950 resulted in the extirpation of giant garter snakes from Kings, Tulare, and Kern counties (Hansen and Brode, 1980).

Changes Since CVP. By the 1970s, the range of the giant garter snake was reduced to the lowlands of the Central Valley from northern Butte County to southern Fresno County. Surveys conducted in the mid 1970s identified 12 distinct giant garter snake populations within the species' entire range. Intensive surveys repeated in the mid-1980s failed to identify any snakes in seven of the previously known locations. Additional surveys in 1992 confirmed the results of the mid-1980 surveys (58 Federal Register 201, 54053-54065, October 20, 1993).

Thirteen distinct populations of giant garter snake have been identified through clusters of historical and recent sightings. Nine of those populations occur today. However, four of these nine populations may become extinct in the near future because of the limited habitat available and low population numbers. No giant garter snakes have been observed at the four southernmost population areas since the mid-1980s (58 Federal Register 201, 54053-54065, October 20, 1993). If additional surveys confirm the absence of giant garter snakes in these four areas, the range of the species will no longer include the entire San Joaquin Valley. The giant garter snake was listed as endangered by California in 1971; it was granted federal listing as threatened in 1993.

Waterfowl

Presettlement Conditions and Extent. Accounts of early settlers and explorers indicated that wetlands of the Central Valley supported a significantly larger and more dispersed waterfowl population than has occurred in recent times (DFG, 1983; Service, 1978). Extensive reductions in wetlands and increases in market hunting contributed to a significant decline in these populations prior to 1900 (DFG, 1983). A survey conducted in 1913 estimated that duck populations had declined from historical levels by 50 percent and goose populations by 75 percent (DFG, 1983).

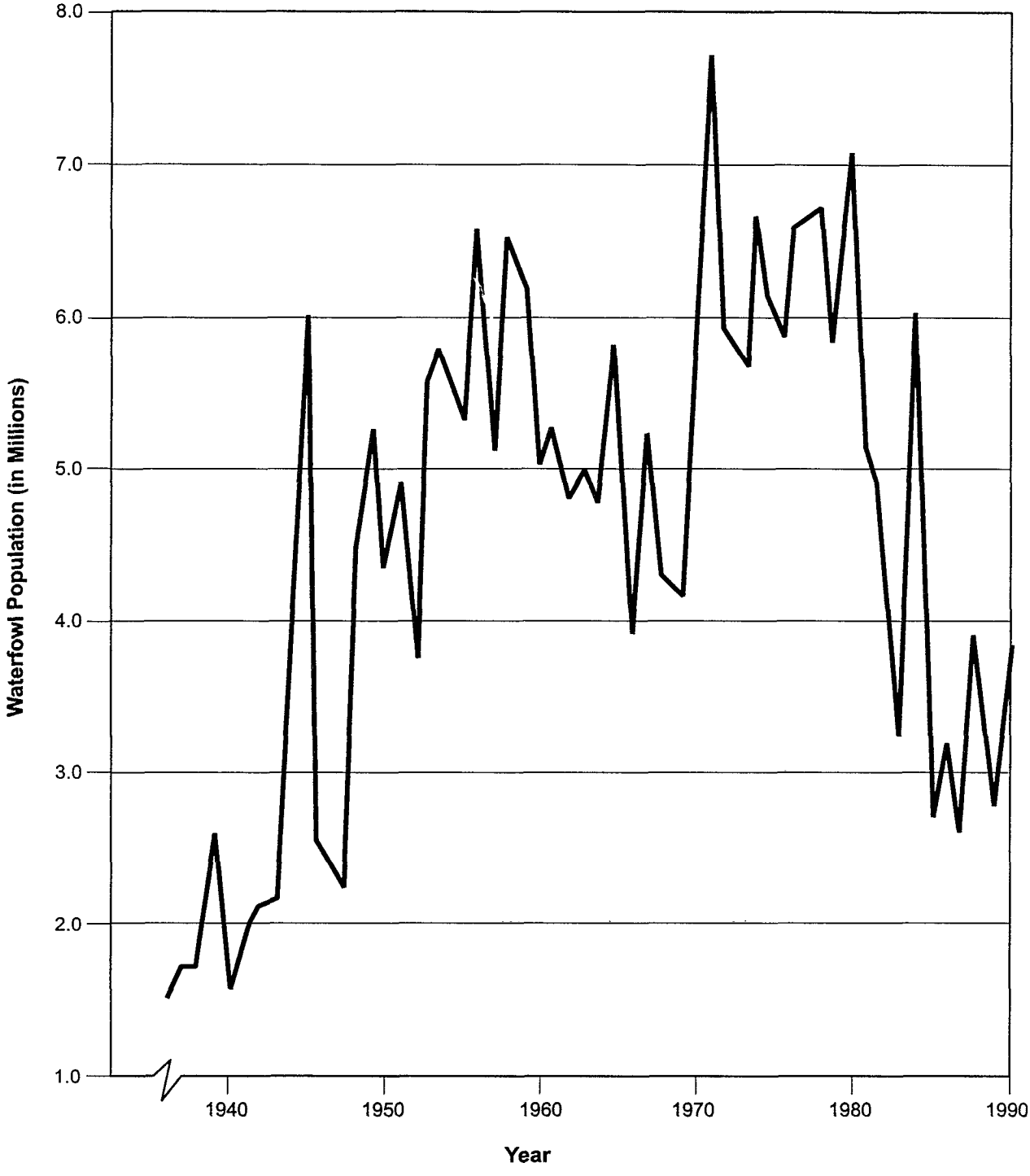
Changes Before CVP. Market hunting, conversion of natural habitats to agricultural and urban uses, and drought conditions all contributed to declines in Central Valley waterfowl populations. Market hunting ceased in the early 1920s when federal and state legislation banned the sale of waterfowl. The largest loss of wetland acreage, approximately 2.5 million acres, occurred between 1906 and 1922 with the advent of large-scale agriculture in the Central Valley (Service, 1978). State and federal wildlife refuges were created to prevent crop depredation by waterfowl and to provide waterfowl sanctuaries. Despite concerted efforts to manage waterfowl, populations declined dramatically by 1935 due to prolonged drought on the Canadian prairies. The Central Valley's midwinter waterfowl population was estimated at 1.5 million in 1936 (Figure II-3).

Central Valley waterfowl populations increased rapidly for the next 20 years (Figure II-3). Several factors, including favorable weather patterns on the Canadian breeding grounds and a reduction in hunters during World War II contributed to this increase. Labor shortages also extended the time required for harvesting rice and other grains, which provided additional forage for waterfowl. Rice production increased from 162,000 acres in 1920 to 240,000 acres in 1945. This additional rice production, coupled with increasing waterfowl populations, resulted in significant crop losses due to waterfowl depredation. However, subsequently increased farming of refuges and leasing and farming of private lands to produce waterfowl foods significantly reduced the levels of crop depredation. Additional federal and state refuges were established and enlarged between 1945 and 1955 to provide waterfowl habitat and minimize crop depredation (DFG, 1983).

Changes Since CVP. By 1945, most of California's natural wetlands had been lost (Figure II-2). Concurrently, rice production increased from 240,000 acres in 1945 to approximately 555,000 acres in 1980 (DFG, 1983). Wintering waterfowl populations in the state increased until 1957, when drought conditions on the Canadian breeding grounds again reduced their populations (Figure II-3). Waterfowl populations recovered by 1970 as a result of favorable conditions on their nesting grounds. For the next decade, California's wintering waterfowl population averaged approximately 6 million birds. The population declined through the 1980s, again due to drought conditions on the Canadian prairies (Yparraguirre, pers. comm.).

As discussed previously, more than 90 percent of the Central Valley's wetlands have been destroyed and many of the remaining areas are degraded. Currently, about 290,000 acres of wetlands and 950 miles of riparian woodland remain in the Central Valley (Central Valley Habitat Joint Venture [CVHJV], 1990). Approximately 30 percent of the wetland habitat is protected in federal and state wildlife refuges; 168,775 acres of wetlands occur on private land (CVHJV, 1990), 49,875 acres of which are permanently protected through conservation easements (CVHJV, 1990). Winter habitat for waterfowl (natural and agricultural habitats) is limited to 345,000 acres of private lands, 55,000 acres of federal National Wildlife Refuges, and 37,500 acres of state Wildlife Management Areas (Service, 1978). An additional 700,000 acres of wetlands may be available to waterfowl during high flood years (Reclamation, 1988).

The most dramatic loss of Central Valley waterfowl populations occurred prior to development of the CVP. The CVP played a role in contributing to more recent losses in Central Valley natural wetland habitat necessary for waterfowl, but this role cannot be isolated or quantified.



SOURCES:
DFG, 1988; Connelly, pers. comm.

FIGURE II-3

NUMBER OF WATERFOWL IN CALIFORNIA DURING MID-WINTER SURVEYS

GRASSLANDS

Vegetation

Presettlement Conditions and Extent. Grasslands once covered more than 14 million acres in California (Barbour et al., 1991). They were dominated by a wide variety of native species, including many perennial bunchgrasses, such as needlegrass, wild rye, melic grass, alkali sacaton, and deer grass. Native wildflowers and other herbs were also abundant. Some ecologists believe that nearly all of the state's original grasslands were dominated by perennial needlegrasses; others argue that annual grasses and wildflowers were dominant in many areas (Barry, 1972; Bartolome and Gemmil, 1981; Wester, 1981). In either case, grasslands were composed entirely of indigenous species until the late 1700s.

Changes Before CVP. Changes in the composition of California's grasslands began in the 1770s, when Spanish settlers introduced a wide variety of annual grasses and forbs from the Mediterranean region. Throughout the 1800s and up to the present, hundreds of non-native plants arrived in the state from around the world. Many were aggressive enough to outcompete the native species and settle permanently into the California landscape. Grasslands were particularly hard hit by the introduction of non-natives, especially during times of heavy grazing and drought. By 1945, most of California's grasslands were no longer dominated by native plants.

Jensen (1947) estimated that grasslands of all types occupied about 10.4 million acres throughout the state in 1945, a decline of 26 percent from presettlement times. Most of this decline resulted from the expansion of croplands. Wieslander's (1945) map of California vegetation shows about 5.8 million acres of grassland in the Central Valley (Table II-1).

Changes Since CVP. Today grasslands occupy about 8.7 million acres statewide (Barbour et al., 1991), a 38 percent decline from historical times. The loss of grasslands dominated by native bunchgrasses has been much greater; only a few small remnants of this type remain. Grassland losses have continued to result from urban expansion and conversion to irrigated croplands. The degradation of grassland quality has also continued, especially on heavily grazed rangelands.

California Jewelflower

Presettlement Conditions and Extent. California jewelflower is an annual herb in the mustard family. It blooms in grassland and mixed grassland-scrub habitats in February and March and sets fruit by April each year. Population sizes vary greatly from year to year. Following wetter-than-average winters, the plants are abundant in numerous populations; in drought years, the plants are scarce, and some populations may not appear at all (Taylor and Davilla, 1986).

Changes Before CVP. The historical range of California jewelflower covered much of the Tulare Basin and several adjoining valleys, roughly including the area bounded by Coalinga, Fresno, Bakersfield, and the Cuyama Valley (Taylor and Davilla, 1986). Today it occurs mostly in the Carrizo and Elkhorn plains and Cuyama Valley. It was recently rediscovered near

Coalinga, and a small planted population persists in Kern County. California jewelflower is no longer found throughout most of its historical range in Fresno, Kings, and Kern counties (Skinner and Pavlik, 1994; NDDB, 1993).

At the time the Service listed California jewelflower as an endangered species (55 Federal Register 56, July 19, 1990), the species was known from only 10 populations. Since then, several more populations have been discovered during intensive surveys following wet winters. All of the previously known and recently discovered populations occur in remnants of mixed native/non-native grassland habitat.

Changes Since CVP. Factors contributing to the decline of California jewelflower include the introduction of highly competitive non-native annual grasses, increased grazing pressure associated with the development of summer water sources, some habitat loss in areas of oil and gas development, and habitat loss in areas of agricultural development (Taylor and Davilla, 1986).

Agricultural expansion appears to have contributed most to this decline because, although many populations persist in heavily grazed rangeland, none survive in agricultural areas. To the extent that agricultural expansion in the southern San Joaquin Valley has been made possible by the CVP, the endangerment of California jewelflower may also be attributable to the CVP.

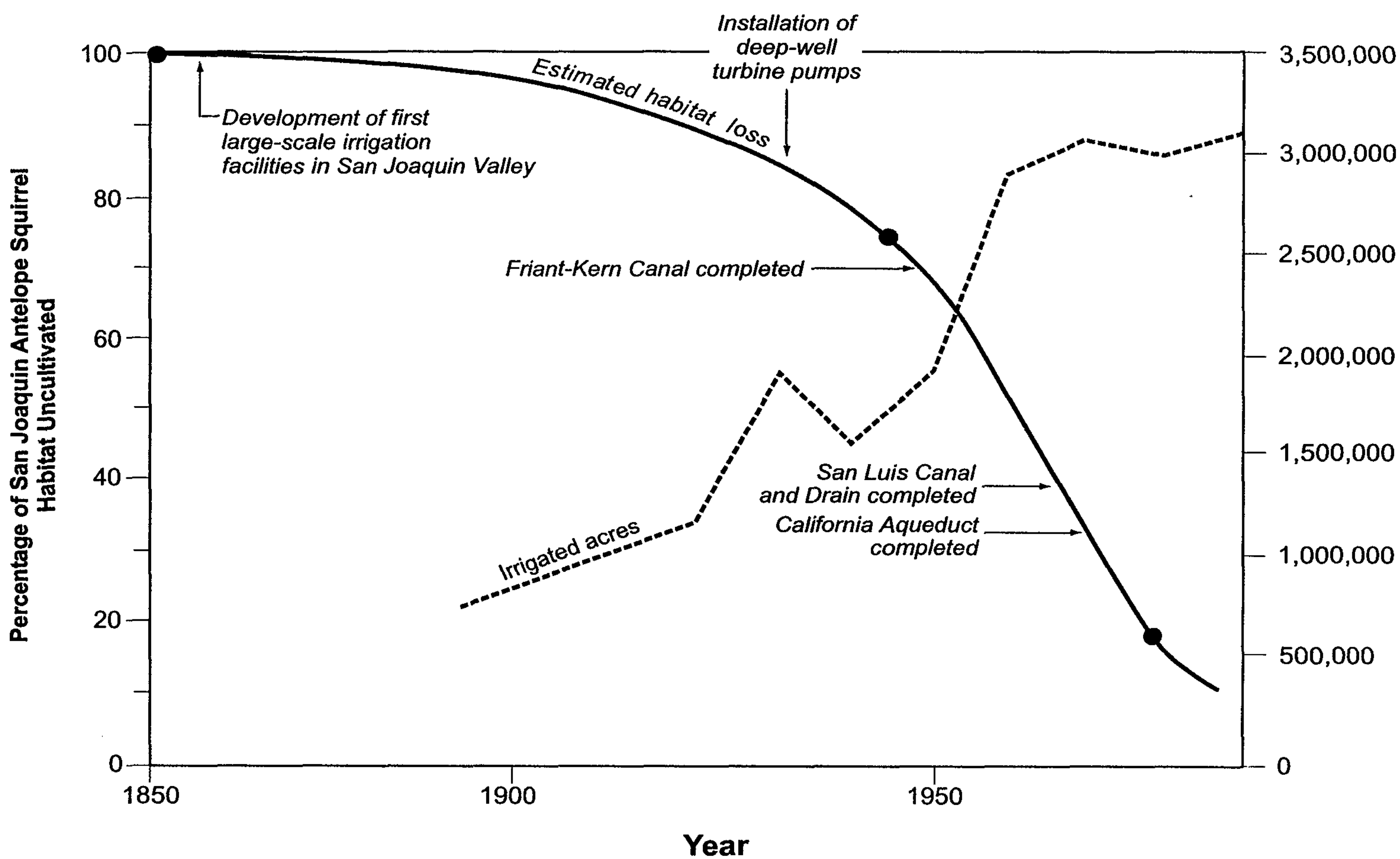
San Joaquin Antelope Squirrel

Presettlement Conditions and Extent. The San Joaquin antelope squirrel is endemic to the arid grasslands of the western and southern San Joaquin Valley. Historically, the squirrels were distributed from southwestern Merced County, along the floor of the valley to its southern end, east along the base of the Tehachapi Mountains, and north to Tipton in Tulare County. Additional populations occurred in the Cuyama Valley and Carrizo and Elkhorn plains (Williams, 1980).

Changes Before CVP. The San Joaquin antelope squirrel occupied an estimated 3.45 million acres of the Tulare Basin prior to cultivation (Williams, 1980). Early reports noted that these squirrels were unevenly distributed and occurred in abundance at only a few localities. Abundance appears to be related to habitat quality (Williams, 1980).

Squirrel populations are densest in areas with friable soils that are free from flooding. Vegetative cover is typically grasslands with sparse to moderate cover of shrubs, such as iodine bush, saltbush, and green ephedra. Shrubs provide shade, and where they are inadequate, the burrows of giant kangaroo rats serve a similar function (Williams, 1980; Harris and Stearns, 1990). Lower densities of squirrels occur in areas with nonfriable or alkaline soils, with moderate to high densities of shrubs, or on steep slopes (Williams, 1980). No San Joaquin antelope squirrels have been observed in cultivated fields (Grinnell and Dixon, 1918; Hawbecker, 1953; Williams, 1980; Harris and Stearns, 1990).

Changes Since CVP. The rate of habitat loss for the San Joaquin antelope squirrel has varied. Approximately 74 percent of the habitat remained in 1945, before implementation of the federal and state water projects (Figure II-4). The greatest loss of habitat occurred after federal and state



SOURCES: Wieslander, 1945; Williams 1980.

FIGURE II-4

ESTIMATED HABITAT LOSS OF THE SAN JOAQUIN ANTELOPE SQUIRREL AND CHANGES IN ACREAGE OF IRRIGATED LAND IN THE SAN JOAQUIN RIVER REGION

water became available for irrigation. By 1979, only 20 percent of the habitat remained (Williams, 1980). Following this analysis, the species was listed as threatened by the State of California. The results of recent surveys supported the earlier conclusions and determined that no prime habitat for this species remains in the San Joaquin Valley (DFG, 1991).

Tule Elk

Presettlement Conditions and Extent. An estimated 500,000 tule elk once occupied the extensive grasslands of all the inland and coastal valleys and lower foothills from southern Shasta County to southern Santa Barbara County (McCullough, 1971).

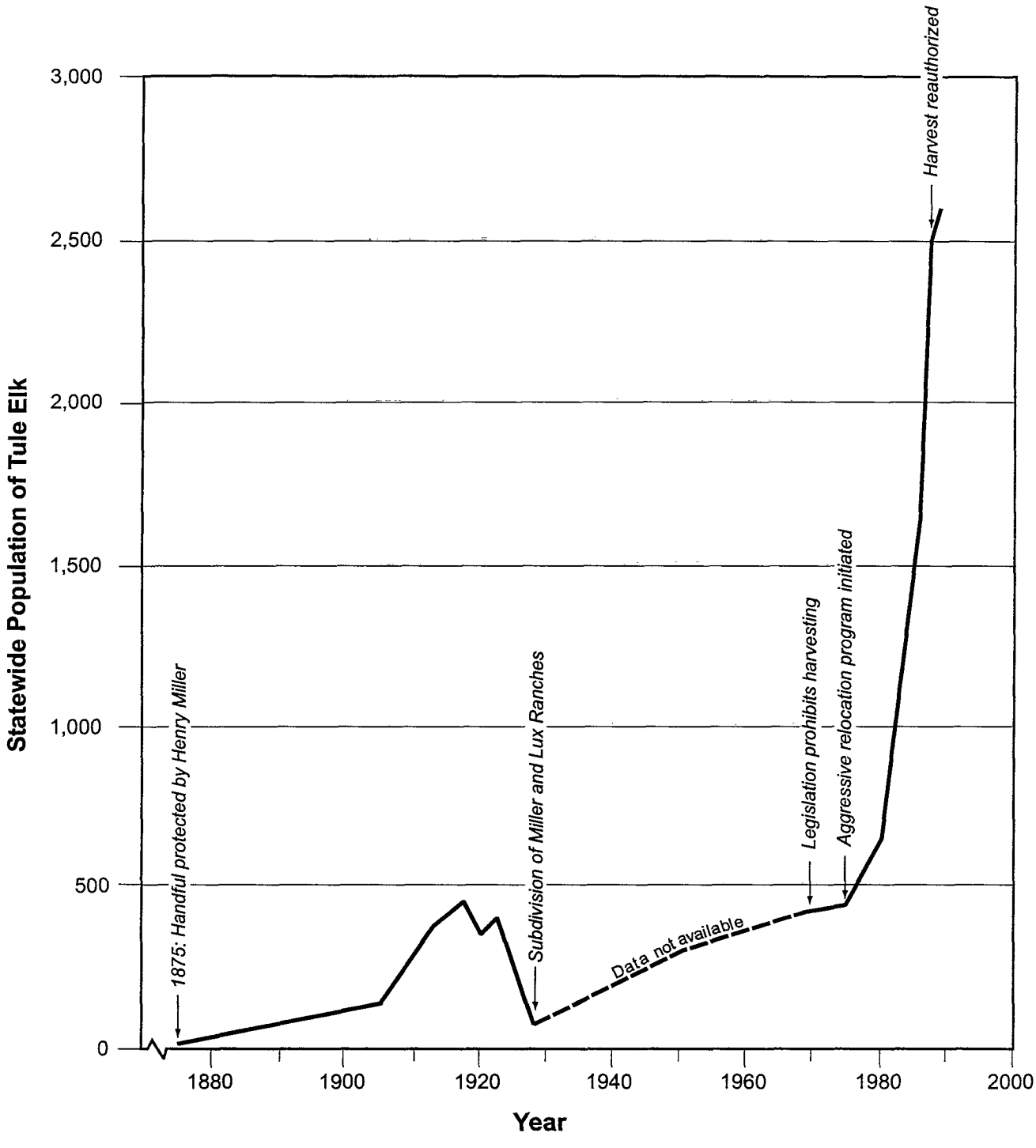
Spanish settlement and fur trappers extirpated localized herds of elk from the coastal prairies and grasslands in southern Sacramento Valley. Although vast herds remained throughout most of the elk's range, few would remain after the Gold Rush. Market hunters slaughtered most of the tule elk to provide meat for the mining camps and cities. By 1860, tule elk could be found only around Buena Vista and Tulare lakes and the foothills to the immediate west.

Changes Before CVP. A small population of tule elk was discovered in 1874 or 1875, when the drainage canal for Buena Vista Lake was completed. The animals occurred on the Miller and Lux Ranch. Henry Lux recognized the importance of maintaining this remnant population and fully protected the animals (McCullough, 1971).

Protecting and relocating animals that caused agricultural damage produced a population of approximately 400 animals by 1923 (Figure II-5). The population declined to approximately 72 animals in 1927 when the Miller and Lux properties were being subdivided into 40- and 160-acre blocks and individual landowners applied their own local damage control measures (McCullough, 1971).

Changes Since CVP. In 1940, all of the tule elk in California were restricted to three separate populations: Owens Valley, Cache Creek in Colusa County, and Tupman Reserve in Kern County. The largest population flourished in the Owens Valley where the Miller-Lux story of agricultural damage was repeated. A series of harvests between 1935 and 1968 reduced the number of animals. The harvests met with mixed reviews from local farmers, hunters, and preservationists. In 1971, state legislation was passed banning future harvests until the statewide population exceeded 2,000 animals (Koch, 1987).

Following the legislated protection, herd sizes were maintained by removing more than 750 animals from overpopulated areas and relocating them to suitable habitat (Koch, 1987). In 1988, the statewide population of tule elk exceeded 2,000 animals (Figure II-5); however, the list of willing landowners with suitable habitat had been exhausted. DFG reauthorized harvesting in two herds in 1989 (Fischer, pers. comm.). In 1992, approximately 2,605 tule elk made up 22 herds, and harvesting was authorized in 6 herds.



SOURCES: 1875–1927 (McCullough, 1971), 1951 and 1970–1984 (Fowler, 1985), 1986 to 1990 (Fischer, pers. comm.).

FIGURE II-5

CALIFORNIA'S TULE ELK POPULATION

CONCLUSIONS

Central Valley Riparian Habitat and Associated Wildlife

At least three-quarters (750,000 acres) of the original riparian vegetation in the Central Valley was eliminated before the first CVP facilities were constructed. Nearly half of the riparian vegetation remaining at that time (30,800 acres) was eliminated by 1985 (Figure II-1). The loss of riparian vegetation eliminated important wildlife habitat.

Causes of decline in Central Valley riparian vegetation and wildlife habitat occurring after construction of the first CVP facilities include:

- conversion of land for irrigated agricultural and municipal and industrial uses, made possible in part by CVP water, as well as other supplemental surface water supplies, groundwater development, and flood protection;
- flow regulation; and
- construction and maintenance of levees, bank erosion, and bank protection projects.

However, it is not possible to clearly isolate and quantify impacts attributable to the CVP alone.

Central Valley Emergent Wetlands and Associated Wildlife

Historically, 4 million acres of seasonal and permanent wetlands in the Central Valley provided habitat for numerous species of wildlife, including many millions of wintering waterfowl. By 1920, approximately 70 percent of the wetlands had been reclaimed, and the wintering waterfowl population had been cut in half. Within the next 20 years, 88 percent of the original wetlands were drained, and the wildlife species were substantially reduced.

Wetland losses continued after implementation of the CVP. The loss of many wildlife species was slowed, however, by the establishment of wildlife refuges and private hunting areas and, in some cases, by the development of suitable agricultural uses, that provided habitat value for many of those species.

It is not possible to quantitatively separate the possible effects of the CVP from earlier impacts that reduced wetland acreage. Nonetheless, substantial incremental declines occurred after CVP operation began. These losses are partly the result of agricultural and urban land conversion made possible, in part, by provision of CVP water and by increased flood protection.

Central Valley Grasslands and Associated Wildlife

Prior to European settlement, the abundance and diversity of wildlife using the Central Valley grasslands were reminiscent of those of the plains of East Africa. The composition of these grasslands began to change with the introduction of Spanish livestock. Market hunting all but eliminated the vast herds of the Central Valley's large grazing animals. By 1945, a substantial portion of the Central Valley's grasslands had been converted to agricultural crops.

The subsequent availability of federal and state water resulted in the conversion of additional grasslands to agricultural crops, particularly in the San Joaquin Valley. The loss of these grasslands, particularly on the west side and southern portions of the San Joaquin Valley, contributed to the loss of habitat for several endemic species and resulted in their listing by federal and state agencies as threatened or endangered.

RECENT CONDITIONS

INTRODUCTION

The extremely varied and diverse vegetation and wildlife communities of the Central Valley cannot be completely described in this technical appendix. Therefore, the purpose of this section is to provide a broad overview of the vegetation and wildlife communities and special-status resources in the CVPIA study area in 1992. Because the CVPIA study area is so large, generalization is necessary to convey a sense of the recent conditions of the natural environment for vegetation and wildlife.

Habitat quality directly affects population sizes in single species or in guilds of several species with similar habitat requirements. Habitat diversity affects the number of different species and their distribution within several habitats. Measurements of habitat quality and habitat diversity require quantitative, site-specific information.

Habitat quality is determined by identifying the species under consideration and evaluating species-specific habitat components. For instance, for a bird that nests in riparian habitat, species-specific measurements may include the sizes and types of trees in the area, the percentage of understory vegetation, and distance to shallow water. For a small rodent, species-specific information may include the percent cover of grasses, soil type, and presence of small mounds for escaping periodic floods.

Habitat diversity is determined by evaluating the size and relationship of several adjoining habitats. Variables that are generally considered include vegetation type and patch size, fragmentation of habitat types, connections among habitats that facilitate travel by wildlife, and the amount of edge around each habitat type.

Site-specific evaluations of habitat quality and diversity are beyond the scope of the PEIS; however, they should be evaluated in subsequent site-specific documents.

HABITAT TYPES

Common Natural Terrestrial Communities

Common natural communities are vegetation types and other habitats that cover relatively large areas and are not significantly threatened or declining (e.g., most conifer forest, chaparral, and annual grassland communities). The following natural community descriptions are based on those in A Guide to Wildlife Habitats of California (Mayer and Laudenslayer, 1988). Table II-2 compares vegetation types used in this document to those of the CNPS, DFG (Holland, 1986),

TABLE II-2

COMPARISON OF VEGETATION TYPES USED IN THIS DOCUMENT WITH OTHER CALIFORNIA VEGETATION CLASSIFICATION SYSTEMS

Common Natural Communities and Rare Natural Communities	Wieslander (1945)	California Native Plant Society (1993)	DFG Classification System (Holland, 1986)
Mixed conifer forest	Pine-Douglas fir-fir (M), pine (P), Douglas fir (D), lodgepole pine-whitebark pine (L), fir (F)	Lower montane coniferous forest	Lower montane coniferous forest
--	--	North Coast coniferous forest	Coast Range and Klamath conifer forest
--	--	Upper montane coniferous forest	Upper montane coniferous forest
--	--	Subalpine coniferous forest	Subalpine coniferous forest
Montane hardwood	Woodland (hardwoods) (W)	Broadleaved upland forest	Broadleaved upland forest
--	--	Cismontane woodland, in part	Cismontane woodland, in part
Pinyon-juniper	Juniper (J), pinyon pine (N)	Pinyon and juniper woodlands	Pinyon and juniper woodlands
--	--	--	Great Basin woodlands
--	--	--	Great Basin pinyon and juniper woodlands
Valley foothill hardwood	Woodland-grass (V)	Cismontane woodland, in part	Cismontane woodland
Valley oak woodland*	--	--	Valley oak woodland*
Valley foothill riparian	--	Riparian forest	Riparian forest
Valley oak riparian forest*	--	--	Great Valley valley oak riparian forest*
Fremont cottonwood riparian forest*	--	--	Great Valley cottonwood riparian forest*
Mixed riparian forest*	--	--	Great Valley mixed riparian forest*
--	--	Riparian woodland	Riparian woodland
Sycamore alluvial woodland*	--	--	Sycamore alluvial woodland*
--	--	Riparian scrub	Riparian scrub
Great Valley willow scrub*	--	--	Great Valley willow scrub*
Great Valley mesquite scrub*	--	--	Great Valley mesquite scrub*
Elderberry savanna*	--	--	Elderberry savanna*
Montane riparian	--	--	Montane riparian forest
Desert riparian	--	--	Mojave riparian forest
Chaparral	Chaparral (C)	Chaparral	Chaparral
Ione chaparral*	--	--	Ione chaparral*

TABLE II-2. CONTINUED

Common Natural Communities and Rare Natural Communities	Wieslander (1945)	California Native Plant Society (1993)	DFG Classification System (Holland, 1986)
Coastal scrub	Coastal sagebrush (T)	Coastal scrub	Coastal scrub
--	--	--	Coastal bluff scrub, in part
Alkali desert scrub	Great Basin sagebrush (S), in part	Chenopod scrub	Chenopod scrub
--	--	--	Desert chenopod scrub
--	--	--	Great Valley chenopod scrub
Valley sink scrub*	--	--	Valley sink scrub*
Valley saltbush scrub*	--	--	Valley saltbush scrub*
Desert scrub	Desert (Z)	Desert scrub	Mojavean desert scrub
--	--	--	Sonoran desert scrub
Sagebrush and bitterbrush scrub	Great Basin sagebrush (S), in part	Great Basin scrub	Great Basin scrub
Inland dunes	--	Inland dunes	Stabilized interior dunes*
--	--	--	Monvero residual dunes*
Coastal beaches and cliffs	--	--	Coastal bluff scrub, in part
--	--	Coastal bluff scrub	--
--	--	--	Coastal dunes
Grassland	Grass (G)	--	Grasslands, vernal pools, and other herb communities
--	--	Valley and foothill grasslands	Valley and foothill grasslands
Valley needlegrass grassland*	--	--	Valley needlegrass grassland*
Serpentine bunchgrass grassland* Valley sacaton grassland*	--	--	Serpentine bunchgrass*
Wildflower field*	--	--	Wildflower field*
--	--	Great Basin grassland	Great Basin grassland
--	--	Coastal prairie	Coastal prairie
Alkali meadow and seep	--	Meadows	Meadows and seeps
--	--	--	Alkali meadow, alkali seep
Vernal pools*	--	Vernal pools*	Vernal pools*
Freshwater emergent wetland	Marsh, in part	--	Bog and marsh
--	--	Marshes and swamps, in part	Marsh and swamp
Coastal and valley freshwater marsh*	--	--	Coastal and valley freshwater marsh*
Cismontane alkali marsh*	--	--	Cismontane alkali marsh*
Bogs and fens	--	Bog and fen	Bog and fen
Saline emergent wetland	Marsh, in part	Marshes and swamps, in part	Marsh and swamp

TABLE II-2. CONTINUED

Common Natural Communities and Rare Natural Communities	Wieslander (1945)	California Native Plant Society (1993)	DFG Classification System (Holland, 1986)
--	--	--	Coastal salt marsh*
Coastal brackish marsh*	--	--	Coastal brackish marsh*
Northern coastal salt marsh*	--	--	Northern coastal salt marsh*
Agricultural	Agricultural (A)	None	None
Pasture	--	--	--
Orchard/vineyard	--	--	--
Row crops	--	--	--
Grain	--	--	--
Rice	--	--	--
Cotton	--	--	--

LEGEND:
* = rare natural community.
-- = indicates no equivalent community type.

and Wieslander (1945) map types. Table II-3 summarizes existing acreages of natural communities and agricultural crops in study area regions in the Central Valley and the Delta.

Lists of all wildlife and plant taxa mentioned in this report are provided in Attachments C and D, respectively. Each attachment contains both scientific and common names. The scientific nomenclature for plants follows Hickman (1993), except for some rare species that follow Skinner and Pavlik (1994).

Mixed Conifer Forest. Mixed conifer vegetation is an assemblage of conifer and hardwood species that forms a multilayered forest. Canopies often approach 100 percent closure. Where openings are present, the forest floor is often covered with an assemblage of shrubs and small trees.

Mature conifers in this vegetation type often reach heights from 100 to 200 feet, with trunk diameters of 3 to 6 feet.

Conifer species often found in mixed conifer forest include white fir, Douglas-fir, ponderosa pine, sugar pine, and incense cedar. Black oak, bush chinquapin, and canyon live oak are typical hardwood species. Shrub species often encountered include deer brush, manzanita, tan oak, bitter cherry, squaw carpet, gooseberries and currants, and mountain misery.

Mixed conifer forest is found in the Sierra Nevada from 2,700 to 4,000 feet elevation in the north and from 4,000 to 10,000 feet in the south and in the Coast and Klamath ranges in elevations from 4,500 to 6,900 feet. Mixed conifer forest dominates the lands that supply most of CVP's water.

The structural complexity of mixed conifer communities makes them important for a variety of wildlife species. Large conifers with lateral branching provide excellent nesting platforms for large raptors, including northern goshawks and California and northern spotted owls. Several species of woodpeckers and sapsuckers, such as the pileated woodpecker, Williamson's sapsucker, white-headed woodpecker, and hairy woodpecker, forage on insects and nest in tree cavities. Other common birds include the western tanager, Steller's jay, red crossbill, golden-crowned kinglet, and blue grouse. Mule deer, black bear, Douglas tree squirrel, long-tailed vole, northern flying squirrel, and Allen's chipmunk are common mammals that find forage and cover in coniferous forests. Common amphibian and reptile species in conifer forests include the black salamander, ensatina, garter snake, and Pacific treefrog.

Montane Hardwood. Montane hardwood vegetation typically consists of a well-defined tree layer composed predominantly of broadleaved hardwood tree species. The shrub layer is usually poorly developed, with a sparse herb layer beneath. In dense stands, tree canopies may actually close but rarely overlap. On good sites, mature trees may reach heights from 56 to 98 feet. Species composition varies considerably, depending on elevation, aspect, latitude, and soil/substrate conditions.

A number of species are commonly encountered in montane hardwood vegetation in the Sierra Nevada and its foothills: black oak, Pacific madrone, tan oak, interior live oak, and at lower elevations, blue oak and foothill pine. Poison oak, mountain mahogany, spiny redberry, and

TABLE II-3

APPROXIMATE NATURAL COMMUNITY AND AGRICULTURAL CROP ACREAGES IN STUDY AREA REGIONS IN THE CENTRAL VALLEY AND DELTA

Habitat	Study Area Region				
	Sacramento River	San Joaquin River	Tulare Lake	Delta	All
Mixed conifer forest	3,690,000	1,053,000	599,000	0	5,342,00
Montane hardwood	370,000	103,000	150,000	0	623,000
Pinyon-juniper	2,000	0	137,000	0	139,000
Valley foothill hardwood	2,055,000	1,377,000	591,000	0	4,023,000
Chaparral	968,000	719,000	421,000	0	2,108,000
Sagebrush scrub	50,000	0	0	0	50,000
Alkali desert scrub and desert scrub	0	14,000	467,000	0	481,000
Grassland	1,066,000	1,073,000	950,000	0	3,089,000
Riparian	14,000	15,000	14,000	7,000	50,000
Freshwater and saline emergent wetland	157,000	138,000	32,000	25,000	352,000
Open water	122,000	52,000	10,000	56,000	240,000
Barren	242,000	8,000	3,000	0	253,000
Subtotal (Natural Habitats)	**8,736,000**	**4,552,000**	**3,374,000**	**88,000**	**16,750,000**
Agriculture					
Grains	601,000	436,000	346,000	97,000	1,480,000
Pasture	442,000	868,000	525,000	95,000	1,930,000
Rice	398,000	19,000	1,000	18,000	436,000
Orchards and vineyards	322,000	843,000	489,000	20,000	1,674,000
Vegetables	221,000	490,000	138,000	275,000	1,124,000
Cotton	0	484,000	701,000	0	1,185,000
Subtotal (Agriculture Habitats)	**1,984,000**	**3,140,000**	**2,200,000**	**505,000**	**7,829,000**
Urban and other					
Urban	252,000	188,000	223,000	46,000	709,000
Other	1,057,000	427,000	484,000	61,000	2,029,000
Subtotal (Urban and Other)	**1,309,000**	**615,000**	**707,000**	**107,000**	**2,738,000**
Total (All Habitats)	**12,029,000**	**8,307,000**	**6,281,000**	**700,000**	**27,317,000**

NOTES:

All acreages are rounded to the nearest 1,000 acres.

Community types that do not occur in the Central Valley or Delta (i.e., coastal and desert communities) are not included in this table.

Riparian vegetation acreage for the Sacramento Valley is based on the Sacramento River Environmental Atlas (DWR, 1978) and excludes an unquantified and possibly substantial amount of vegetation along tributaries to the Sacramento River.

Habitat classification for the Delta region differs slightly from that used in other regions because of the different data source. Grasslands in the Delta region are included in "Agriculture." "Freshwater emergent wetland" in the Delta includes all palustrine wetlands. "Saline emergent wetland" in the Delta includes all estuarine wetlands.

SOURCES:

Natural Communities: DFF unpublished map (digital format).

Urban Areas: Landsat Thematic Mapper data (classified using GRASS software) and DWR Bulletin 160-93.

Agricultural Habitat: DWR Bulletin 160-93.

Delta: "Wetlands"coverage for Delta from Teale Data Center, Sacramento, CA, compiled from National Wetland Inventory maps.

"Other" Areas: Calculated as the difference between the total area within the region boundaries and the sum of all natural, agricultural, and urban habitats. "Other" includes a variety of industrial, small urban, and other areas, including some natural habitats.

manzanitas are common shrub species. In more coastal locations, California bay, huckleberry oak, Pacific madrone, and canyon live oak occur. Shrubs found in coastal areas are similar to those in the Sierra Nevada. In most cases, the herb layer is composed of a few forb and grass species.

The elevations of montane hardwood vegetation can vary from 300 feet near the Pacific Ocean to near 9,000 feet in southern California.

Montane hardwood habitat is used by a variety of reptiles, birds, and mammals. Acorns produced by oak trees provide important forage for mule deer, black bear, western gray squirrel, wild turkey, scrub jay, acorn woodpecker, and band-tailed pigeon. Common amphibian and reptile species found in montane hardwood forests include ensatina, western fence lizard, sagebrush lizard, California mountain kingsnake, sharp-tailed snake, rubber boa, and western rattlesnake.

Pinyon-Juniper. Pinyon-juniper vegetation is typically an open woodland of relatively low, bushy trees. The shrub layer may be dense or nearly absent, and herbaceous vegetation is typically fairly sparse. Dominant species in the southern Sierra Nevada and Transverse ranges include single-leaf pinyon, California juniper, Mormon tea, desert bitterbrush, rabbitbrush, and sagebrush.

The pinyon-juniper community typically occurs on steep, rocky, or well-drained soils mostly outside the CVPIA study area, in the Great Basin, Mojave Desert, and peninsular ranges; however, narrow belts of this habitat type are found on mountain slopes around the southern rim of the Tulare Lake Region.

Pinyon seeds and juniper berries are important food sources for many wildlife species. Animals characteristic of this community include the pinyon mouse, bushy-tailed wood rat, pinyon jay, plain titmouse, and bushtit.

Valley Foothill Hardwood. Valley foothill hardwood vegetation, which varies considerably depending on site conditions, is composed of three subtypes: valley oak woodland, blue oak woodland, and blue oak/foothill pine woodland. Valley foothill hardwood vegetation generally has a tree layer dominated by one or more species of oak. The shrub layer is often absent at lower elevations but consists of scattered clumps of several species at higher elevations. The herbaceous layer of all three subtypes consists mostly of non-native annual grasses and forbs.

At lower elevations and on sites with deep soils, valley oak is the dominant tree. Valley oaks range in height from 50 to 115 feet, with mature trunks reaching 3.3 feet or more in diameter. The valley oak subtype varies from savannah-like with an open canopy to forest-like with a nearly closed canopy. Other trees commonly associated with the valley oak woodland subtype include western sycamore, interior live oak, northern California black walnut, box elder, and blue oak. Shrubs are generally sparse but include poison oak, California coffeeberry, blue elderberry, and blackberries. Grasses and forbs include ripgut grass, wild oats, rye-grasses, and Italian ryegrass.

Above the valley floor and on sites with shallower soils, blue oak intergrades with valley oak and becomes the dominant tree in the overstory. Generally, the blue oak subtype forms a woodland with scattered trees, but given favorable conditions, canopy closure may approach 100 percent. The canopy is dominated by mature blue oak trees ranging from 16 to 50 feet in height. Other tree species common in the blue oak woodland subtype of this vegetation type include coast live oak near the Coast Ranges, interior live oak near the Sierra Nevada foothills, and foothill pine at higher elevations. Associated shrub species include California coffeeberry, buck brush, poison oak, California buckeye, western redbud, and manzanita species. The herbaceous layer is dominated by annual grasses and forbs, such as filarees, brome grasses, wild oats, and fiddlenecks. Perennial grasses encountered in this subtype are needlegrasses and melic grasses.

The blue oak/foothill pine woodland subtype is found intergrading with blue oak woodland at higher elevations and is diverse both in structure and composition. Blue oak and foothill pine compose the overstory of this habitat, with blue oak being more abundant. Interior live oak and California buckeye are associated with this vegetation type in the Sierra Nevada foothills. In the Coast Ranges, associated trees include coast live oak, valley oak, and California buckeye. Where blue oak is dominant in the overstory, the understory consists primarily of the grasses and forbs described for the blue oak woodland subtype. At higher elevations, where blue oak is replaced by interior live oak, the understory usually includes a patchwork of shrubs such as ceanothus, Mariposa manzanita, whiteleaf manzanita, spiny redberry, poison oak, California yerba santa, western redbud, and oak gooseberry.

Valley foothill hardwood vegetation occurs from nearly sea level for valley oak woodland to nearly 4,000 feet elevation for blue oak/foothill pine woodland. Valley foothill hardwood vegetation is found surrounding the Central Valley.

Valley foothill hardwood habitat provides shade, shelter, and nesting and foraging habitat for many wildlife species. Studies indicate that hardwood ecosystems, such as oak woodlands, support a larger number of breeding wildlife species than any other nonriparian California woodland community (Mayer and Laudenslayer, 1988). Primary cavity-nesting birds (e.g., acorn woodpecker) excavate nest holes in living and dead trees, and these cavities are subsequently used by other (secondary) cavity-nesting species, such as the American kestrel, western screech owl, ash-throated flycatcher, white-breasted nuthatch, plain titmouse, and western bluebird. Dead tree limbs also provide nesting habitat for other cavity-nesting birds and small mammals, such as the Nuttall's woodpecker, downy woodpecker, northern flicker, and western gray squirrel.

Oak foliage and bark attract the ash-throated flycatcher, western wood peewee, plain titmouse, Bewick's wren and Hutton's vireo, insects that are important in the diet of birds. The gopher snake, common garter snake, bullfrog, western toad, and Pacific treefrog are also common in valley foothill hardwood communities. Other species include the raccoon, opossum, and dusky-footed woodrat.

Chaparral. Chaparral is characterized by the presence of woody, often hard-leaved shrubs in a nearly impenetrable thicket. Shrub heights and densities vary considerably with site conditions. Chaparral can range in height from 3 to 20 feet, with 10 feet being the average height. Chaparral can be divided into three general types: montane, mixed, and chamise-redshank.

Montane chaparral varies from prostrate to tree-like forms, depending on site conditions. Within montane chaparral, conifer or oak trees may occur in scattered stands, but they never dominate the overstory. Montane chaparral generally occurs throughout the coniferous forest zone. Species that characterize montane chaparral include snow bush, greenleaf manzanita, snowbrush ceanothus, pinemat manzanita, and bitter cherry. Montane chaparral is found in mountainous terrain from 3,000 to 9,800 feet elevation in northern California and above 7,000 feet in southern California.

Mixed chaparral is found at lower elevations than montane chaparral and usually forms dense, nearly impenetrable thickets with shrub cover approaching 80 percent. Species composition of mixed chaparral varies considerably from northern to southern California and with climatic conditions, aspect, and parent material. Scrub oak, ceanothus, and manzanitas are common mixed chaparral species. Other associated shrubs include chamise, poison oak, toyon, sugar bush, laurelleaf sumac, California flannel bush, and yerba santas. Mixed chaparral generally occurs below 5,000 feet elevation on mountain ranges throughout California, except the desert mountains.

At lower elevations and on drier sites, chamise-redshank chaparral becomes more common. Mature chamise-redshank chaparral is generally single-layered with little or no herbaceous layer. Shrub canopies in frequently overlap and are often impenetrable due to interwoven branches. Chamise-redshank chaparral often occurs as nearly pure stands of chamise or redshank, with the purest stands on the most dry slopes. Chamise is by far the most common dominant of the two. On more moist sites, toyon, sugar bush, poison oak, and spiny redberry are common associates with chamise. At upper elevations where chamise-redshank chaparral intergrades with mixed chaparral, common chamise associates include manzanita, scrub oak, and ceanothus. Common redshank associates are sugar bush, laurelleaf sumac, and ceanothus. Where redshank is dominant in southern California, black sage and California buckwheat are common associated shrubs following a disturbance. Chamise-redshank chaparral is usually found below 4,000 feet except in the Sonoran and Mojave deserts.

Chaparral habitat lacks the structural diversity of forests and woodlands but provides forage and cover to a variety of wildlife. Common wildlife species are the brush rabbit, black-tailed deer, gray fox, western rattlesnake, and several species of birds, including California quail, wrentit, orange-crowned warbler, rufous-sided towhee, and California towhee.

Coastal Scrub. Coastal scrub is typified by low to moderately sized shrubs with soft leaves and flexible branches arising from a woody base. Structure of coastal scrub varies considerably from north to south paralleling the Pacific coastline.

Northern coastal scrub between Humboldt and San Mateo counties varies from a low patchy cover of nearly prostrate shrubs interspersed with grassland to a dense cover of shrubs, subshrubs, and perennial herbs, with shrubs reaching 7 feet in height. Bush lupine, many colored lupine, coyote brush, blue-blossom ceanothus, bush monkeyflower, poison oak, California sagebrush, and blackberries are common northern coastal scrub species.

Southern coastal scrub from about San Mateo County south is often called southern sage scrub due to the dominance of California sagebrush or various sage species. In wetter areas within

southern coastal sage scrub, black sage and California buckwheat are codominants. As conditions become drier (from Santa Barbara southward), purple sage becomes codominant with black sage and California buckwheat.

Coastal scrub is usually found within 20 miles of the ocean in the north and up to 50 miles from the ocean in the south. Elevations of coastal scrub range from sea level to nearly 3,000 feet.

Common wildlife species occurring in coastal scrub include the western fence lizard, orange-crowned warbler, California thrasher, California quail, brush rabbit, Heerman's kangaroo rat, mule deer, gray fox, and coyote.

Alkali Desert Scrub. Alkali desert scrub is generally characterized by a dominance of chenopods (members of the Goosefoot family) or other halophytes and is often thought of as existing in two distinct phases: xerophytic (drought-tolerant plants) and halophytic (salt-tolerant plants).

The xerophytic phase is represented by open stands of widely spaced, low (0.8 foot) to moderately high (7 feet) grayish, spiny, and small-leaved shrubs and subshrubs. As the name implies, this phase occurs on relatively dry soils. Allscale, fourwing saltbush, Parry saltbush, shadscale, and big saltbush are common shrubby saltbush species of this phase. Other important shrubs include bud sagebrush, Nevada tea, Fremont dalea, and creosote bush. Cheesebush, alkali goldenbush, and honeysweet tidestromia are common subshrubs in this phase. Forbs and grasses that characterize this phase include Torrey blazing star, kidney-leaved buckwheat, and apricot globemallow.

The halophytic phase is characterized by closely spaced, not very woody, and more or less succulent plants that tolerate periodic flooding. This phase generally does not exceed a height of 3.3 feet. Common shrub and subshrubs found in this phase include arrow weed, greasewood, alkali goldenbush, kochia, iodine bush, and alkali rubber rabbitbrush. Common forbs and grasses are alkali heath, alkali weed, alkali heliotrope, arrow-grass, yerba mansa, and alkali sacaton.

Alkali desert scrub phases occur from below sea level in Death Valley to above 5,900 feet elevation in locations within the Great Basin. In the CVPIA study area, it occurs at low elevations in the western San Joaquin Valley and in the Tulare Basin.

Common birds that forage or nest in alkali desert scrub include roadrunner, mourning dove, blue-gray gnatcatcher, common raven, sage sparrow, white-crowned sparrow, house finch, and American and lesser goldfinch. Common mammals include pocket gopher, California ground squirrel, desert cottontail, deer mouse, California vole, Heermann's kangaroo rat, black-tailed hare, striped skunk, badger, and coyote. Reptiles, such as side-blotched lizard, western whiptail, western fence lizard, gopher snake, and western rattlesnake, are commonly observed in alkali desert scrub habitat.

Desert Scrub. Desert scrub vegetation is characterized by the presence of scattered assemblages of broadleaved-evergreen or deciduous microphyllous shrubs usually less than 6.5

feet in height. Canopy cover from these shrubs is usually less than 50 percent, and often there is bare ground between plants.

Creosote bush is often considered the dominant plant in desert scrub; however, this is probably due to its tall relative stature rather than its numbers. Some plants common to desert scrub burro bush, bladderpod, desert agave, brittlebush, California barrel cactus, Engelmann's hedgehog cactus, desert globemallow, ocotillo, beavertail cactus, rubber rabbitbrush, and Mojave yucca. Scattered among the shrubs are forbs and grasses, such as basket evening primrose, galleta, big galleta, and bur-marigold.

Desert scrub is the most widespread vegetation in the Mojave and Colorado deserts and is generally found below 4,000 feet elevation.

Desert scrub provides habitat for a variety of wildlife species, especially reptiles and rodents. Typical species found in desert scrub include Couch's spadefoot toad, horned lizard, desert iguana, sidewinder, common kingsnake, several species of pocket mice and kangaroo rats, coyote, bobcat, ash-throated flycatcher, black-throated sparrow, Gambel's quail, and greater roadrunner.

Sagebrush and Bitterbrush Scrub. Sagebrush and bitterbrush scrub vegetation is typified by large, open stands of big sagebrush or bitterbrush of fairly uniform height. Depending on site conditions, other species may become locally dominant.

Sagebrush stands are often wholly dominated by big sagebrush and bitterbrush stands, often almost entirely by bitterbrush; however, many stands include other species such as low sagebrush, silver wormwood, mountain sagebrush, Mormon tea, desert peach, western choke cherry, rabbitbrush, and curlleaf mountain mahogany. In communities not fully dominated by shrubs, forbs and grasses such as Idaho fescue, blue rye-grass, bottlebrush, squirreltail, one-sided bluegrass, bluebunch wheatgrass, and needlegrasses often are abundant. At higher elevations, sagebrush or bitterbrush scrub occur as understories to montane coniferous forest and juniper.

Sagebrush scrub vegetation occurs along the east and northeast borders of California on dry slopes and flats from an elevation of about 1,600 to 10,500 feet. In the CVPIA study area, sagebrush and bitterbrush scrub occur in northeastern Shasta County, on and near the Modoc Plateau.

Sagebrush and bitterbrush scrub provide foraging habitat for mule deer and pronghorn antelope and are a major winter-range type used by migrating deer. Sagebrush and bitterbrush scrub are essential habitat for nesting sage and blue grouse, sage thrasher, and sagebrush vole. Common mammal species found in these communities include black-tailed jackrabbit, cottontail rabbit, California ground squirrel, least chipmunk, dusky-footed wood rat, several species of pocket mice and kangaroo rats, deer mouse, grasshopper mouse, coyote, bobcat, and mountain lion. Birds include the black-billed magpie, gray flycatcher, pinyon jay, red-tailed hawk, Swainson's hawk, prairie falcon, American kestrel, and great horned owl. Reptiles, such as western fence lizard and rubber boa, also reside in sagebrush and bitterbrush scrub.

Inland Dunes. Inland dunes (i.e., Antioch Dunes and Monvero Residual Dunes) are mostly dominated by herbaceous plants with a scattering of low shrubs or coast live oak. The low shrubs are usually less than waist high and provide less than 10 percent cover (Holland, 1986). Plants characteristic of inland dune vegetation include California croton, California matchweed, telegraph weed, Contra Costa wallflower, and Antioch Dunes evening-rimrose. A more detailed description of inland dunes is included in the "Rare Natural Communities" section.

Coyote, gray fox, striped skunk, deer mouse, red-tailed hawk, savannah sparrow, American pipit, horned lark, and western fence lizard are common wildlife species that occur in or visit inland dune habitats.

Coastal Beaches and Cliffs. The vegetation of coastal beaches and cliffs is exposed to a nearly continual salt-laden, moist wind off the Pacific Ocean. Coastal beaches and their associated dunes are dominated by herbaceous plants, whereas cliffs are generally dominated by shrubs.

When coastal beaches and dunes are vegetated, they are dominated by an assemblage of grasses, forbs, and small shrubs. Common plants occupying northern coastal beaches and dunes include European sea-rocket, coastal sand-verbena, beach-bur, European beachgrass, fig-marigolds, beach morning-glory, and beach rye-grass. In southern coastal beaches and dunes, the vegetation is similar to that in the north but has fewer perennial grasses (e.g., European beachgrass and beach rye-grass) and a higher proportion of small shrubs (e.g., beach saltbush) (Holland, 1986).

Coastal cliffs are vegetated with low shrubs, herbaceous perennials, and annual grasses and forbs. Plants commonly encountered on northern coastal cliffs include yellow hairgrass, sea-pink, coast buckwheat, seaside daisy, lizard tail, manycolored lupine, live-forevers, and seaside plantain. Southern cliffs have plant species like those of the north with the addition of saltbushes, goldenbushes, fig-marigolds, and giant coreopsis. Coastal beach and cliff vegetation can be found from sea level to about 650 feet elevation.

Common shorebirds such as sanderlings, western sandpiper, and marbled godwits occur along the beaches. Song sparrows and white-crowned sparrows nest in areas vegetated with low shrubs. California ground squirrel, deer mouse, and red fox occur in disturbed dune and ecotone areas. Coastal cliffs of California provide important nesting habitat for several species of seabirds, among them the black oystercatcher, pelagic cormorant, pigeon guillemot, Brandt's cormorant, western gull, and common murre. Many of these species are also found along the rocky coastline during fall and winter.

Grassland. Grassland vegetation is characterized by a predominance of annual or perennial grasses in an open grassland. Most of the grassland in California is dominated by naturalized annual grasses with perennial grasses existing in relictual prairies or on sites with conditions unfavorable for annual grasses, such as serpentine. Grassland vegetation as a whole has relatively high species diversity when compared to other California plant communities.

Annual grasses found in grassland vegetation include wild oats, soft chess, ripgut grass, medusa head, wild barley, red brome, and slender fescue. Perennial grasses found in grassland vegetation are purple needlegrass, Idaho fescue, and California oatgrass. Forbs commonly encountered in

grassland vegetation include long-beaked filaree, redstem filaree, dove weed, clovers, Mariposa lilies, popcornflower, and California poppy. Vernal pools found in small depressions with an underlying impermeable layer are isolated wetlands within grassland vegetation. Vernal pools are discussed in further detail in the "Rare Natural Communities" section. Grassland vegetation occurs from sea level to about 3,900 feet in elevation.

Grassland habitats are important foraging areas for black-shouldered kite, red-tailed hawk, Swainson's hawk, northern harrier, American kestrel, yellow-billed magpie, loggerhead shrike, savannah sparrow, American pipit, mourning dove, Brewer's blackbird, red-winged blackbird, and a variety of swallows. Birds such as killdeer, ring-necked pheasant, western kingbird, western meadowlark, and horned lark nest in grassland habitats.

Grasslands also provide important foraging habitat for the coyote and badger because this habitat supports large populations of small prey species, such as the deer mouse, California vole, pocket gopher, and California ground squirrel. Common reptiles and amphibians of grassland habitats include western fence lizard, common kingsnake, western rattlesnake, gopher snake, common garter snake, western toad, and western spadefoot toad.

Barren Areas. Barren areas are defined for the purpose of this PEIS as sparsely vegetated or unvegetated lands. Within the CVPIA study area, barren habitat occurs mostly in lava fields and other volcanic terrain. The sparse vegetation and wildlife in barren areas are generally representative of that in grassland, sagebrush, mixed conifer forest, or other habitats occurring on better developed soils nearby.

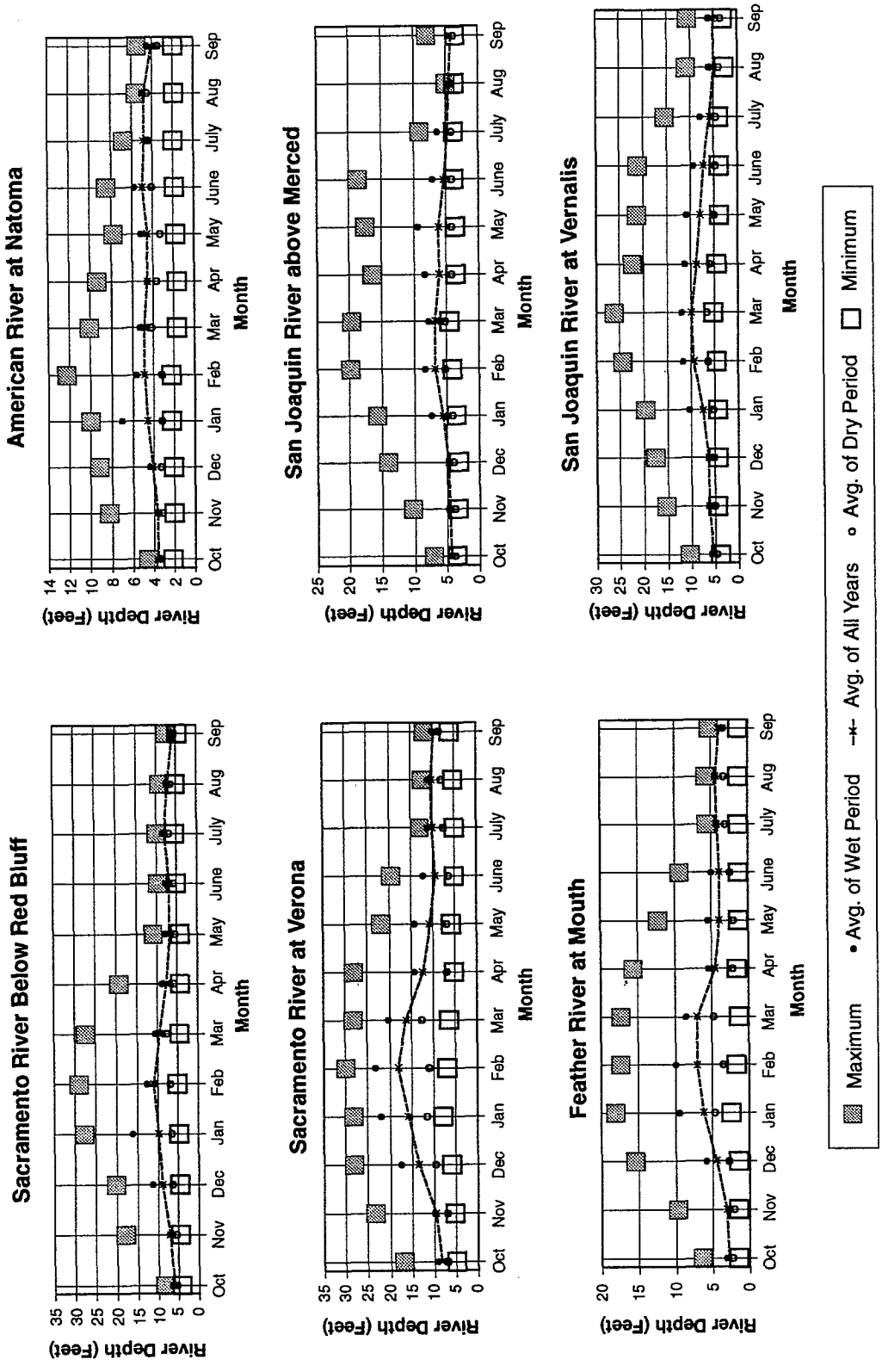
Riparian Communities

Riparian communities occur along creeks and rivers, and are found throughout the CVPIA study area. These communities have adapted to wide yearly and seasonal fluctuations in flow volumes, an abundance of floodplain moisture, and a dynamic erosion-deposition cycle.

Riparian habitats are usually in a constant successional state because of the dynamic nature of topography and hydrology (Campbell and Green, 1968). The resulting successional processes are responsible for the variation in structure (number of relative heights of vegetation layers) and species composition of vegetation types in riparian habitats.

Fluvial processes such as flooding, with its resulting sediment deposition and bank erosion, create three characteristic riparian landforms: gravel point bars, low terraces, and high terraces. Each landform has a different hydrology because of its physical relationship to the aquifer and flooding. Floods deposit nutrient-rich sediments that contribute to terrace formation by increasing elevations above the floodplain. Floods also break and abrade vegetation on gravel bars and low terraces, create anaerobic (i.e., without oxygen) soil conditions during flood events, erode riverbanks, and deposit entrained sediment on point bars.

Figure II-6 illustrates simulated monthly changes in mean river depth and width under existing conditions for selected locations on Central Valley rivers. The data are averaged over the entire simulated period and for representative dry and wet periods.



NOTE:
All years = simulated 1922-1990
Wet period = simulated 1967-1971
Dry period = simulated 1928-1934.

FIGURE II-6

SIMULATED MONTHLY RIVER STAGE AT SIX LOCATIONS

Riparian vegetation is important because of its scarcity and resource values. Riparian habitats support a wide diversity of plant and wildlife species whose numbers are disproportionately large relative to the extent of the habitat. Riparian areas also support several legally protected plant and animal species. Riparian habitats serve humans directly by forming a buffer between rivers and streams and intensively managed farmlands and urban landscapes, enhancing water quality through filtration of surface runoff, stabilizing streambanks, and moderating floodflows (Murray, Burns, and Keinlen Consulting Engineers, 1978; Brice, 1977; Groeneveld and Griepentrog, 1985).

Riparian habitats typically support a great diversity of wildlife species because they present a unique combination of surface water and groundwater, fertile soils, high nutrient availability, and vegetation layering, all of which form a variety of microclimates (Warner, 1979). For example, breeding birds restricted to riparian vegetation (obligates) may outnumber obligates of other habitats such as grasslands sevenfold (Tubbs, 1980); at least 65 bird species are known to nest in riparian habitats of the Sacramento Valley (Gaines, 1974b). The linear nature of riparian corridors is another ecological factor responsible for the high species diversity and abundance in these habitats; the "edge effect" of transitions between two habitat zones such as riparian and annual grassland promote greater wildlife diversity than in either habitat alone (Odum, 1978).

Valley Foothill Riparian. Valley foothill riparian vegetation occurs in valleys and bottomlands bordered by gently sloping alluvial fans and dissected terraces and coastal plains. Valley foothill riparian vegetation generally consists of woodlands or forests of broadleaved winter-deciduous hardwood trees as the overstory, with a variety of shrubs and vines composing the midstory, and a few grass and forb species in combination with vines composing the understory. The floodplains of valley foothill riparian communities are usually well developed.

Gravel Bar. Gravel bar habitats are subject to seasonal flooding and are sensitive to changes in flow volumes, timing, and rates of change in flow volumes. Plant species that occur on gravel bars require coarse mineral substrates that are wetted during seed dispersal and during the establishment phase. Therefore, the location of the wetted shoreline zone during late spring and early summer, and its location relative to winter floodflows, are critical factors affecting the location and extent of gravel bar communities. High spring flows and low summer flows often keep gravel bar plant communities from developing.

Two vegetative communities, willow scrub and willow-cottonwood forests, develop on gravel bars. Willow scrub vegetation is the "pioneering" vegetation in two topographic locations, point bars and creek edges, where dense thickets of one or more willow species (e.g., sandbar, red, arroyo, black willow) develop, and canal slough banks and low river terraces, where dense willow thickets also contain small amounts of cottonwood, white alder, and mule fat, with occasional interior live oak and elderberry along the upper edges.

Willow-cottonwood forests form dense sapling stands or forests to 60 feet in height. Black willow, arroyo willow, and cottonwood dominate the canopy. Older stands typically have a midstory of willows and box elder or thickets of California wild grape, blackberries, and poison oak. Herbaceous vegetation can be sparse or dense and includes species such as cocklebur, mugwort, umbrella-sedge, and horseweeds.

Species that forage on seeds and foliage in scrub and herb habitats along creeks and rivers include the California ground squirrel, Botta's pocket gopher, California vole, California quail, mourning dove, European starling, American goldfinch, and Brewer's blackbird. Aquatic areas within the river channels also provide foraging habitat for carnivores and omnivores such as river otter, common merganser, common goldeneye, and a variety of gulls.

Ground insectivores of the gravel bar riparian community include the western fence lizard, killdeer, spotted sandpiper, western kingbird, and broad-footed mole. Vertebrate predators include the gopher snake, red-tailed hawk, and striped skunk.

Unvegetated vertical banks along the rivers provide nesting substrates for a variety of specially adapted species. The bank swallow, belted kingfisher, and northern rough-winged swallow depend on vertical banks for nesting, and a few other species such as common barn owls and burrowing owls will also nest in these habitats.

Because willow scrub habitat frequently grows in dense clumps, it offers cover to a variety of wildlife species. Beavers preferentially feed on young willow shoots, and many small birds and mammals feed on willow seeds. Willows support an abundance of insect prey that feed on fresh foliage and stems during the growing season. These insects in turn support a high density and diversity of migratory and resident insectivorous birds, including the western flycatcher, yellow warbler, MacGillivray's warbler, Wilson's warbler, and song sparrow. Some species have declined or been eliminated from the valley floor as nesting species, among them the willow flycatcher, yellow warbler, and yellow-breasted chat (Remsen, 1978).

Low Terrace. Low terrace habitats develop as sediment accumulates on gravel bars and elevates them above the floodplain. Communities of this habitat are sensitive to floodplain water-level fluctuations and changes in flood intensity or duration. The communities are typically inundated only during floodflows.

Three plant communities develop on low terrace sites: mature cottonwood riparian forest, mixed riparian herb/scrub, and alder-willow forests. Mature cottonwood forests develop from young-growth willow-cottonwood forests. Forest heights can exceed 100 feet with a canopy of cottonwood or cottonwood-black willow. California wild grape or mistletoe may also occur in the canopy. A midstory of black willow, box elder, Oregon ash, and Northern California black walnut is typical of stands not choked by California wild grape, and a dense herb-vine growth often forms an impenetrable understory.

The mixed riparian herb/scrub community is located on riverbanks, berms, and terraces; this vegetation occupies sites where disturbance from levee maintenance and farming practices prevent the development of mature riparian forests. Herbaceous dominants include weedy annual grasses, sedges, rushes, and numerous forbs such as horsetails, mustards, and thistles. The scrub layer consists of shrub, vine, and tree saplings of willow, mule fat, blackberries, California wild grape, California wild rose, box elder, Fremont cottonwood, and Oregon ash.

Alder-willow forests are primarily associated with canals, sloughs, and channelized rivers where steep gravel, rock, or riprap banks extend to the shoreline defined by sustained summer water levels. Alder-willow forests typically form narrow bands along the shoreline that often overhang

the water. The 10- to 40-foot-tall canopy is dominated by white alder, arroyo willow, black willow, and red willow, with some Fremont cottonwood and Oregon ash. Higher adjacent ground supports other riparian communities.

Large trees in these forests provide habitat elements required by a number of wildlife species. Cottonwood trees provide adequate nesting support for larger birds such as hawks, owls, American crow, great egret, and great blue heron. Cavity-nesting species such as woodpeckers, wood ducks, bats, western gray squirrel, raccoon, and ringtail require mature stands.

The mixed riparian scrub community provides a variety of resources used by wildlife. Many plants within this habitat produce fruits that are important to wildlife. Common wildlife species in mixed scrub areas include those dependent on nectar, fruit, and seeds, such as Anna's hummingbird, scrub jay, black-headed grosbeak, lazuli bunting, rufous-sided towhee, house finch, Virginia opossum, raccoon, striped skunk, and gray fox. The mixed scrub habitat also supports many of the insectivorous bird species that occur in willow scrub habitat.

The typically narrow, linear nature of the alder-willow forest favors forms of wildlife that forage in adjacent herbland or agricultural habitats, including black-shouldered kite, American kestrel, and western kingbird. It also provides perches and cover for species that forage in or over the water, including double-crested cormorant, green-backed heron, belted kingfisher, violet-green swallow, tree swallow, black phoebe, beaver, river otter, and various bat species.

High Terrace. High terrace habitats are inundated during peak storm runoff events only and are not subject to severe physical battering or erosion (aside from bank erosion) or long-term flooding.

Mixed riparian forest and valley oak riparian forest typify high terrace riparian communities. Mixed riparian forests develop from mature cottonwood forests as terrace elevations increase and cottonwoods senesce and die, thereby "releasing" midstory trees from the inhibition of overstory shading. This community is characterized by lush, multilayered 150-foot-tall gallery forests. The canopy includes Fremont cottonwood, western sycamore, Oregon ash, Northern California black walnut, and valley oak. Midstories include black willow, box elder, and young trees of canopy species. Shrub understories include often impenetrable vine thickets of California wild grape, blackberries, poison oak, California wild rose, and California pipestem clematis. These vines drape over the midstory and canopy layers, imparting a junglelike appearance. Herb layers are typically dense.

Mixed riparian forests support the most dense and diverse wildlife communities in the Central Valley. The diversity of plant species and growth forms provides a variety of foods and microhabitat conditions for wildlife. Many of the mixed riparian plants provide valuable fruits, nuts, or seeds. Wildlife present include most of the species that occur in cottonwood forest and riparian scrub habitats. Oaks, walnuts, and other mast-producing trees support certain species that do not occur in the other habitats, such as acorn woodpeckers, plain titmouse, white-breasted nuthatch, and western gray squirrel.

Valley oak riparian forests develop on the highest terraces where flooding is least frequent and short in duration. Valley oak riparian forest develops from mixed riparian forests where dense

California wild grape vines have not prevented establishment of oak seedlings. The sparse-to-dense canopy consists of valley oak occasionally interspersed with Northern California black walnut. The sparse midstory consists of tree saplings, California wild grape, poison oak, blue elderberry, and blackberries. A lush grass or sedge-dominated herbaceous layer is typical. Valley oak riparian forests are the rarest community in the Sacramento Valley relative to their original extent. Such rarity stems from the valley oaks' position on high terraces, which are attractive sites for urban and agricultural development because of their fertile soil, high water infiltration rates, and infrequent floods.

Valley oak riparian forests typically grow some distance from the river channel. The discontinuous canopy allows dense growth of annual grasses in many areas. Oak forests provide nesting sites for red-tailed hawk, Swainson's hawk, and herons and egrets that require sturdy nesting sites and an open canopy for easy nest access. Valley oak stands also provide the best habitat for the acorn woodpecker, plain titmouse, and western gray squirrel. The open oak canopy provides perch sites for aerial foraging species such as the Lewis' woodpecker, ash-throated flycatcher, and western wood-peewee. It also offers perch sites for species that search for prey on the ground, such as the western bluebird and northern flicker. The furrowed bark on older oaks provides foraging habitat for species such as the Nuttall's woodpecker and white-breasted nuthatch that probe and peck for insects. Older trees provide an abundance of holes for cavity-dependent species.

Montane Riparian. The riparian communities of mountainous (i.e., montane) areas differ from valley foothill communities in extent and composition because the floodplain is constricted to narrow canyon bottoms, which limits river meandering and the lateral extent of the floodplain aquifer.

Because of the narrow floodplain, montane riparian vegetation is confined to a narrow band along the water's edge and to low terraces and gravel bars within the channel. The multilayered vegetation is nearly continuous along the bank, with Fremont cottonwood, white alder, willows, western sycamore, valley oak, and Oregon ash prevailing as common canopy species. A relatively dense shrub layer of willows, buttonbush, spicebush, creek dogwood, mule fat, and poison oak is typical. Because it is near woodlands and forests, dogwood, bigleaf maple, canyon live oak, Douglas-fir, and incense cedar are often intermixed.

Narrow bands of montane riparian habitat provide valuable wildlife habitat despite their small areal extent. These areas are typically cooler, moister, and more productive than surrounding habitats. Insectivorous species occurring in these habitats include warbling vireo, Wilson's warbler, yellow warbler, and a variety of shrew species. Herbivores and omnivores that frequent streamside vegetation are the rufous-sided towhee, fox sparrow, and western gray squirrel. Black-tailed deer make extensive use of all these habitats for fawning, foraging, and escape cover.

Herbaceous Wetland Communities

Wetland communities develop in the presence of hydrologic conditions that create seasonal or year-round inundation or saturated soils. Wetland communities are also characterized by specific vegetation types and nonoxidizing soils.

Wetland communities are important because they provide habitat for dependent plant and wildlife species and because they are scarce. Each wetland community type is adapted to specific hydrologic situations and is therefore sensitive to changes in water table elevations.

Two broad categories of wetland communities occur in the CVPIA study area, fresh emergent wetland and saline emergent wetland.

Freshwater Emergent Wetlands. Freshwater emergent wetlands are characterized by the presence of erect, rooted, herbaceous plants that require or are tolerant of saturated or flooded soils. Fresh emergent wetlands are inundated or saturated for a sufficient period to create anaerobic conditions in the root zone. Vegetation in these wetlands can vary from small isolated clumps within a body of water to large uninterrupted expanses covering many acres. Three types of fresh emergent wetlands are described in this technical appendix: freshwater marsh, vernal pool, and managed wetlands.

Freshwater Marsh. Freshwater marshes develop where fine-textured sandy and silty soils are permanently inundated or saturated. The community is intolerant of quickly flowing water, water depths exceeding 5 feet, rapid or wide fluctuations in water level, and saltwater. This community is restricted to ponds, canals, sloughs, river backwaters, and similar habitats.

Freshwater marshes in the Sacramento Valley are dominated by dense growths of tules and cattails, with occasional verbena, smartweed, rose-mallow (California hibiscus), and various rush and sedge species.

Open water in and near freshwater marshes and along rivers, oxbows, and quiet backwaters is dominated by floating and submerged aquatic species. Common dominants include pondweeds, water-milfoil, waterweeds, duckweeds, bladderworts, and waterlily.

Freshwater marshes of the CVPIA study area provide important habitat for waterfowl and a variety of other wildlife species, including grebes, herons, egrets, bitterns, coots, shorebirds, rails, hawks, owls, muskrat, raccoon, opossum, and beaver. Many other upland species such as ring-necked pheasant, California quail, black-tailed hare, and desert cottontail take cover and forage at the margins of wetland habitats. Many reptiles and amphibians such as common garter snake, aquatic garter snake, Pacific treefrog, and bullfrog also breed and feed in freshwater habitats of the region.

Vernal Pools. Vernal pools develop in shallow basins that form in flat-to-hummocky terrain. Soil durapans underlying the basins prevent water infiltration and the nearly level terrain inhibits surface runoff. Saturated soil conditions cause the water table to become exposed because it is "perched" on the durapan. Hence, surface water accumulates in the basins, forming a seasonal wetland.

Vernal pools are important communities because of their current scarcity. Holland (1978) estimated that 5 to 30 percent of California's vernal pools are intact today; the figure for the Central Valley is about 5 percent.

Vernal pools support an ephemeral flora dominated by terrestrial annual species, with perennial and aquatic species often contributing significant cover. Vernal pool species flower throughout the spring, resulting in conspicuous zonation patterns formed by consecutively blooming species around drying pool margins. Characteristic dominant plants include popcornflower, low barley, downingia, coyote-thistle, goldfields, meadowfoam, owl's clover, pogogyne, woolly marbles, and navarretia.

Although vernal pools are an ephemeral aquatic habitat, invertebrates and amphibians also have adapted to this resource. When standing water is available, California tiger salamanders, western spadefoot toads, and Pacific treefrogs may use the pools for egg-laying and for the development of young. Aquatic invertebrates, such as fairy shrimp, tadpole shrimp, clam shrimp, cladocerans, copepods, and crawling water beetles, may also inhabit vernal pools. In winter and spring, water birds such as mallards, cinnamon teal, killdeer, California gulls, green-backed herons, great blue herons, and great egrets may use vernal pools for resting and foraging grounds. Western kingbirds, black phoebes, and Say's phoebes feed on flying insects above vernal pools.

Managed Wetlands. Managed wetlands are used on federal and state refuges to maximize habitat suitability for waterfowl and other wetland-dependent wildlife. Managed wetlands can be broadly categorized into permanent wetlands, semi-permanent wetlands, seasonal wetlands, and moist soil plant areas.

Permanent wetlands are flooded throughout the year, with periodic drainage to control emergent vegetation and increase productivity. Water is maintained at a depth from 30 to 48 inches. Dominant vegetation includes cattails, tules, and pondweeds.

Semi-permanent wetlands are frequently the low portions of seasonal wetlands that remain flooded after seasonal wetlands have dried or are drained. This type of wetlands management maintains water on the site for 8 to 12 months annually and provides important summer water and brood ponds for resident waterfowl and other wildlife.

Seasonal wetlands are flooded in fall and maintained through winter or spring but are drained or allowed to dry through summer.

Moist soil plant areas are seasonal wetlands managed for high production of preferred waterfowl forage plants and invertebrates. These areas may be irrigated during summer to stimulate plant growth. Water regimes are selected for specific plant associations, including swamp timothy, watergrass, or smartweed.

Saline Emergent Wetland. Saline emergent wetland vegetation is dominated by water-seeking vegetation living in brackish or saline waters or soils. Vegetation is mostly composed of perennial grass-like plants and forbs. Forbs in saline emergent vegetation are usually succulent and not very woody. Mats of algae often carpet moist soils and plant stems. Component plants are present in zones or patches relating to elevational gradients above the mean water level, and vegetative cover is generally complete except where creeks or ponds exist.

Characteristic species of lower, and consequently more saline, sites are cord grasses, pickleweed, saltwort, fleshy jaumea, California sea-blite, and alkali heath. Typical species of more brackish

sites include bird's-beak, sea-lavender, African brass-button, saltmarsh dodder, tule, slender cattail, silverweed, and slough sedge.

Saline emergent wetland vegetation occurs in the upper intertidal zone from about mean lower high water to extreme high water. Maximum elevation is about 10 feet above mean lower low water.

Saline emergent wetlands provide habitat for a variety of bird, mammal, reptile, and amphibian species. Birds that commonly use this habitat include salt marsh yellowthroat, song sparrow, marsh wren, Virginia rail, American coot, and several species of shorebirds, including ducks, herons, egrets, and swallows. Raccoon, opossum, striped skunk, red fox, and coyote forage along the edges of saline emergent wetlands.

Open Water. Open water areas are defined for the purpose of this PEIS to include river channels, lakes, reservoirs, and estuaries. These areas are generally unvegetated, except for occasional beds of aquatic plants. The open water zones of lakes and large rivers provide resting and escape cover for many species of waterfowl. Gulls, terns, kingfishers, osprey, and bald eagle hunt in open water. Insectivorous birds and bats feed over open water. Common mammals in open water include muskrat, beaver, and river otter (Mayer and Laudenslayer, 1988).

Agricultural Habitats

Although natural communities provide the highest value for wildlife, many of these natural habitats have been largely replaced by agricultural habitats with varying benefits to wildlife. Six agricultural types were identified in the CVPIA study area: pasture, orchard-vineyard, row crops, grain, rice, and cotton. The intensive management of agricultural lands, including disking, grazing, crop rotation, and the use of chemicals, reduces the value of these habitats for wildlife. However, many wildlife species have adapted to particular crop types and now use them for foraging and nesting. Compared to other agricultural crops, rice and grain crops are considered of high value for wildlife because of the importance of waste grain to foraging wildlife species, and flooded rice fields provide habitat similar to some natural wetlands. Compared to rice and grains, pasture and row crops provide moderate-quality habitat due to limited cover and foraging opportunities. Orchard-vineyard and cotton crops provide low-quality wildlife habitat due to frequent disturbance, resulting in limited foraging opportunities, and lack of cover. Table II-3 summarizes the acreage of natural communities and agricultural crops in study area regions in the Central Valley and Delta.

Pasture. Pasture habitat consists of irrigated and nonirrigated lands that are dominated by grasses and legumes. The vegetation composition of pastures varies with management practices, affecting the abundance and composition of wildlife. Irrigated pastures may offer some species habitats similar to those of seasonal wetlands and nonirrigated pastures; however, the frequent harvesting reduces habitat quality for ground-nesting wildlife. Irrigated pastures also provide foraging and roosting opportunities for many shorebirds and wading birds, including black-bellied plover, killdeer, long-billed curlew, and white-faced ibis. Lightly grazed, nonirrigated pastures may have value similar to that of annual and perennial grasslands, providing forage for seed-eating birds and small mammals when the seeds ripen. Alfalfa grown in irrigated pastures provides high-quality foraging habitat for rodents.

Small mammals occupying pasture habitat include California voles, Botta's pocket gophers, and California ground squirrels. Raptors, including red-tailed hawks, black-shouldered kites, and prairie falcons, prey upon rodents. Areas where alfalfa or wild oats have been recently harvested provide high-quality foraging habitat for raptors. Ground-nesting birds, such as ring-necked pheasant, waterfowl, and western meadowlark, occupy pasture habitat if adequate residual vegetation is present.

Orchard-Vineyard. Orchard-vineyard habitat consists of cultivated fruit or nut-bearing trees and grape vines. This habitat is planted in a uniform pattern and intensively managed. Understory vegetation is usually sparse; however, in some areas, grasses are allowed to grow between vineyard rows to reduce erosion. Wildlife species associated with vineyards include the deer mouse, mourning dove, and black-tailed hare. The nut crop from orchards provides feed for American crows, scrub jay, northern flicker, Lewis' woodpecker, and California ground squirrel. The fruit crops from orchards provide additional food for yellow-billed magpies, American robin, northern mockingbird, black-headed grosbeak, gray squirrel, raccoon, and mule deer.

Row Crops. Row crops include tomatoes, broccoli, artichokes, lettuce, sugar beets, and strawberries. Intensive management and the use of chemicals to control pests in row crops limit their use by wildlife. Rodent species that forage in row crops include the California vole, deer mouse, and California ground squirrel. These rodent populations are preyed on by Swainson's hawks, red-tailed hawks, and black-shouldered kites.

Grain. Grains crops include barley, wheat, corn, and oats. Many of these crops are planted in fall and harvested in spring. Grain crops are intensively managed, and chemicals are often used to control pests and diseases. This management strategy reduces their value to wildlife; however, the young green shoots of these crops provide important foraging opportunities for such species as greater white fronted geese, tundra swans, wild pigs, and tule elk. Other species, including red-winged blackbirds, Brewer's blackbirds, ring-necked pheasants, waterfowl, and western harvest mice, feed on the seeds produced by these plants.

Rice. Cultivated rice in the Central Valley has some of the attributes found in seasonal wetlands; however, the intensive management of this habitat reduces many of the benefits found in pristine wetlands. Flooded rice fields provide nesting and foraging habitat for waterfowl and shorebirds. The grain produced by this crop provides important forage for many wildlife species. After harvest, waste grain is fed upon by waterfowl (e.g., mallards and Canada geese), sandhill cranes, California voles, and deer mice. Raptors, including northern harriers, black-shouldered kites, and ferruginous hawks, feed upon rodents in this habitat. Irrigation ditches used to flood rice fields often contain dense cattail vegetation. These ditches provide habitat for wildlife species, such as the Virginia rail, American bittern, snowy egret, marsh wren, common yellowthroat, and song sparrow.

Cotton. Cotton is of limited value to wildlife because of the intensive management of this crop and the use of chemicals to control pests and disease. Mourning doves and house mice are found in this crop type. During irrigation when vegetation is short and sparse, additional wildlife, including killdeer, American pipet, and horned lark, may be attracted.

Reservoir Habitats

Reservoirs created for the storage of water also provide habitat for wildlife, primarily waterbirds (e.g., gulls, waterfowl, wading birds, shorebirds, and coots and rails) during fall and winter. Most reservoirs are not optimum habitat because frequently fluctuating water levels do not allow establishment of vegetation along shorelines, and steep sides limit the amount of shallow water habitat preferred by most species of waterbirds for resting, foraging, and nesting.

Shoreline Habitat. Shoreline habitat includes the area above and below the high-water level. The habitat above the high-water level is the natural habitat that occurred in the area before inundation of the reservoir. Common habitats around reservoirs are mixed conifer forest, montane hardwood, valley foothill hardwood, chaparral, and grassland. These habitats were described earlier in "Common Natural Communities."

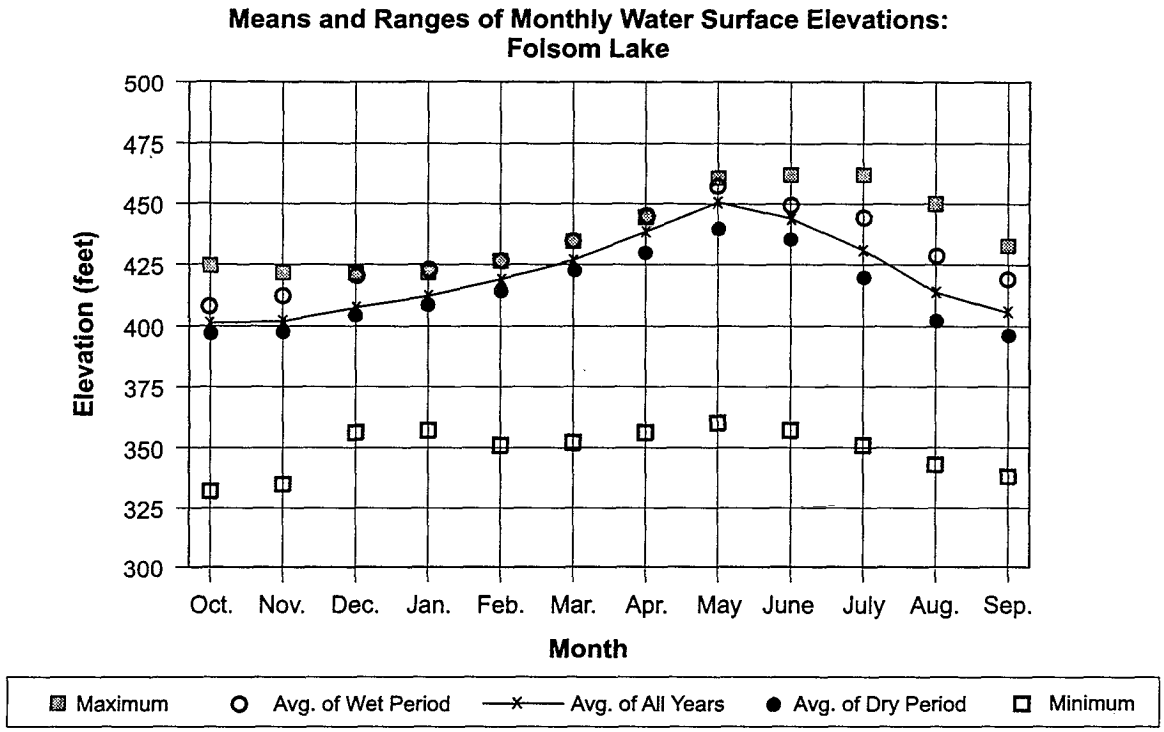
The other portion of shoreline habitat occurs in the area between the high- and low-water elevations. The amount of shoreline varies within a year as the reservoir fills during winter and spring and is drained during summer and fall. The fluctuating water levels result in constant erosion and extended periods of inundation and exposure that inhibits the establishment of vegetation. Furthermore, the native soil is generally eroded by wave action and fluctuating water levels. Common vegetation along the shoreline may be ruderal annual forbs and grasses.

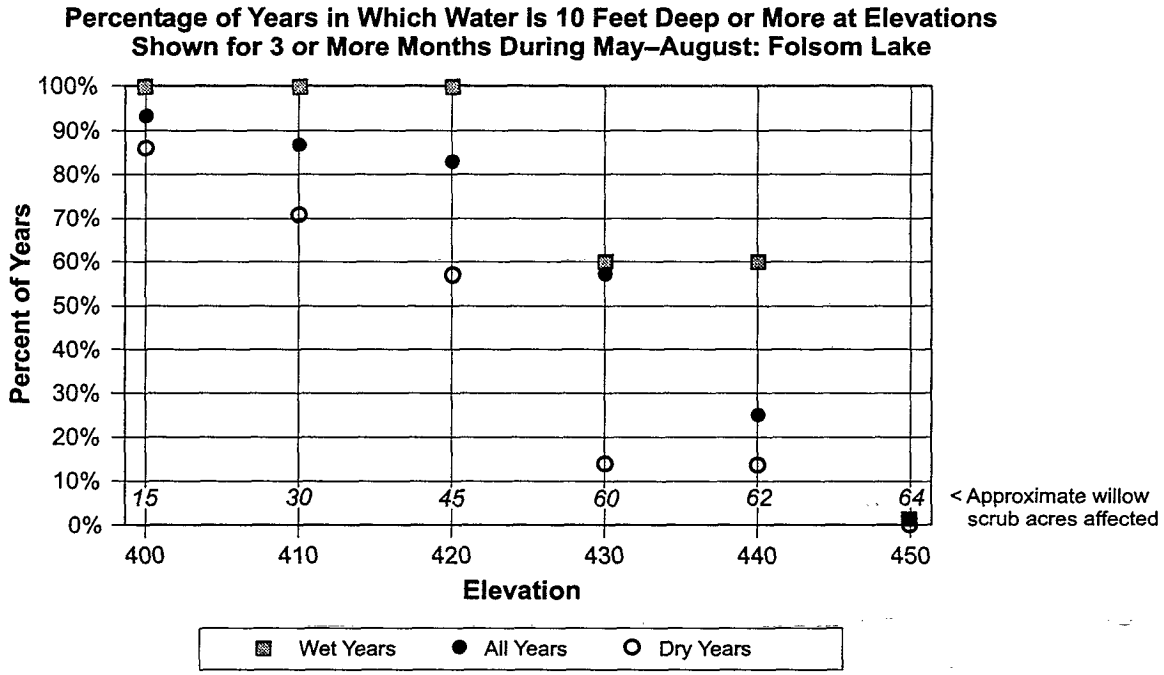
Some reservoirs developed moderate amounts of willow scrub vegetation in their drawdown zones during the dry years from 1987 to 1993 (e.g., Folsom Lake contains scattered small patches of Goodding's black willow totaling approximately 65 acres). Figure II-7 illustrates the percent of years in which water levels at Folsom Lake exceed selected elevations occupied by willows for long enough periods to drown some or all of them.

Shorelines tend to have low value for most wildlife species because generally no vegetation exists to provide forage and cover for wildlife. Shorelines are used by small numbers of shorebirds (e.g., killdeer, black-necked stilt, and American avocet), wading birds (e.g., herons and egrets), dabbling ducks (e.g., mallards, American wigeon, and gadwall), and American coots that feed on invertebrates, herbaceous vegetation, or seeds scattered along the shoreline. Additional species include raccoon, striped skunk, coyote, and Pacific treefrog.

Shallow Water Habitat. Shallow water wildlife habitat in a reservoir is the area with less than 1 foot of water. The extent of this habitat is generally limited because of the steep sides of most reservoirs. Vegetation is adapted to grow in an oxygen-deficient habitat. Plants such as milfoils and waterweeds become evident late in the growing season after drawdowns in the reservoirs have begun. Emergent aquatic plants, such as cattails and tules, may establish in some shallow water areas, but this vegetation rarely persists because of the variations in water levels.

Shallow water habitat is optimal foraging depth for dabbling ducks, coots, and wading birds. These animals feed on aquatic invertebrates, small fish, amphibians, and aquatic plants. Shallow water may also be used by muskrats, raccoons, and skunks.





NOTE:
All years = simulated 1922-1990
Wet period = simulated 1967-1971
Dry period = simulated 1928-1934.

FIGURE II-7

SIMULATED FOLSOM LAKE CONDITIONS AFFECTING DRAWDOWN ZONE VEGETATION

Open Water Habitat. Open water habitat for wildlife is any portion of the water that is deeper than 1 foot. This habitat is generally devoid of vegetation because of the lack of oxygen and light, and cold temperatures that limit photosynthetic capacities of plants.

This habitat provides resting and foraging areas for diving ducks (e.g., lesser scaup, bufflehead, ruddy duck, and common merganser), gulls, grebes, and other open water birds. Most diving ducks forage in water less than 15 feet deep. Grebes and cormorants commonly dive to deeper depths searching for fish. Gulls commonly rest on deeper portions of reservoirs, far from potential shoreline disturbance.

RARE NATURAL COMMUNITIES

Rare natural communities are recognized by state and federal agencies as important habitats because of their high species diversity and richness, high productivity, unusual nature, limited distribution, and declining status, or some combination of these qualities. The NDDB maintains a list of rare natural communities. The Service considers certain habitats, such as wetland and riparian communities, important to wildlife. Under Section 404 of the Clean Water Act, the COE and USEPA consider wetland habitats important for water quality and wildlife. Table II-4 lists rare natural communities known or with potential to occur in the Sacramento River, San Joaquin River, Tulare Lake, and Delta regions of the study area. Table II-5 includes the same information for study area regions outside the Central Valley and the Delta.

The following descriptions, based on Holland (1986) and CNPS (1993), focus on rare natural communities that occur in all study area regions other than transfer areas.

Valley Foothill Hardwood – Valley Oak Woodland

Valley oak woodland is an open-canopied community with valley oak often the only tree species present. Valley oak is California's largest broadleaved tree, attaining heights from 50 to 115 feet. An herbaceous understory exists and few shrubs, if any, are present.

Valley oak woodland occurs in the Sacramento and San Joaquin valleys adjacent to the Sierra Nevada foothills and in the valleys of the Coast Ranges from Lake County to western Los Angeles County. This community is found at elevations from sea level to 2,540 feet, occurring in all the study area regions except the Delta. Large areas of this community have been eliminated by woodcutting and conversion of habitat to agricultural and urban lands.

Valley Foothill Riparian Communities

Valley Oak Riparian Forest. This community is similar to the valley foothill riparian community described earlier, but it is characterized by a closed canopy dominated primarily by one species, valley oak. Valley oak riparian forest is restricted to higher sections of floodplains that are away from the active river channels, yet still receive annual deposits of silty alluvium and have a shallow water table.

TABLE II-4

RARE NATURAL COMMUNITIES KNOWN OR WITH POTENTIAL TO OCCUR IN THE CENTRAL VALLEY

Rare Natural Community	Study Area Region (Central Valley Only)			
	Sacramento River	San Joaquin River	Tulare Lake	Delta
Alkali meadow and seep	x	x	x	
Bog and fen	x	x	x	
Cismontane alkali marsh	x	x	x	x
Coastal and valley freshwater marsh	x	x	x	x
Coastal brackish marsh	x			x
Elderberry savanna	x	x		
Fremont cottonwood riparian forest	x	x	x	x
Great Valley mesquite scrub		x	x	
Great Valley willow scrub	x	x	x	x
Ione chaparral	x	x		
Mixed riparian forest	x	x	x	x
Monvero residual dunes		x		
Northern coastal salt marsh	x			x
Serpentine bunchgrass grassland	x			
Stabilized interior dunes			x	x
Sycamore alluvial woodland		x	x	
Valley needlegrass grassland	x	x	x	x
Valley oak riparian forest	x	x	x	x
Valley oak woodland	x	x	x	
Valley sacaton grassland		x	x	
Valley saltbush scrub			x	
Valley sink scrub		x	x	
Vernal pool	x	x	x	
Wildflower field	x	x	x	x
Total in each region	**17**	**19**	**18**	**11**

TABLE II-5

RARE NATURAL COMMUNITIES KNOWN OR WITH POTENTIAL TO OCCUR IN THE SAN FRANCISCO BAY AND CENTRAL COAST REGIONS

Rare Natural Community	Study Area Region outside the Central Valley	
	San Francisco Bay Region	Central Coast Region
Alkali meadow	x	
Alkali seep	x	
Central dune scrub	x	x
Central foredunes		x
Central maritime chaparral		x
Cismontane alkali marsh	x	
Coastal and valley freshwater marsh	x	x
Coastal brackish marsh	x	x
Coastal terrace prairie	x	
Maritime Coast Range ponderosa forest	x	x
Monterey cypress forest		x
Monterey pine forest	x	x
Monterey pygmy cypress forest		x
Northern Bishop pine forest	x	
Northern foredune grassland	x	
Northern claypan vernal pool	x	x
Northern coastal salt marsh	x	x
Northern interior cypress forest	x	x
Northern maritime chaparral	x	
Northern vernal pool	x	x
Serpentine bunchgrass	x	x
Stabilized interior dunes	x	
Sycamore alluvial woodland	x	x
Valley needlegrass grassland	x	x
Valley oak woodland	x	x
Valley sink scrub	x	x
Wildflower field	x	x
Total in each region	**23**	**19**

NOTE:
See Holland (1986) for descriptions.

Once extensive along the major streams of the Sacramento and northern San Joaquin valleys, this community has suffered extensive losses due to conversion to agriculture and harvesting of firewood. Valley oak riparian forest occurs in all of the study area regions.

Fremont Cottonwood Riparian Forest. This community is also similar to the valley foothill riparian community but is characterized by a dense tree layer co-dominated by Fremont cottonwood and black willow. It occurs on sites along perennial or nearly perennial streams that receive frequent flooding. These sites are inundated during winter and spring and receive subsurface irrigation from a shallow water table during the remainder of the year.

Historically abundant along major streams throughout the Central Valley, Fremont cottonwood riparian forest now occurs only in small, scattered, isolated patches. Major losses to this community have resulted from flood control, water diversion, agricultural development, and urban expansion. It occurs in all regions of the study area.

Mixed Riparian Forest. This community is similar to the valley foothill riparian community described earlier. It consists of a closed canopy dominated by any of several species, including box elder, northern California black walnut, western sycamore, Fremont cottonwood, black willow, yellow willow, and red willow. Mixed riparian forest occurs on relatively fine-textured alluvium slightly back from the active river channel. Overbank flooding usually occurs annually. This community may intergrade with Fremont cottonwood riparian forest closer to the river channel and valley oak riparian forest farther from the river.

Mixed riparian forest is found along low-gradient streams throughout the Central Valley. Clearing for agriculture, flood control, and urban expansion has severely reduced the abundance of this community. Mixed riparian forest occurs in all of the study area regions.

Sycamore Alluvial Woodland. Sycamore alluvial woodland is a broadleaved riparian woodland community dominated by moderately spaced western sycamore trees. California buckeye and blue elderberry are common components of the subcanopy. An understory of annual grasses and mule fat is typical.

Sycamore alluvial woodland is found along braided, depositional channels of intermittent streams that are usually characterized by cobbly or boulder substrates. This community is found in the San Joaquin River and Tulare Lake regions.

Great Valley Willow Scrub. Great Valley willow scrub is an open to dense streamside community that forms a shrubby thicket dominated by any of several willow species. An herbaceous understory of naturalized and native annual grasses and forbs exists in more open-canopied stands.

Great Valley willow scrub occurs along the major rivers and many smaller streams in the Central Valley, typically below 1,000 feet. It has the potential to occur in the Sacramento River, San Joaquin River, Tulare Lake, and Delta regions.

Great Valley Mesquite Scrub. This community is an open woodland or savanna dominated by mesquite, a phreatophyte (i.e., a plant that sends roots down to the water table), and allscale.

An understory of naturalized annual grasses is typical. Great Valley mesquite scrub occurs on sandy loam soils in areas with hot, dry summers and moist, foggy winters.

This community was once common in the southern San Joaquin Valley from Bakersfield to the inner South Coast Range at Tupman and Buena Vista Lake. The NDDB also cites this community as occurring farther north. It has been virtually extirpated by flood control, agricultural development, and groundwater pumping. Great Valley mesquite scrub occurs in the San Joaquin River and Tulare Lake regions.

Elderberry Savanna. Elderberry savanna is a community of early successional stages dominated by open stands of blue elderberry. The understory is characterized by naturalized annual grasses and forbs. This community occurs on deep alluvial soils removed from the active river channel and is subject to occasional flooding during high rainfall events.

Elderberry savanna is patchily distributed among riparian stands throughout the Sacramento River and northern San Joaquin River regions, as far south as Merced County.

Chaparral Community – Ione Chaparral

This community is characterized by Ione manzanita as the sole or dominant shrub in the canopy layer. Occasional trees, such as canyon live oak or foothill pine, are present. Other associates of the shrub layer include deer weed, scrub oak, and sticky whiteleaf manzanita. Only a sparse ground layer exists.

Ione chaparral is restricted to the foothills of Amador and Calaveras counties, in the Sacramento River and San Joaquin River regions.

Rare Alkali Desert Scrub Communities

Valley Sink Scrub. This succulent shrubland community is dominated by alkali-tolerant species, such as iodine bush and bush seepweed. Soft chess and other annuals may sparsely vegetate the understory.

Valley sink scrub occurs on heavy saline or alkaline clay soils of lakebeds or playas with high ground water supplies in the Central Valley. It once surrounded the San Joaquin Valley lakes and was prevalent around water bodies in the Sacramento Valley. This community has been virtually extirpated by flood control, agricultural conversion, and groundwater pumping. Valley sink scrub occurs in the San Joaquin River and Tulare Lake regions.

Valley Saltbush Scrub. This community is characterized by a low cover of chenopod (i.e., a member of the goosefoot family, Chenopodiaceae) scrub species and herbaceous annuals. Dominant shrubs include allscale and spinescale saltbush.

Valley saltbush scrub is found on nonalkaline sandy and loamy soils of alluvial fans. It is distributed in the southern and southwestern San Joaquin Valley (Tulare Lake Region) and in the Carrizo Plains of eastern San Luis Obispo County.

Inland Dune Communities

Stabilized Interior Dunes. This is an open community characterized by a scattering of annual and perennial herbs, grasses, and low-growing shrubs. Common species include Antioch Dunes evening-primrose, California croton, California matchweed, Contra Costa wallflower, auriculed barestem buckwheat, and telegraph weed. Individuals of coast live oak may also be present.

Stabilized interior dunes form a riverbank community occurring on the lower reaches of the San Joaquin River at Antioch. The dunes were formed from glacial outwash of the Pleistocene Sierra Nevada. Historically very limited, this community has been further reduced by agricultural and industrial development, road building, and sand quarrying. Stabilized interior dunes occur in the Delta Region.

Monvero Residual Dunes. This open community is dominated by the shrubs desert tea and narrowleaf goldenbush. An understory of grasses, such as desert needlegrass and Indian ricegrass, and several forbs characteristic of the Colorado and Mojave deserts occur in the Monvero residual dunes.

This community is found on hilltop sand accumulations that have weathered in place from Miocene sandstones. It is restricted to the lower inner south Coast Range in western Fresno County, from approximately 1,500 to 3,000 feet elevation. Monvero residual dunes occur on the west side of the San Joaquin River Region.

Grassland Communities

Valley Needlegrass Grassland. This community is dominated by the tussock-forming purple needlegrass; naturalized annual forbs and grasses are also common.

Valley needlegrass grassland is found on fine-textured soils that receive ample water during winter. This community is much reduced in its historical range, which includes the Sacramento, San Joaquin, and Salinas valleys and the Los Angeles Basin. Valley needlegrass grassland occurs in the Sacramento River and San Joaquin River, Tulare Lake, and Delta regions.

Serpentine Bunchgrass Grassland. Serpentine bunchgrass grassland is a perennial bunchgrass community dominated by several native grasses and forbs, such as foothill needlegrass, nodding needlegrass, California melic grass, California lotus, and California poppy. It is restricted to serpentine sites primarily in the Coast Ranges but is also found in limited extent in the Sierra Nevada and southern California mountains. Serpentine bunchgrass grassland also occurs in the Sacramento River Region.

Valley Sacaton Grassland. This tussock-forming community is dominated by alkali sacaton. It occurs on fine-textured, poorly drained alkaline soils. Seasonally high water tables are typical in this community.

Once extensive in the Tulare Lake Basin and San Joaquin Valley north to Stanislaus and Contra Costa counties, this community is now much reduced. Valley sacaton grassland occurs in the San Joaquin River and Tulare Lake regions.

Wildflower Field. Wildflower fields are a herbaceous community with a conspicuous display of any number of wildflower species, such as California poppy, bicolored gilia, tidy tips, bicolored lupine, and owl's clovers.

Wildflower fields are found in the valleys and foothills of most of the California Floristic Province, generally the area west of the Pacific Divide possessing a Mediterranean-type climate. Wildflower fields occur below 2,000 feet elevation in the north and from about 4,000 to 5,000 feet in the south and are found in the Sacramento River, San Joaquin River, Tulare Lake, and Delta regions.

Vernal Pool

Vernal pools are shallow, seasonal water bodies that accumulate water during winter and spring due to the presence of an impermeable subsurface layer. Annual herbs bloom after water evaporates in late spring. Species composition varies among pools, but may include downingia, coyote-thistle, goldfields, popcornflower, and woolly marbles.

Vernal pools occur in the Central Valley, southern central coast, south coast, and Modoc Plateau of California from sea level to 3,610 feet. They also may occur in the Sacramento River, San Joaquin River, Tulare Lake, and Delta regions.

Freshwater Emergent Wetland Communities

Coastal and Valley Freshwater Marsh. This wetland community occurs on sites permanently flooded with slow-moving freshwater, where deep, peaty soils tend to accumulate. It is dominated by densely spaced perennial, emergent grass-like plants. Bulrushes and cattails dominate individually or together.

Coastal and valley freshwater marsh is extensive in the upper Delta and common in the Sacramento and San Joaquin valleys in floodplain areas such as river oxbows. It also occurs along the fringes of perennially flooded drainage ditches, canals, ponds, and lakes and in coastal valleys near river mouths. This community is found in the Sacramento River, San Joaquin River, Tulare Lake, and Delta regions.

Cismontane Alkali Marsh. This community is characterized by many of the same species as coastal brackish marsh (see "Saline Emergent Wetland Communities" in the next section). Soils are perennially inundated or saturated and are alkaline due to high evaporative pressures and low freshwater inputs.

Cismontane alkali marsh occurs along lakebeds and other floodplains of the Sacramento and San Joaquin rivers as well as Kings and Kern counties of the Tulare Lake Region.

Alkali Meadows and Seeps. These communities are composed of perennial grasses, sedges, or herbs. Species richness is typically low and may include plants such as alkali sacaton, saltgrass, ditchgrasses, and rushes. Sites supporting alkali meadows and seeps are more or less permanently moist and are characterized by alkaline or saline soils.

Alkali seeps are found primarily in the desert regions of California and less commonly in other areas. Alkali meadows occur mainly in valley bottoms and on the lower portions of alluvial slopes from 3,500 to 7,000 feet, they are also scattered throughout the California Floristic Province (Hickman, 1993). Alkali meadows and seeps occur throughout the Central Valley.

Bogs and Fens. Bogs are characterized by a dense growth of herbaceous perennials and low-growing shrubs. Fens are similar to bogs, but with a richer flora that includes larger shrubs. Common species may include sedges, roundleaf sundew, California pitcher plant, Labrador tea, Douglas' false-willow, and sphagnum moss.

Bogs are found scattered in the Klamath and Coast ranges, Sierra Nevada, and Cascade Range. They inhabit cold, acidic, poorly drained, low-nutrient areas. NDDB occurrences of bogs and fens have been reported for the Sacramento River Region, the east side of the San Joaquin River Region, and the west side of the Tulare Lake Region.

Saline Emergent Wetland Communities

Coastal Brackish Marsh. Coastal brackish marsh is similar to coastal and valley freshwater marsh with the addition of species, such as saltgrass and pickleweed that are more tolerant of higher salinities. Salinities tend to vary considerably with changes in the tide.

This community typically occurs at the interior of coastal bays and estuaries where freshwater and saltwater intermix, and in coastal lagoons. It is well developed at Suisun Bay at the mouth of the Delta. Coastal brackish marsh is found in the west side of the Sacramento River Region and the Delta Region.

Northern Coastal Salt Marsh. This highly productive community is dominated by salt-tolerant hydrophytes (i.e., water-loving plants). Pacific cord grass grows nearest to the open water, and pickleweed grows farther away on slightly higher elevations. A more diverse mix of species occurs at the transition with the adjacent upland community.

This community is found along the sheltered fringes of bays, lagoons, and estuaries, with regular saltwater tidal inundation. Northern coastal salt marsh is distributed along the coast from the Oregon border south to Point Conception. In the Central Valley, northern coastal salt marsh is found in the western Delta Region.

SPECIAL-STATUS SPECIES

Special-status species are plants and animals that are recognized as rare by state and federal agencies and conservation groups. They include federally listed and state-listed threatened or endangered species, species proposed for state or federal listing as threatened or endangered, and federal candidate species. Complete definitions of special-status species are provided in Chapter III.

The rich biological heritage in California includes more than 750 native vertebrate species, 6,800 plant species, and 25,000 native insect species. More than one-third of the plant and freshwater fishes are endemic to California. Because of this rich biological diversity, the number of species

with limited distributions and high sensitivity is large. Special-status plant and animal species occurring within the CVPIA area are identified in Table II-6.

TABLE II-6

NUMBERS OF SPECIAL-STATUS PLANT AND ANIMAL SPECIES THAT OCCUR IN THE CVPIA STUDY AREA

Listing Status	Plants	Animals
Federally listed as threatened or endangered	28	22
Proposed for federal listing as threatened or endangered	18	0
State listed as threatened, endangered, or (for plants only) rare	15	9
Federal candidate	5	4
Total	**66**	**35**

NOTE:
Many species have a federal and state status. However, in this table, each species was assigned to the highest-ranked category of legal protection (federally listed = highest, state = lowest) and counted only once.

Tables II-7 and II-8 list the numbers of special-status plant and wildlife species, respectively, by status level and habitat in each Central Valley region.

Attachment A summarizes information on the legal status, geographic distribution, and habitat requirements of special-status wildlife species. Attachment B summarizes the same data for special-status plants. Additional information on special-status plants and wildlife species is provided for each of the geographic regions in the study area under region-specific discussions.

Brief profiles of federally listed wildlife and plant species or those proposed for listing that occur in the Central Valley and the Delta are provided in Attachments G and H, respectively. Profiles are also provided for candidates for federal listing, many of which are likely to be proposed for federal listing during the environmental review period for the CVPIA.

SIGNIFICANT NATURAL AREAS

The SNA Program is administered by DFG and designed to encourage recognition of the state's most significant natural areas and to seek perpetuation of these areas (California Fish and Game Code, 1930-1933). SNAs have no legal status. They have been identified in response to a legislative mandate to raise the level of awareness about California's natural diversity and to identify opportunities for cooperative efforts to conserve important biological resources.

DFG has used only the NDDB to identify SNAs. The exact boundaries of SNAs have not been established because thorough field surveys have not been completed. SNAs have been identified on the basis of biological value alone; geological or cultural resource values have not been included in the inventory. To qualify as an SNA, a site must meet one of the following four criteria:

- The species or community (element) is extremely rare.
- There is an assemblage of three or more rare elements.

TABLE II-7

NUMBERS OF SPECIAL-STATUS PLANTS BY STATUS LEVEL AND HABITAT IN EACH CENTRAL VALLEY REGION

Region/Status	Mixed Conifer Forest	Montane Hardwood	Pinyon-Juniper	Valley-Foothill Hardwood	Valley-Foothill Riparian	Inland Dunes	Montane Riparian	Chaparral	Alkali Desert Scrub	Desert Scrub	Sagebrush & Bitterbush Scrub	Grassland	Freshwater Emergent Marsh	Saline Emergent Marsh
Sacramento River														
Federally listed or proposed	1	8		7				6	1			18	1	1
State listed	2	2		2	1			2	1			3	3	1
Federal candidate		1		1				3						
Sacramento River Totals	**3**	**11**		**10**	**1**			**11**	**2**			**21**	**4**	**2**
Delta														
Federally listed or proposed						2						9		2
State listed					1							2	2	1
Federal candidate														
Delta Totals					**1**	**2**						**11**	**2**	**3**
San Joaquin River														
Federally listed or proposed		6	1	9				2	4			15		
State listed	4	4		4	2			4				2	2	1
Federal candidate	1	2		3				2				1		
San Joaquin River Totals	**5**	**12**	**1**	**16**	**2**			**8**	**4**			**18**	**2**	**1**
Tulare Lake														
Federally listed or proposed		2	3	4				1	5			12		
State listed	1	1		1						1		1		
Federal candidate		1		1								1		
Tulare Lake Totals	**1**	**4**	**3**	**6**				**1**	**5**	**1**		**14**		

NOTE:
Coastal and desert habitats that do not occur in the Central Valley are not included in this table.

TABLE II-8

NUMBERS OF SPECIAL-STATUS WILDLIFE SPECIES BY STATUS LEVEL AND HABITAT IN EACH CENTRAL VALLEY REGION

Region/Status	Mixed Conifer Forest	Montane Hardwood	Pinyon-Juniper	Valley-Foothill Hardwood	Valley-Foothill Riparian	Inland Dunes	Montane Riparian	Chaparral	Alkali Desert Scrub	Desert Scrub	Sagebrush & Bitterbush Scrub	Grassland	Freshwater Emergent Marsh	Saline Emergent Marsh	Lacustrine	Riverine	Irrigated Pasture	Row Crops	Grain Crops	Rice
Sacramento River																				
Federally listed or proposed	1				1							3	8		4	4	1		1	
State listed					1		1					1	2	1	2	1		1	1	
Federal candidate												2	1				1		1	
Sacramento River Totals	**1**				**2**		**1**					**6**	**11**	**1**	**6**	**5**	**2**	**1**	**3**	
Delta																				
Federally listed or proposed						1							8	2	3	3	1		1	
State listed					2		1						1	1		1	2	1	3	
Federal candidate					1								1		1		1		1	
Delta Totals					**3**	**1**	**1**						**10**	**3**	**4**	**4**	**4**	**1**	**5**	
San Joaquin River																				
Federally Listed or proposed	1				2				6	1		5	6		3	3	1		1	
State Listed				1	3		1					1	1		1			2	1	
Federal Candidate												2	1		1		1		1	
San Joaquin River Totals	**1**			**1**	**5**		**1**		**6**	**1**		**8**	**8**		**5**	**3**	**2**	**2**	**3**	
Tulare Lake																				
Federally listed or proposed	1				2				5			5	4		2	1				
State listed	1				3		1	1				1	1		1			2	1	
Federal candidate						1					1	2	2		1		1		1	
Tulare Lake Totals	**2**				**5**	**1**	**1**	**1**	**5**		**1**	**8**	**7**		**4**	**1**	**1**	**2**	**2**	

NOTE:
Coastal and desert habitats that do not occur in the Central Valley are not included in this table.

- The element is the best example (relatively undisturbed condition).
- The element is a center of high diversity.

DFG has identified SNAs in all of the counties considered in the PEIS. However, in this technical appendix, SNAs have been identified for study area geographic regions only in the Central Valley and Delta. SNAs are used in this technical appendix to geographically portray the location of special-status species and rare natural areas. Their distribution is described separately for each of these regions in the following sections.

WATERFOWL AND SHOREBIRDS

Importance of the Central Valley

The wetlands of the Central Valley provide the most important wintering area for waterfowl on the Pacific Flyway, supporting approximately 60 percent of the population (CVHJV, 1990). The Central Valley is reported to have the highest waterfowl use on the North American continent, being used by approximately 18 percent of the continental wintering waterfowl population (DFG, 1983). The Central Valley is of particular importance to certain species, such as the northern pintail, with more than 65 percent of the North American population using the area (CVHJV, 1990). The Central Valley is ranked fourth of 33 areas on the national priority list of the Service's Migratory Bird Land Acquisition Program, and it has the highest priority for preservation of wintering areas in the nation (DFG, 1983).

After waterfowl, shorebirds are the most numerous group of birds using the Pacific Flyway wetlands. California supports an estimated 570,000 wintering shorebirds, including nearly the entire continental population of stilts, avocets, willets, and curlews and the West Coast populations of semi-palmated plovers, least sandpipers, and dowitchers. (Page et al., 1992.) The Central Valley supports one of the largest concentrations of wintering shorebirds in western North America; more than 270,000 birds were counted during winter 1992-1993 (Shuford et al., 1993).

In 1986, the United States and Canadian federal governments signed the North American Waterfowl Management Plan (NAWMP), which provides a broad framework for waterfowl and wetland conservation and management. Objectives of the NAWMP include the restoration and maintenance of the diversity, abundance, and distribution of waterfowl that occurred during 1970-1979. Implementation of the NAWMP is the responsibility of regional joint ventures among agencies and public organizations. (CVHJV, 1990.)

Objectives of the Central Valley Habitat Joint Venture

The CVHJV was established in 1988 to develop an implementation plan to meet the objectives of the NAWMP in the Central Valley It is guided by an implementation board, composed of representatives from the California Waterfowl Association, Defenders of Wildlife, Ducks Unlimited, National Audubon Society, Waterfowl Habitat Owners Alliance, and The Nature Conservancy (TNC). Technical assistance and advice is provided by the Service, DFG, California Department of Food and Agriculture, and other agencies and organizations. (CVHJV, 1990.)

The goal of the CVHJV is to "protect, maintain, and restore habitat to increase waterfowl populations to desired levels in the Central Valley of California consistent with other objectives of the NAWMP." The six objectives developed for the CVHJV to meet this goal are as follows:

- protect 80,000 additional acres of existing wetlands through acquisition of fee-title or perpetual conservation easements;
- secure an incremental, firm 402,450-acre-foot water supply that is of suitable quality and is delivered in a timely manner for use by National Wildlife Refuges (NWRs), state Wildlife Management Areas (WMAs), and the Grasslands Resource Conservation District (GRCD);
- secure CVP power for NWRs, WMAs, the GRCD, and other public and private lands dedicated to wetland management;
- increase wetland areas by 120,000 acres and protect these wetlands in perpetuity by acquisition of fee-title or conservation easement;
- enhance wetland habitats on 291,555 acres of public and private lands; and
- enhance waterfowl habitat on 443,000 acres of agricultural lands. (CVHJV, 1990.)

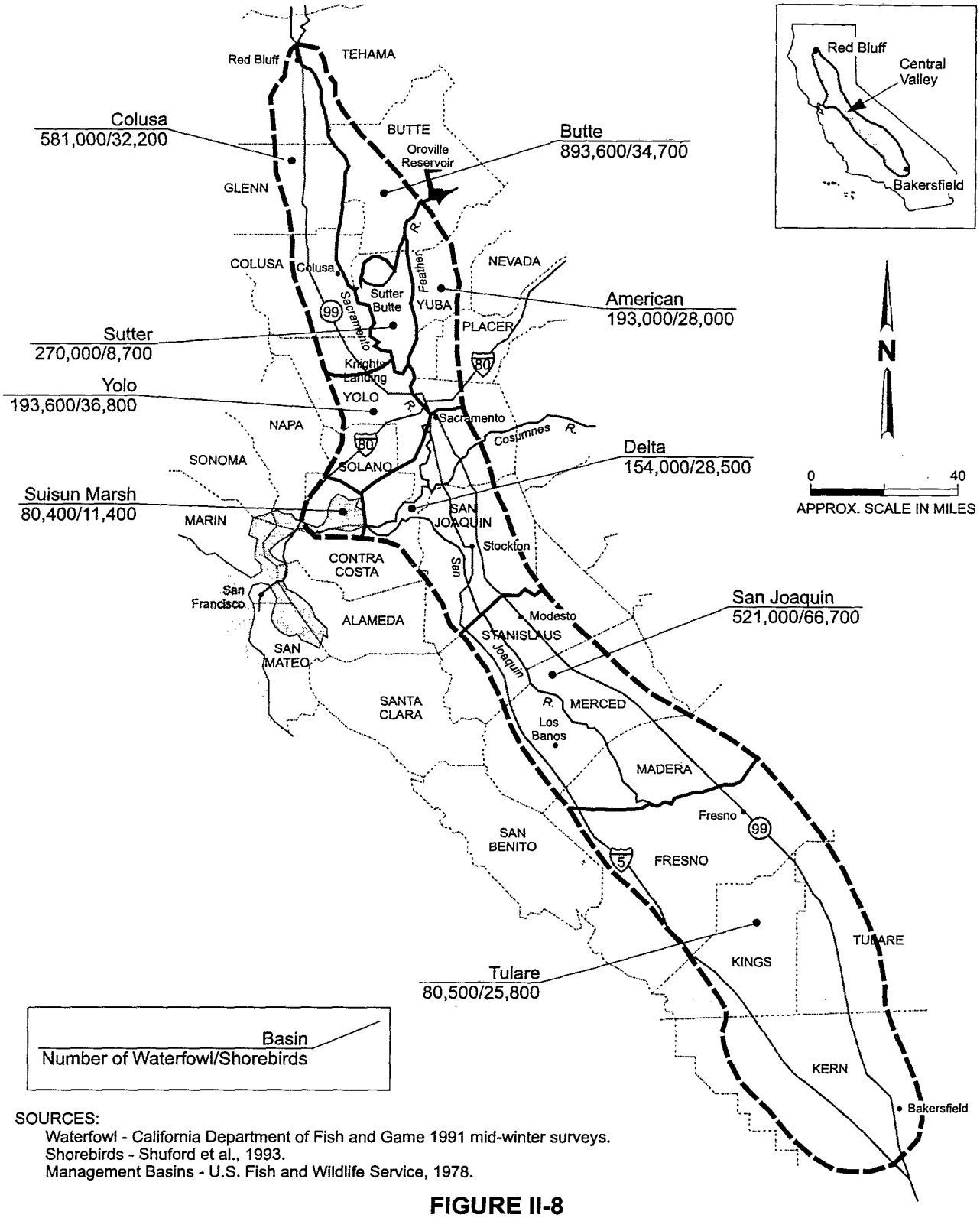
To achieve these objectives, an implementation plan was developed that provides strategies and administrative recommendations for meeting CVHJV's goal. The Central Valley was broken into nine planning units or management basins (Figure II-8). The Sacramento Valley makes up the northern half of the Central Valley and contains five of the drainage basins: Butte, Colusa, Sutter, American, and Yolo. The San Joaquin and Tulare basins form the southern portion of the Central Valley. The Sacramento-San Joaquin Delta Basin receives the water draining the northern and southern portions of the Central Valley and drains this water into the final basin,San Francisco Bay and Suisun Marsh (CVHJV, 1990.) Winter waterfowl and shorebird populations are shown in Figure II-8.

RESOURCES IN EACH STUDY REGION

This section describes the biological resources in each of the study regions. These descriptions are broken out by generalized resource category.

Sacramento River Region

Natural and Agricultural Communities. Nine natural terrestrial community types in the Sacramento River Region occupy nearly 8.7 million acres out of a total land area of 12 million acres (Figure II-9). They are mixed conifer forest, montane hardwood, valley foothill hardwood, chaparral, sagebrush scrub, montane riparian and valley foothill riparian, grassland, and freshwater and saline emergent wetlands (marsh). Table II-3 summarizes the area of each of these habitat types to the nearest 1,000 acres.



SOURCES:
Waterfowl - California Department of Fish and Game 1991 mid-winter surveys.
Shorebirds - Shuford et al., 1993.
Management Basins - U.S. Fish and Wildlife Service, 1978.

FIGURE II-8

MANAGEMENT BASINS AND WINTERING WATERFOWL AND SHOREBIRD POPULATIONS IN THE CENTRAL VALLEY

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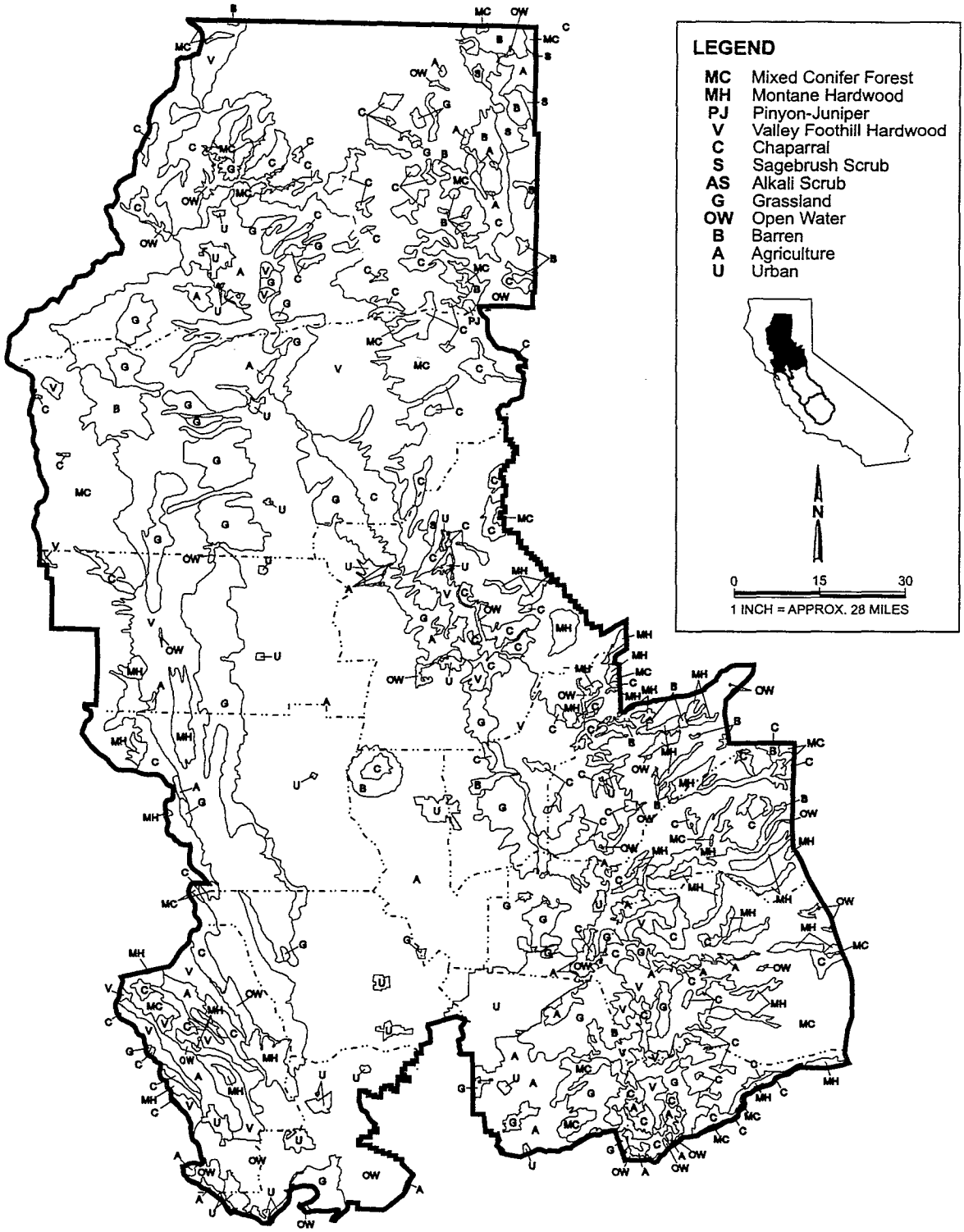

SOURCES:
Vegetation categories are derived from CALVEG data (Matyas and Parker, 1980) modified by the DFF and are greatly generalized. Numerous vegetation types occupying small areas are not shown because of map scale.

FIGURE II-9

GENERAL VEGETATION TYPES OF THE SACRAMENTO RIVER REGION

Mixed coniferous forest is the most abundant natural community in this region (3,690,000 acres). Grassland is the most common natural community on the valley floor and adjacent foothills, occupying 1,066,000 acres. Approximately 242,000 acres are naturally unvegetated (barren) land in the northeast portion of Shasta County that consists of lava beds and similar substrates unsuitable for vegetation.

The lowland areas of the Sacramento River Region are dominated by agricultural land, occupying approximately 1,984,000 acres. Agricultural crops in the Sacramento River Region include grains, pasture, rice, orchards and vineyards, and vegetables. Grains and pasture are the most abundant crops in the region, at 601,000 and 442,000 acres, respectively.

Riparian and Wetland Communities. The major rivers of the Sacramento River Region are the Sacramento, Pit, Fall, McCloud, Yuba, Feather, Bear, and American and Cache Creek. Estimates of riparian vegetation acreage in the Sacramento River Region vary widely because each mapping effort has covered different geographic areas and used different vegetation classifications or mapping criteria. Warner and Hendrix (1985) estimated that approximately 175,000 acres of riparian vegetation exist in the northern portion of the Central Valley (this may include portions of the Delta). Frayer et al. (1989) estimated that 34,600 acres of "palustrine forested and scrub/shrub" (riparian wetlands) occur in the Central Valley; presumably, most of this habitat type is in the Sacramento River Region. The Sacramento River Environmental Atlas (DWR, 1978) documented 13,107 acres of "young trees, sub-climax, and climax native vegetation" on high and low terraces along the Sacramento River from Colusa to Keswick Dam (this excludes vegetation along tributary rivers and streams). The lower 60 miles of the Sacramento River are leveed and support relatively little riparian vegetation.

Approximately 157,000 acres of wetlands occur in the Sacramento River Region (Table II-3). Almost half of those are saline emergent wetlands in Suisun Marsh. A total of 8,000 acres was recorded along the Sacramento River in 1984 between Collinsville and Chico Landing.

Rivers and Reservoirs. Rivers and 12 reservoirs in the Sacramento River Region that could be affected by implementation of the CVPIA are described in this technical appendix (Figure II-10). The total length of shoreline, relative percent of shoreline vegetation, and area of water appear in Table II-9. Wildlife species that frequent these reservoirs are described below.

Whiskeytown Lake supports primarily diving ducks and western and Clark's grebes (Laymon, pers. comm.). Between 1970 and 1990, this reservoir supported one nesting pair of bald eagles (Jurek, 1990).

Shasta Lake has generally low waterbird use because of its steep-sided slopes and the minimal amount of shallow water, which limits the available foraging habitat for most waterbirds (Laymon, pers. comm.); however, Shasta Lake does have one of the highest concentrations of nesting bald eagles and ospreys in California (Laymon, pers. comm.). Between 1970 and 1990, 13 nesting bald eagles were observed (Jurek, 1990), and the reservoir also supports up to 20 nesting ospreys (Laymon, pers. comm.).

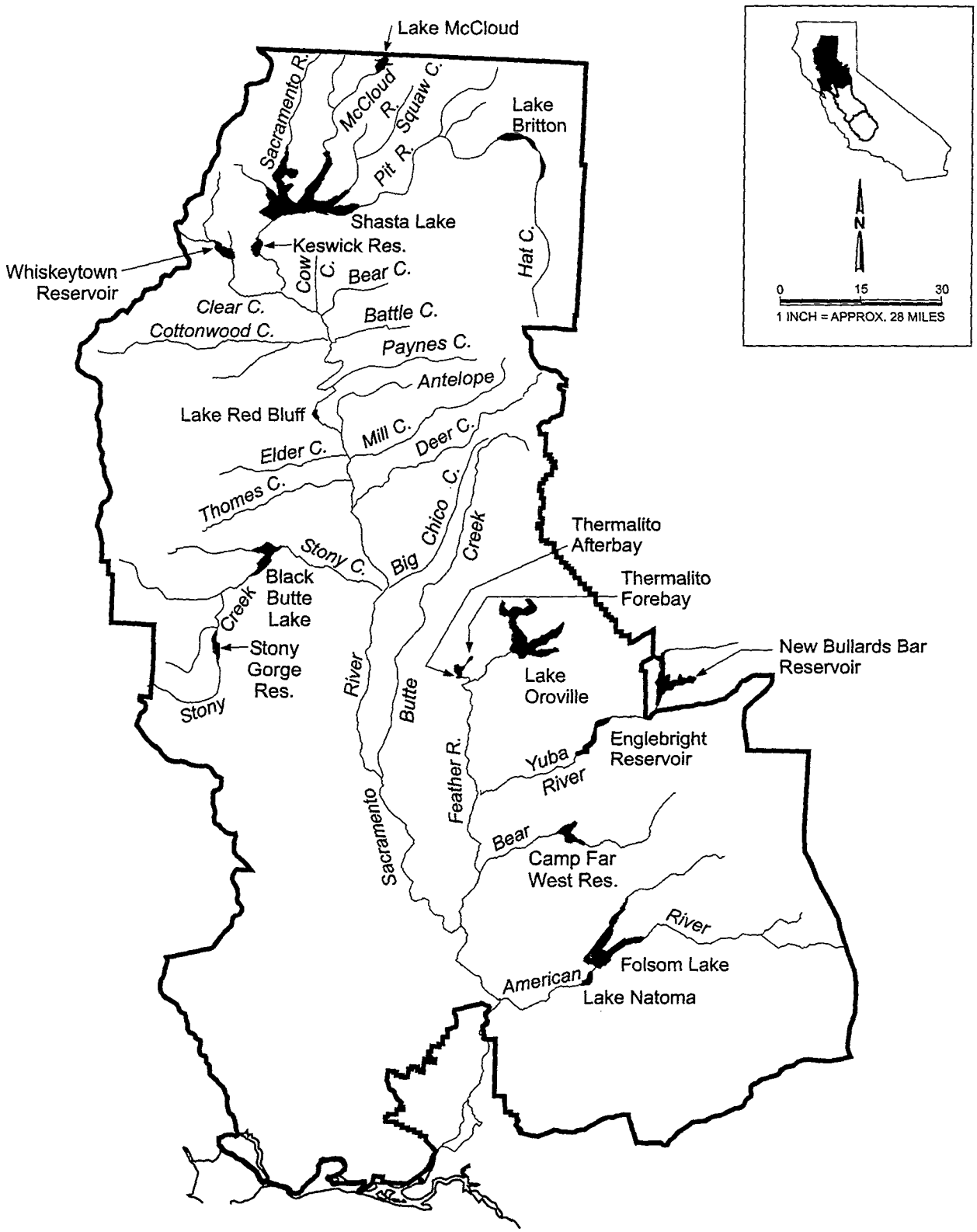

FIGURE II-10

RIVERS AND RESERVOIRS OF THE SACRAMENTO RIVER REGION

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TABLE II-9

SHORELINE MILES, RELATIVE PERCENTAGES OF SHORELINE VEGETATION TYPES, AND TOTAL WATER ACREAGE AT SELECTED RESERVOIRS IN THE SACRAMENTO RIVER REGION

		Shoreline Vegetation Type						
Reservoir	Shoreline Miles	Mixed Conifer Forest	Montane Hardwood	Valley Foothill Hardwood	Chaparral	Grassland	Other	Total Water Acreage
Whiskeytown Lake	51	80%			20%			3,250
Shasta Lake	370	50%			35%	15%		30,000
Lake Red Bluff	4					50%	50%	575
Keswick Reservoir	19					100%		630
Lake Oroville	*123			90%	10%			*16,400
Thermalito Afterbay	*125					10%	90%	*3,800
Thermalito Forebay	*7					45%	55%	*650
Englebright Lake	*8			100%				*750
New Bullards Bar Reservoir	*22	80%	20%					*3,100
Camp Far West Reservoir	*17			70%		20%	10%	*3,000
Folsom Lake	75	3%		30%	20%	5%	42%	11,500
Lake Natoma	14						100%	500

NOTE:
Shoreline miles and total water acreage data were taken from Reclamation (1990a) except where denoted by an asterisk; these data were computed by planimetry of 1:500,000-scale USGS topographic maps.

Lake Red Bluff supports small numbers of waterbirds. The American coot is the dominant waterbird at this reservoir. Mallards, buffleheads, and common goldeneye are also found on the lake.

Keswick Reservoir supports small numbers of waterbirds. Approximately 1,500 to 2,000 American coots are the dominant waterbird at this reservoir. Mallards, buffleheads, and common goldeneye (around 100 each of each species) are also found on the reservoir (Laymon, pers. comm.).

Lake Oroville supports a large number of waterbirds during the year. Several hundred waterfowl, mostly dabbling ducks, winter there regularly. More than 15,000 gulls use the open water as a night roost, and several hundred eared grebes winter on the lake. About six Canada geese nest in the area. The lake receives minimal use by shorebirds (Snowden, pers. comm.)

Between 1970 and 1990, two bald eagles nested on or near the lake (Jurek, 1990), and several ospreys also bred at the reservoir (Snowden, pers. comm.). An estimated 33 bald eagles presently winter in the area (Snowden, pers. comm.).

Thermalito Afterbay is used by a large number of waterbirds during winter (Snowden, pers. comm.). Forty to fifty thousand wintering waterfowl (primarily northern pintail, American wigeon, and ruddy duck) use the lake regularly, and more than 10,000 American coots occur there. Approximately 2,000 tundra swans also roost at the lake. Several hundred Clark's, western, and eared grebes and gulls feed and roost at the lake. Three to four bald eagles are known to use the lake daily (Snowden, pers. comm.)

Thermalito Forebay also supports large numbers of waterbirds, but the species composition differs from that of Thermalito Afterbay. The forebay supports up to 10,000 dabbling ducks during winter, in addition to several thousand ruddy ducks. Approximately 15,000 snow and Ross' geese occur there during winter. The forebay is also used by several thousand Canada geese as a night roost. Ospreys also forage occasionally at the forebay (Snowden, pers. comm.)

Englebright Lake receives low use by waterbirds (Laymon, pers. comm.). Several hundred diving ducks (e.g., ring-necked duck, ruddy duck, and redhead) use the lake irregularly (Whitmore, pers. comm.). Shorebirds are uncommon to rare at Englebright Lake (Laymon, pers. comm.), and wintering bald eagles occasionally forage there (Whitmore, pers. comm.).

New Bullards Bar Reservoir receives little waterfowl use (Whitmore and Laymon, pers. comms.). Diving ducks, such as the common merganser and ruddy duck, occur in low numbers during winter. Between 1970 and 1990, one bald eagle's nest was observed at the lake (Jurek, 1990). One pair of ospreys is known to nest at this reservoir (Whitmore and Laymon, pers. comms.).

Hundreds of diving ducks (mostly ring-necked, ruddy, and redhead ducks) and fewer numbers of dabbling ducks winter at Camp Far West Reservoir. Two to five bald eagles winter at Camp Far West Reservoir (Whitmore, pers. comm.)

Approximately 40 great blue herons occur at Folsom Lake during winter, but other wading birds and shorebirds are less common. Dabbling ducks (e.g., mallards [400 to 500] and American wigeons [100 to 500]) and geese (1,400 to 2,400 Canada geese) are regular winter residents at Folsom Lake. Diving waterbirds are less common than dabbling ducks. The lake supports about 700 western grebes and 50 pied-billed grebes during winter. More than 2,000 gulls use Folsom Lake as a night roost during winter.

Dabbling ducks (e.g., mallards and American wigeons) and Canada geese are regular winter residents at Lake Natoma. Diving waterbirds are less common than dabbling ducks. The lake supports small numbers of western grebes and pied-billed grebes during winter.

Special-Status Plants. Attachment F lists 34 special-status plants that occur in the Sacramento River Region. The largest number of special-status species in this region (12) occurs in chaparral. The second largest number of special-status species (11) occurs in hardwood forest (Table F-1).

Special-Status Wildlife. Attachment E identifies 19 special-status wildlife species that could occur in the Sacramento River Region and their preferred habitats. The majority of these species are associated with grasslands, freshwater emergent wetlands, lakes, and rivers on the valley floor (Table E-1). Many of these species have been listed by federal and state wildlife agencies because of habitat loss associated with agricultural development and water projects. Grain crops also provide important habitat for species such as the Aleutian Canada goose, Swainson's hawk, and greater sandhill crane.

Significant Natural Areas. There are 188 designated SNAs in the Sacramento River Region (Figure II-11). Many of these are along the Sacramento River and contain habitats such as

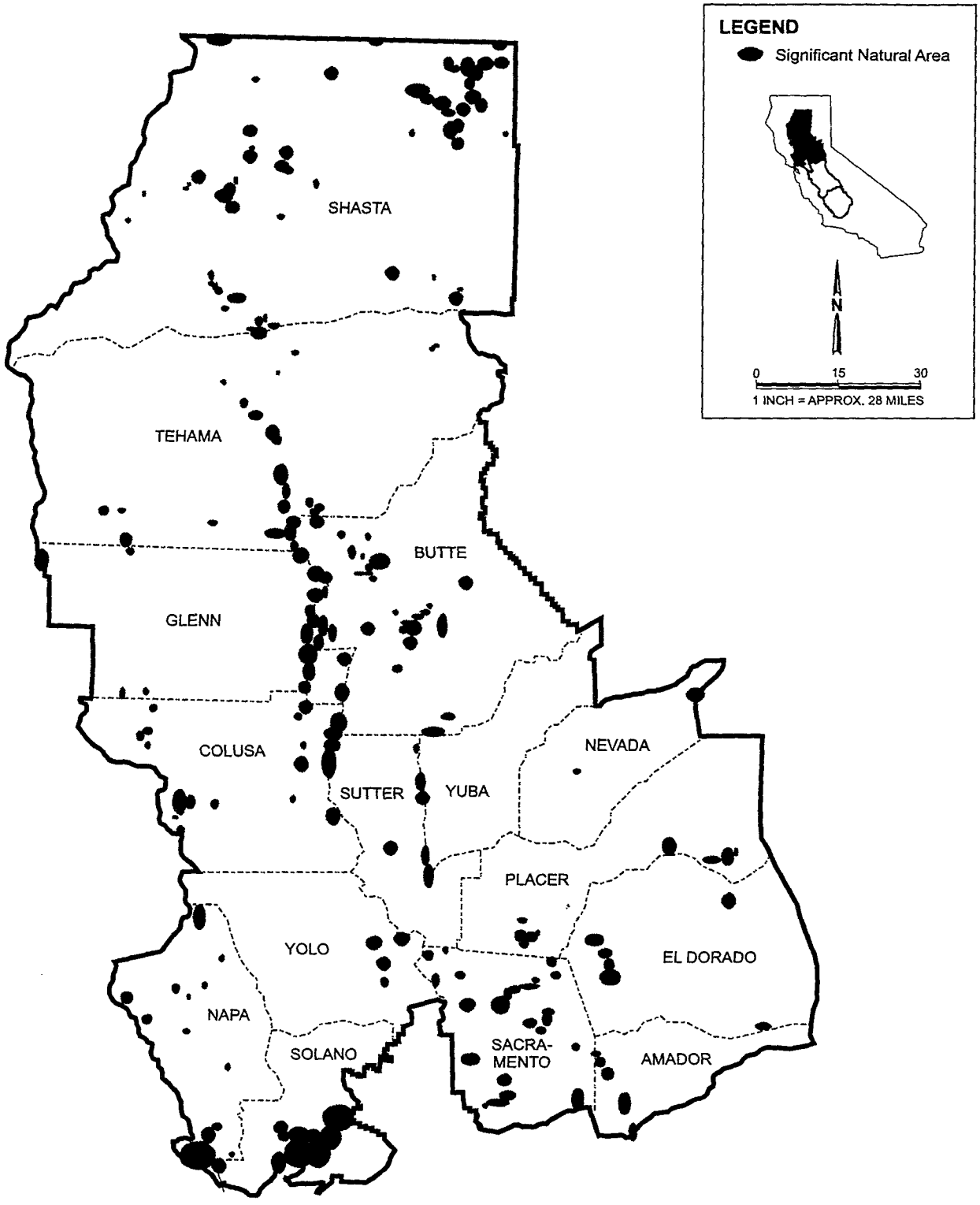


FIGURE II-11

LOCATION OF SIGNIFICANT NATURAL AREAS IN THE COUNTIES OF THE SACRAMENTO RIVER REGION

Fremont cottonwood riparian, valley oak riparian, mixed riparian, and Great Valley willow scrub. These habitats support riparian-dependent, special-status wildlife species, such as western yellow-billed cuckoo, bank swallow, and the valley elderberry longhorn beetle. SNAs are also designated along other significant waterways, such as creeks, lakes, or reservoirs, that support special-status wildlife or plant species (e.g., the Shasta salamander, Shasta sideband snail, bald eagle, bank swallow, Shasta crayfish, and rough sculpin in the northern region). Designated vernal pool and grassland habitats throughout the Sacramento Valley may support valley needlegrass grassland, California tiger salamanders, and burrowing owls or northern claypan vernal pools, which support many endemic vernal pool plant species. Finally, marsh habitats in the southern portion of the region contain northern coastal salt marsh, which supports several special-status species, including California clapper rail, California black rail, Suisun Marsh aster, Suisun thistle, and Suisun song sparrow.

Waterfowl and Shorebirds. This section provides an overview of waterfowl use in the Sacramento Valley, a brief description of wetland management for waterfowl, and a description of waterfowl use and habitat in major waterfowl use areas in the Sacramento Valley. Although the Modoc NWR is located in the Pit River Valley, it is discussed under the Sacramento River Region to simplify the organization of this document.

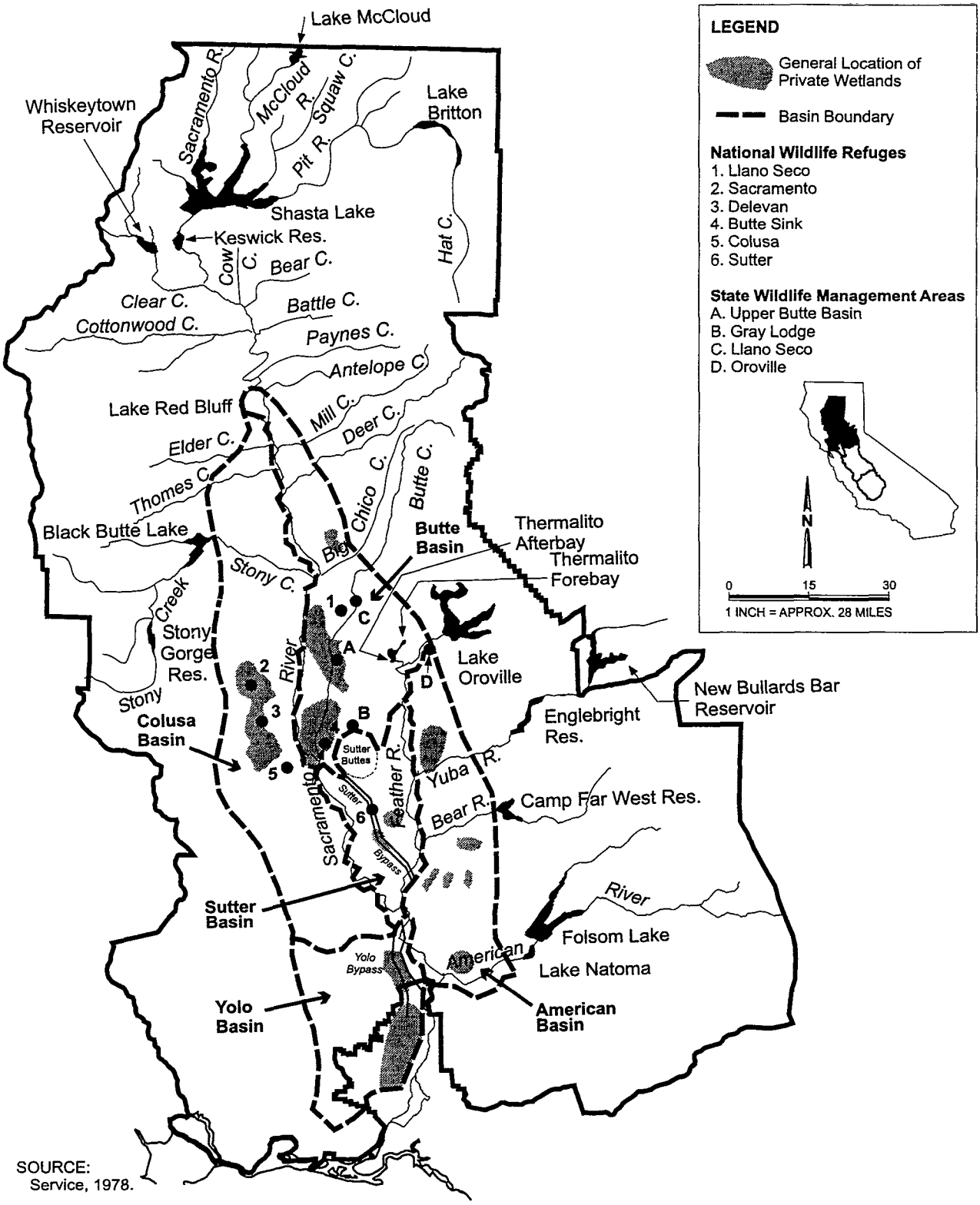
DFG conducts annual statewide surveys of waterfowl numbers throughout winter. This document presents January 1991 midwinter survey results to indicate waterfowl use and species composition within an area.

Private duck clubs and state and federal refuges in the Sacramento Valley provide essential habitat for wintering waterfowl and shorebirds. Approximately 55 percent of the waterfowl that winter in the Central Valley use Sacramento Valley wetlands (CVHJV, 1990). Midwinter waterfowl surveys in 1991 estimated 2,127,800 waterfowl in the valley, including approximately 1,432,000 ducks and 572,800 geese. Approximately 76 percent of the ducks were northern pintails, mallards, and American wigeons. Snow and Ross' geese constituted 82 percent of the geese present. Additionally, there were more than 25,000 swans and 25,000 American coots in the valley.

Sacramento Valley wetlands also provide important habitat for shorebirds, with more than 140,000 shorebirds counted in the valley during winter 1992-1993 (Shuford et al., 1993). The valley is particularly important to shorebirds in spring, when 30,000 to 300,000 shorebirds use wetlands in the valley as staging areas during migration to northern breeding grounds (Page et al., 1992).

The Sacramento River Region is divided into the Butte, Colusa, American, Sutter, and Yolo basins (CVHJV, 1990) (Figure II-12). Waterfowl and shorebird numbers and habitats for each basin are described below.

Butte Basin. Butte Basin includes approximately 1,000 square miles in the northern Sacramento Valley (Figure II-12). Approximately 23 percent of the waterfowl wintering in the Central Valley use the 26,150 acres of wetland habitat in Butte Basin (CVHJV, 1990). Nearly 35,000 shorebirds were counted in Butte Basin during winter 1992-1993 (Shuford et al., 1993).



SOURCE:
Service, 1978.

FIGURE II-12

LOCATION OF WINTERING WATERFOWL HABITAT IN THE SACRAMENTO RIVER REGION

Most of the shorebirds using this basin are dowitchers, least sandpipers, and yellowlegs (Page et al., 1992).

Private lands provide 67 percent of the wetlands in Butte Basin. Hunting clubs maintain more than 30,000 acres of waterfowl habitat, including about 18,000 acres of natural wetlands and 12,000 acres of flooded rice fields. Most of the privately owned natural wetlands are in the Butte Sink, with 42 hunting clubs managing more than 11,000 acres of natural wetlands (CVHJV, 1990). Conservation easements established by the Service permanently protect 5,350 acres of private wetlands managed by duck clubs (CVHJV, 1990). The Nature Conservancy (TNC) has a 2,300-acre riparian conservation easement on the former Llano Seco Ranch (Forrest, pers. comm.). An additional 1,200 acres of riparian woodland and 5,900 acres of wetlands are protected by conservation easements on other portions of the Llano Seco Ranch (Forrest, pers. comm.), and 500 acres of wetland habitat are protected in the National Audubon Society's Paul L. Wattis Audubon Sanctuary.

Gray Lodge, Upper Butte Basin, and Oroville WMAs are in the Butte Basin. Table II-10 lists the acreages of habitat types on wildlife refuges in the Sacramento Valley.

TABLE II-10

ACREAGE OF HABITAT TYPES ON FEDERAL AND STATE WILDLIFE REFUGES IN THE SACRAMENTO RIVER REGION

Refuge	Permanent Wetlands (1)	Semi-Permanent Wetlands	Seasonal Wetlands	Moist Soil Plants	Riparian	Uplands	Cereal Grains
Gray Lodge WMA	470	300	-	4,874	800	1,650	-
Upper Butte WMA	-	-	3,000	300	700	-	5,000
Oroville WMA	-	-	-	-	3,600	1,700	-
Sacramento NWR	4	398	5,611	386	-	3,354	-
Delevan NWR	177	285	3,257	373	-	1,162	-
Colusa NWR	220	2,769	-	142	-	909	-
Sutter NWR	81	-	1,810	93	-	607	-
Modoc NWR	1,400	-	650	2,000	-	1,700	-

NOTE:
(1) Managed wetlands on refuges are described under wetland communities.

Gray Lodge WMA, established in 1931, was the first Sacramento Valley wildlife refuge (Reclamation, 1992). The refuge currently maintains 8,100 acres of wetland and upland habitat (Reclamation, 1992). Most of the refuge (approximately 4,870 acres) is managed for moist soil plants to provide waterfowl foraging habitat (Reno, pers. comm.) (Figure II-12).

The refuge provided an annual average of 57.1 million duck use-days and 1.2 million geese use-days in 1987-1989 (Reclamation, 1992). Northern pintails made up almost 30 percent of the duck population in the 1991 mid-winter survey, with mallards and wigeons making up another 40 percent of the population. Ross' and snow geese were the most common geese on the refuge.

The refuge provided habitat for between 1,000 and 10,000 shorebirds annually from 1988 to 1992. The majority of the birds in fall were dowitchers, least sandpipers, and yellowlegs. The refuge also provided important spring staging habitat for western sandpipers and dunlins. (Page et al., 1992.)

Several special-status raptors use the refuge, including bald eagle, Swainson's hawks, and peregrine falcons. Other special-status animals that are known to occur or could potentially occur on the refuge are the Aleutian Canada goose, California black rail, lesser sandhill crane, greater sandhill crane, western yellow-billed cuckoo, bank swallow, and giant garter snake. The rose-mallow (California hibiscus), a special-status plant, also occurs on the refuge (Reno, pers. comm.).

The establishment of the Upper Butte Basin WMA began in 1989 with the acquisition of the Shore Ranch and was expanded with the aquisition of Llano Seco and Howard Slough. At present, the refuge has approximately 9,000 acres of land and plans to acquire an additional 3,520 acres in the future. Although the refuge has not converted much of the newly acquired lands to natural habitats, it currently provides 3,300 acres of wetlands, primarily seasonal marsh (Figure II-12). Approximately 4,000 acres of flooded rice fields and 1,000 acres of undeveloped rice fields are on the refuge. (Blake, pers. comm.)

Although this refuge provides important habitat for wintering waterfowl and shorebirds, bird use-days are not yet available. Fifty-one special-status plant and animal species are known to occur or have the potential to occur on the refuge. These include several raptors, the California black rail, western yellow-billed cuckoo, greater sandhill crane, and willow flycatcher. Spring-run salmon also occur in Butte Creek (Blake, pers. comm.).

The 7,000-acre Oroville WMA consists of the former borrow area of Oroville Dam and approximately 1,700 acres of adjacent grasslands (Figure II-12). Much of the borrow area has become cottonwood riparian forest. The grasslands are located along the northern and eastern sides of Thermalito Afterbay, where the natural shoreline supports emergent marsh habitat. Thermalito Afterbay covers approximately 5,000 acres, with 4,300 acres of open water surface. (Johnson, pers. comm.)

The combination of open water, emergent marsh, upland grassland, and riparian habitats supports a diversity of wildlife. The refuge is used as a resting area for thousands of migrating waterfowl and provides nesting opportunities for waterfowl and upland birds (Johnson, pers. comm.). Survey and use data are not available for this refuge.

Bald eagles regularly forage in the area (Snowden, pers. comm.), and there is a high potential for the cottonwood riparian forests to support western yellow-billed cuckoos (Johnson, pers. comm.). Vernal pools in the grasslands may support several special-status plants and invertebrates, including four species of listed fairy shrimp.

Colusa Basin. The 1,600-square-mile Colusa Basin west of Butte Basin stretches from Red Bluff in the north to Cache Creek in the south (Figure II-12). The basin is drained by the Colusa Trough, a natural depression that historically collected water and flooded the basin's marshes in winter and spring (CVHJV, 1990). Although flood control projects have eliminated

severe flooding, approximately 26,000 acres of natural wetlands remain in or adjacent to the Colusa Trough, supporting 15 percent of the wintering waterfowl population (CVHJV, 1990) and 12 percent of the wintering shorebirds in the Central Valley (Shuford et al., 1993). The wetlands of the Colusa Basin supported more than 32,000 shorebirds in winter 1992-1993 (Shuford et al., 1993) and support between 30,000 and 300,000 shorebirds during spring staging before migration to northern breeding grounds (Page et al., 1992).

Private lands contain approximately 5,270 acres of wetlands in the Colusa Basin (Rollins, pers. comm.), of which about 2,585 acres are in Service conservation easements (CVHJV, 1990). Additionally, almost 22,000 acres of flooded rice fields are maintained as seasonal waterfowl habitat by hunting clubs (CVHJV, 1990).

More than 23,035 acres of the Colusa Basin are protected on federal lands or through federal conservation easements (CVHJV, 1990). Federal refuges in the Colusa Basin include the Sacramento, Delevan, and Colusa NWRs.

The 10,783-acre Sacramento NWR was created in 1937. The refuge maintains approximately 6,680 acres of wetland habitats, including more than 5,600 acres of seasonally flooded marsh (Figure II-12). An additional 750 acres of unflooded wetlands could provide wetland habitat if water were available (Forrest, pers. comm.).

The refuge provided an annual average of 41.8 million duck use-days and 12.2 million geese use-days in 1987-1989 (Reclamation, 1992). More than 72 percent of the ducks in the 1991 midwinter surveys were northern pintails, wigeons, and mallards. More than 50 percent of the geese present were Ross' or snow geese. From 1988 to 1982, the refuge provided habitat for an annual average of 1,000 to 10,000 shorebirds in fall and winter, with 10,000 to 100,000 shorebirds using the refuge in spring (Page et al., 1992).

The refuge supports several special-status animal and plant species, including peregrine falcon, bald eagle, vernal pool tadpole shrimp, Conservancy fairy shrimp, palmate-bracted bird's beak, hairy Orcutt grass, Hoover's spurge, and three species of saltbush (Forrest, pers. comm.).

The Delevan NWR, authorized in 1962, currently consists of 5,634 acres of wetland and upland habitats (Figure II-12). More than 4,000 acres of wetlands on the refuge include approximately 3,260 acres of seasonal wetlands (Forrest, pers. comm.). The refuge has 380 acres of unflooded wetlands that could provide additional wetland habitat if water were available (Forrest, pers. comm.).

Delevan NWR provided an annual average of 25.2 million duck use-days and 9.2 million geese use-days from 1987 to 1989 (CVHJV, 1990). Mid-winter waterfowl surveys in 1991 showed that the refuge supported a diversity of duck species with mallards, wigeons, green-winged teal, northern shovelers, and northern pintails each making up 14 to 24 percent of the duck population. White-fronted and Canada geese were present, with white-fronted geese constituting almost 80 percent of the population. From 1988 to 1992, the refuge provided habitat for an annual average of 1,000 to 10,000 shorebirds in fall and winter, with 10,000 to 100,000 shorebirds using the refuge in spring (Page et al., 1992).

Several species of raptors use the refuge. Other special-status species known to occur on the refuge include the palmate-bracted bird's beak plant (Forrest, pers. comm.).

The Colusa NWR, established in 1944, currently consists of 4,040 acres of wetland and upland habitat. More than 3,100 acres of wetlands on the refuge include approximately 2,700 acres of semi-permanent wetlands (Forrest, pers. comm.).

The refuge provided an annual average of 23.3 million duck use-days and 3.0 million geese use-days between 1987 and 1989 (CVHJV, 1990). During mid-winter waterfowl surveys in 1991, mallards, wigeons, and northern shovelers made up approximately 76 percent of the duck population; Ross' and snow geese made up 92 percent of the goose population. From 1988 to 1992, an annual average of between 10,000 and 100,000 shorebirds used the Colusa NWR in spring as a staging area (Page et al., 1992).

Colusa NWR provides habitat for several special-status raptors and the palmate-bracted bird's beak plant, a species listed by DFG and the Service as endangered.

American Basin. The 600-square-mile American Basin lies east of the Sacramento and Feather rivers and west of the Sierra foothills (Figure II-12). Historically, the basin was flooded by waters from the American, Yuba, Feather, Sacramento, and Bear rivers; however, flood control projects have eliminated flooding in the basin (CVHJV, 1990).

Approximately 5 percent of the Central Valley's wintering waterfowl population is supported by the basin (CVHJV, 1990). The basin provided habitat for nearly 28,000 shorebirds during winter 1992-1993 (Shuford et al., 1993).

No publicly owned lands or conservation easements protect waterfowl habitat in the basin (CVHJV, 1990), and the existing 3,150 acres of wetlands are privately owned. Private hunting clubs manage approximately 8,800 acres of seasonally flooded rice fields (CVHJV, 1990).

Sutter Basin. Sutter Basin lies between the Feather and Sacramento rivers, extending from the Sutter Buttes in the north to the confluence of the two rivers in the south (Figure II-12). Historically, the 250-square-mile basin contained 40,000 to 50,000 acres of seasonal and permanent wetlands from the overflow of the Sacramento and Feather rivers (CVHJV, 1990). The basin now has approximately 3,090 acres of wetlands, supporting 7 percent of the Central Valley's wintering waterfowl population (CVHJV, 1990). Approximately 8,700 shorebirds were counted in Sutter Basin during winter 1992-1993 (Shuford et al., 1993).

Within the Sutter Basin, most of the remaining wetlands are in a floodplain of the Sacramento River, referred to as the Sutter Bypass. This bypass provides significant waterfowl and shorebird habitat when it floods in wet winters (CVHJV, 1990). Even during the drought years of 1988-1992, the bypass provided winter habitat for up to 1,000 shorebirds, primarily lesser sandpipers (Page et al., 1992).

Private duck hunting clubs provide approximately 500 acres of waterfowl habitat, of which most acres are natural wetlands. Most of the private waterfowl habitat is located in the Sutter Bypass (CVHJV, 1990). None of the private land is permanently protected through conservation

easements. Sutter NWR is the only publicly owned waterfowl habitat in Sutter Basin (CVHJV, 1990).

The Sutter NWR consists of 2,591 of wetlands and scattered upland habitat in and adjacent to the Sutter Bypass (Reclamation, 1992). More than half the refuge (1,810 acres) is managed as seasonal wetlands (Forrest, pers. comm.) (Figure II-12).

The refuge provided an annual average of 13.2 million ducks use-days and 1.4 million geese use-days in 1987-1989 (Reclamation, 1992). During mid-winter waterfowl surveys in 1991, mallards, wigeons, and northern pintails made up 78 percent of the duck population; Ross' and snow geese made up 94 percent of the goose population.

From 1988 to 1992, Sutter NWR provided wintering habitat for an annual average of up to 1,000 dunlins. The refuge was also an important spring staging area, with 3,000 to 30,000 shorebirds present, including western sandpipers, least sandpipers, dunlins, dowitchers, and black-necked stilts (Page et al., 1992). The rose-mallow (California hibiscus), a candidate species for federal listing, is known to occur on the refuge.

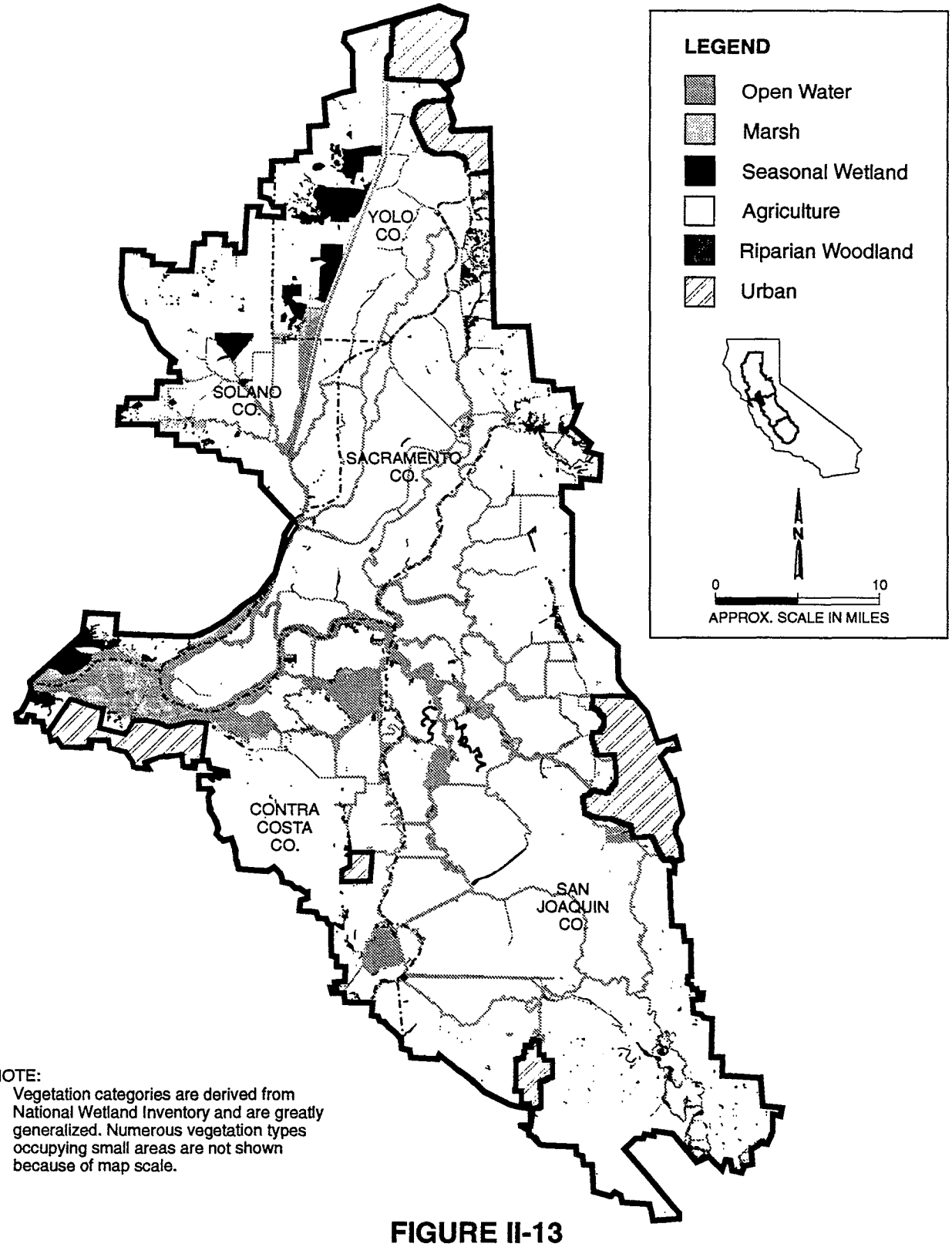
Yolo Basin. The 400-square-mile Yolo Basin is north of the Delta. Historically, the basin received overflow from the Sacramento and American rivers and from Putah Creek, Willow Slough, and Cache Creek. Marshes in the southern portion of the basin adjacent to the Delta were permanent wetlands, while more northerly areas had seasonal wetland from winter and spring floods (CVHJV, 1990).

Most of the remaining wetlands of the Yolo Basin are in the Yolo Bypass, a managed floodplain to the Sacramento River (Figure II-12). The wetlands of the bypass provide important wintering habitat for waterfowl and shorebirds. During mid-winter waterfowl surveys in 1991, an estimated 40,640 waterfowl were counted in the Yolo Bypass, including 34,700 ducks. The bypass also supported nearly 37,000 shorebirds during winter 1992-1993 (Shuford et al., 1993). Most of the shorebirds during 1988 to 1992 surveys were least sandpipers, but substantial numbers of dowitchers, black-bellied plovers, black-necked stilts, American avocets, yellowlegs, and long-billed curlews were also present (Page et al., 1992). A 3,000-acre WMA has been established; however, construction and restoration of wetlands has not been initiated.

Approximately 8,700 acres of natural wetlands in the Yolo Basin are privately owned. Private duck clubs maintain approximately 25,800 acres of additional waterfowl habitat as flooded and unflooded fields. As of 1992 (the "affected environment" year in this study), none of the private wetlands were protected through conservation easements. (CVHJV, 1990.) Since 1992, conservation projects have been implemented in parts of the Yolo Bypass.

Sacramento-San Joaquin Delta Region

Natural and Agricultural Communities. Two natural terrestrial community types occur in the Delta Region, occupying approximately 88,000 acres out of a total land area of 644,000 acres (Figure II-13). The natural communities are valley foothill riparian and freshwater and saline emergent wetlands. Table II-3 summarizes the area of each of these habitat types to the nearest 1,000 acres.



NOTE:
Vegetation categories are derived from National Wetland Inventory and are greatly generalized. Numerous vegetation types occupying small areas are not shown because of map scale.

FIGURE II-13

GENERAL VEGETATION TYPES OF THE DELTA REGION

The lowland areas of the Delta Region (the Delta islands) are dominated by agricultural land and occupy approximately 505,000 acres. Agricultural crops in the Delta Region include vegetables, grains, pasture, orchards and vineyards, and rice. Vegetable crops are the most abundant crops in the region.

Riparian and Wetland Communities. Emergent wetland is the most abundant natural community in the Delta (25,000 acres). The major rivers of the Delta consist of the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras. National Wetland Inventory maps document approximately 7,000 acres of riparian vegetation occurs primarily on the levees of the Delta islands and along the Cosumnes and Mokelumne rivers.

Rivers and Reservoirs. The major rivers of the Delta Region are the Sacramento and San Joaquin rivers. No reservoirs are located in the Delta Region.

Special-Status Plants. Attachment F lists 16 special-status plant species that occur in the Delta Region. The largest number of special-status species (11) occurs in grassland, which includes vernal pools. The second largest number of special-status species (3) occurs in saline emergent wetland (Table F-2).

Special-Status Wildlife. Attachment E identifies 22 special-status wildlife species that could potentially occur in the Delta Region and their preferred habitats. Most of these species are associated freshwater emergent wetlands, open water of marshes, and cereal and grain crops (Table E-2). Species such as the California tiger salamander, giant garter snake, and various fairy shrimp were probably common species in the Delta prior to the conversion of natural habitat to intensive agricultural production.

Significant Natural Areas. A total of 29 SNAs in the Delta Region protect freshwater, brackish, and salt marsh; inland dune; and valley sink scrub habitats (Figure II-14). Most of the marsh habitats occur at the convergence of the Sacramento and San Joaquin rivers and throughout the network of sloughs and troughs that make up the central portion of the Delta Region. This wetland area supports wintering waterfowl and shorebirds and several special-status species, including the giant garter snake, salt marsh harvest mouse, and California black rail. Also in this vicinity are stabilized inland dunes, including the Antioch Dunes, which provide habitat for a variety of endemic plants and invertebrates (e.g., the Antioch Dunes evening-primrose, Contra Costa wallflower, and Lange's metalmark butterfly). SNAs in the southern portions of the region contain valley sink scrub habitat and Great Valley mixed riparian forest, valley oak riparian forest, and cottonwood riparian forest.

Waterfowl and Shorebirds. The Delta encompasses approximately 1,100 square miles from Sacramento south to the Stanislaus River (DFG and DWR, 1988) (Figure II-15). The Delta is characterized by numerous islands surrounded by sloughs and channels formed from the confluence of the Sacramento, San Joaquin, Cosumnes, Mokelumne, and Calaveras rivers. The wetland habitat matrix of the Delta historically covered approximately 345,000 acres (Association of Bay Area Governments et al., 1991) and provided one of California's most significant waterfowl areas (CVHJV, 1990). Agricultural and industrial development have eliminated most of the marsh habitat in the Delta; currently, approximately 8,500 acres of wetlands remain (CVHJV, 1990).

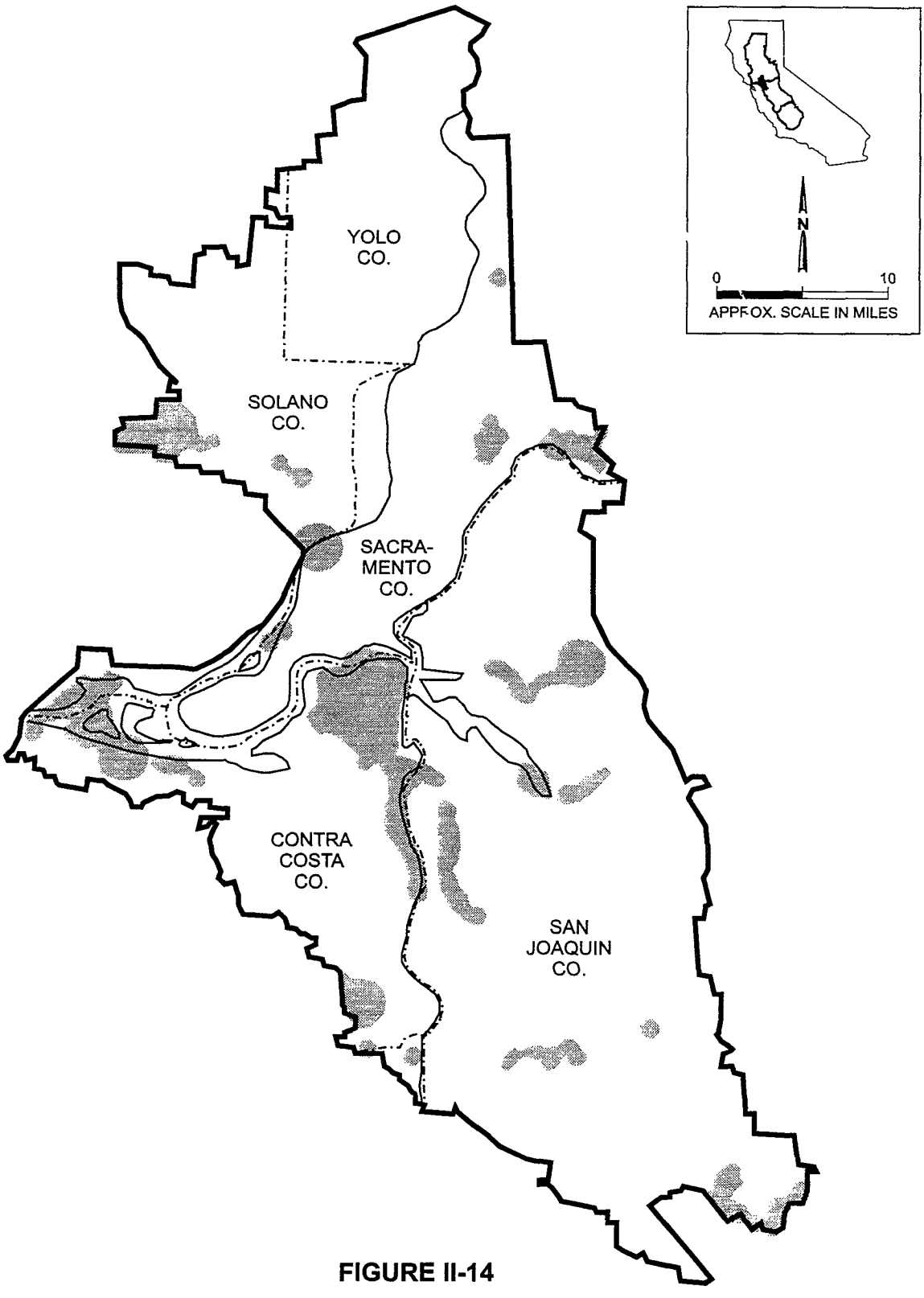


FIGURE II-14

LOCATION OF SIGNIFICANT NATURAL AREAS IN THE COUNTIES OF THE DELTA REGION

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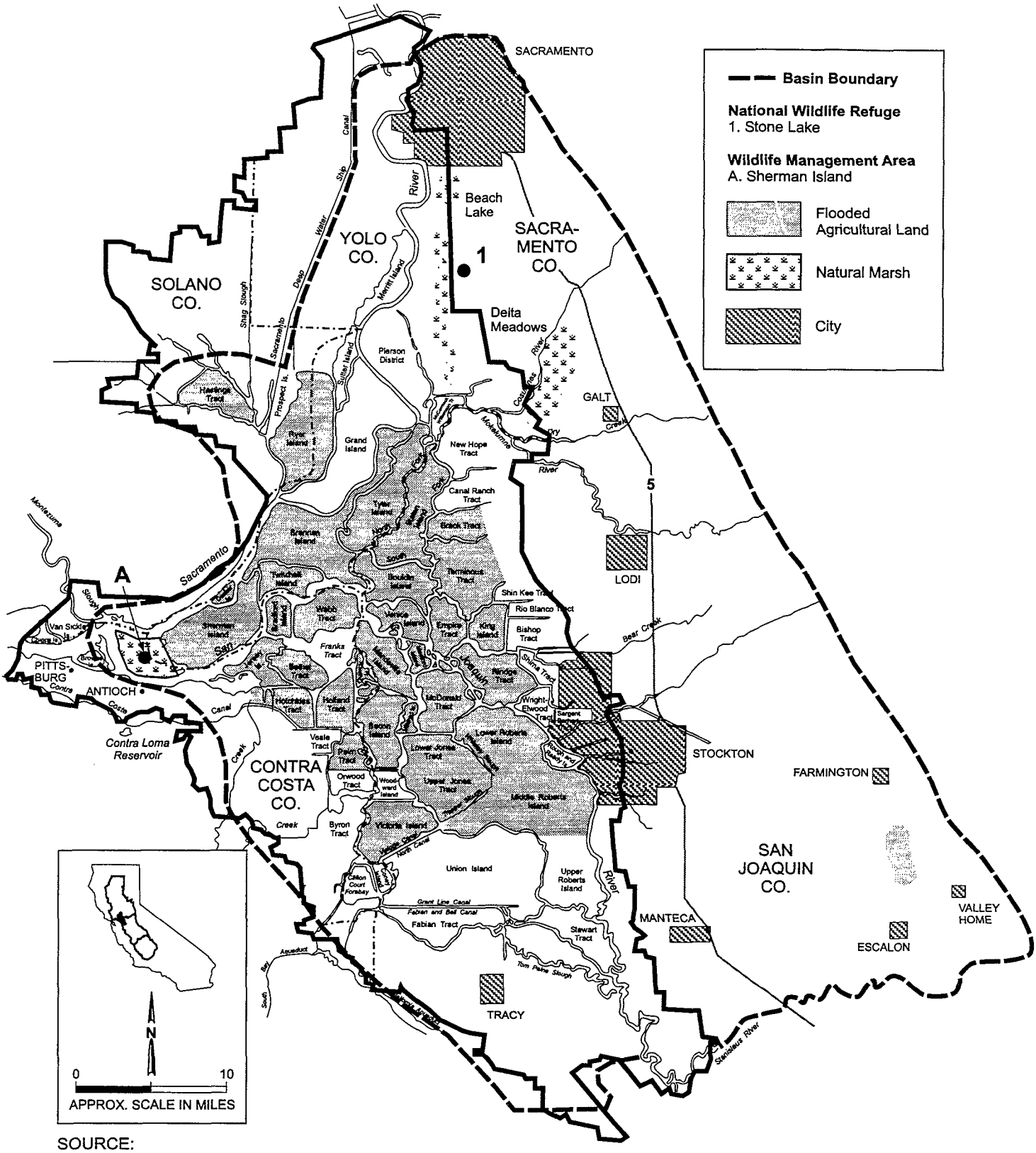


SOURCE:
Service, 1978.

FIGURE II-15

LOCATION OF WINTERING WATERFOWL HABITAT IN THE DELTA REGION

The Delta supports approximately 10 percent of the Central Valley's wintering waterfowl and shorebird populations (CVHJV, 1990; Shuford et al., 1993). Several waterfowl species are particularly dependent on the Delta. Nearly 75 percent of all tundra swans and more than one-third of all white-fronted geese in the Central Valley winter in the Delta (DFG, 1987). During mid-winter waterfowl surveys in 1991, an estimated 154,800 waterfowl and more than 4,000 cranes were counted in the Delta. An estimated 110,000 ducks were present, including more than 77,500 northern pintails and 11,300 mallards. Most of the approximately 18,900 geese counted were lesser snow geese and white-fronted geese. An estimated 25,000 tundra swan were also counted. During the 1992-1993 winter, 28,500 shorebirds were counted in the Delta, primarily dunlins and long-billed dowitchers (Shuford et al., 1993).

Private duck clubs own more than 36,000 acres in the San Joaquin drainage portion of the Delta, of which approximately 3,400 acres are natural wetlands. None of these lands are permanently protected through conservation easements. (CVHJV, 1990.)

County ownership or conservation easements protect 5,300 acres of natural habitats in the Delta. Natural lands owned or managed by the county include 1,000 acres in the bufferlands managed by the Sacramento Regional County Sanitation District and 2,700 acres in the North Stone Lakes NWR managed by Sacramento County (Service, 1992). These protected natural habitats are a complex of wetlands, uplands, riparian forests, and oak woodlands (Service, 1992). TNC and Ducks Unlimited manage the 1,500-acre Cosumnes River Preserve, which contains 400 acres of restored wetlands (CVHJV, 1990). Publicly managed lands in the Delta include the Stone Lakes NWR and Sherman Island WMA.

Stone Lakes National Wildlife Refuge. In 1992, the conceptual plan for the Stone Lakes NWR was approved. The 18,200-acre refuge located in southwestern Sacramento County will be made up of a core area and a cooperative wildlife management area. The core area will consist of 9,146 acres of land, including Upper Beach Lake, Lower Beach Lake, North Stone Lake, South Stone Lake, and the adjacent wetlands and uplands. The 9,066-acre Cooperative Management Wildlife Area will be privately owned with agricultural production to benefit wildlife and managed through voluntary cooperative agreements, memoranda of understanding, and conservation easements. (Service, 1992.)

The refuge footprint is a complex of agricultural land and natural habitats, with approximately 8,100 acres in native habitats. The dominant native habitat is annual grassland, making up more than 5,800 acres.

Present wetlands cover approximately 2,200 acres, with more than 1,100 acres providing seasonal wetlands. (Service, 1992.)

Sherman Island Wildlife Management Area. Sherman Island WMA consists of 3,100 acres of riparian and freshwater wetlands on lower Sherman Island that are managed by DFG. Sherman Island is at the confluence of the Sacramento and San Joaquin rivers at the western edge of the Delta (DFG and DWR, 1988). The refuge consists of a matrix of tidal marshes and open water. This refuge protects important Delta wetland habitats. Water availability on the refuge is primarily dependent on tidal influences and rainwater (Mapes, pers. comm.).

San Joaquin River Region

Natural and Agricultural Communities. The natural terrestrial community types in the San Joaquin River Region occupy approximately 4.6 million acres out of a total land area of 8.3 million acres (Figure II-16). The natural communities are mixed conifer forest, montane hardwood, valley foothill hardwood, riparian (montane riparian and valley foothill riparian), chaparral, grassland, and freshwater and saline emergent wetlands. Table II-3 summarizes the area of each of these habitat types to the nearest 1,000 acres.

Grassland is the most abundant natural community in this region, with 1.1 million acres mostly on the edges of the valley floor. Valley foothill woodland is the next most common natural community, occupying 1.4 million acres of the foothill areas of the region.

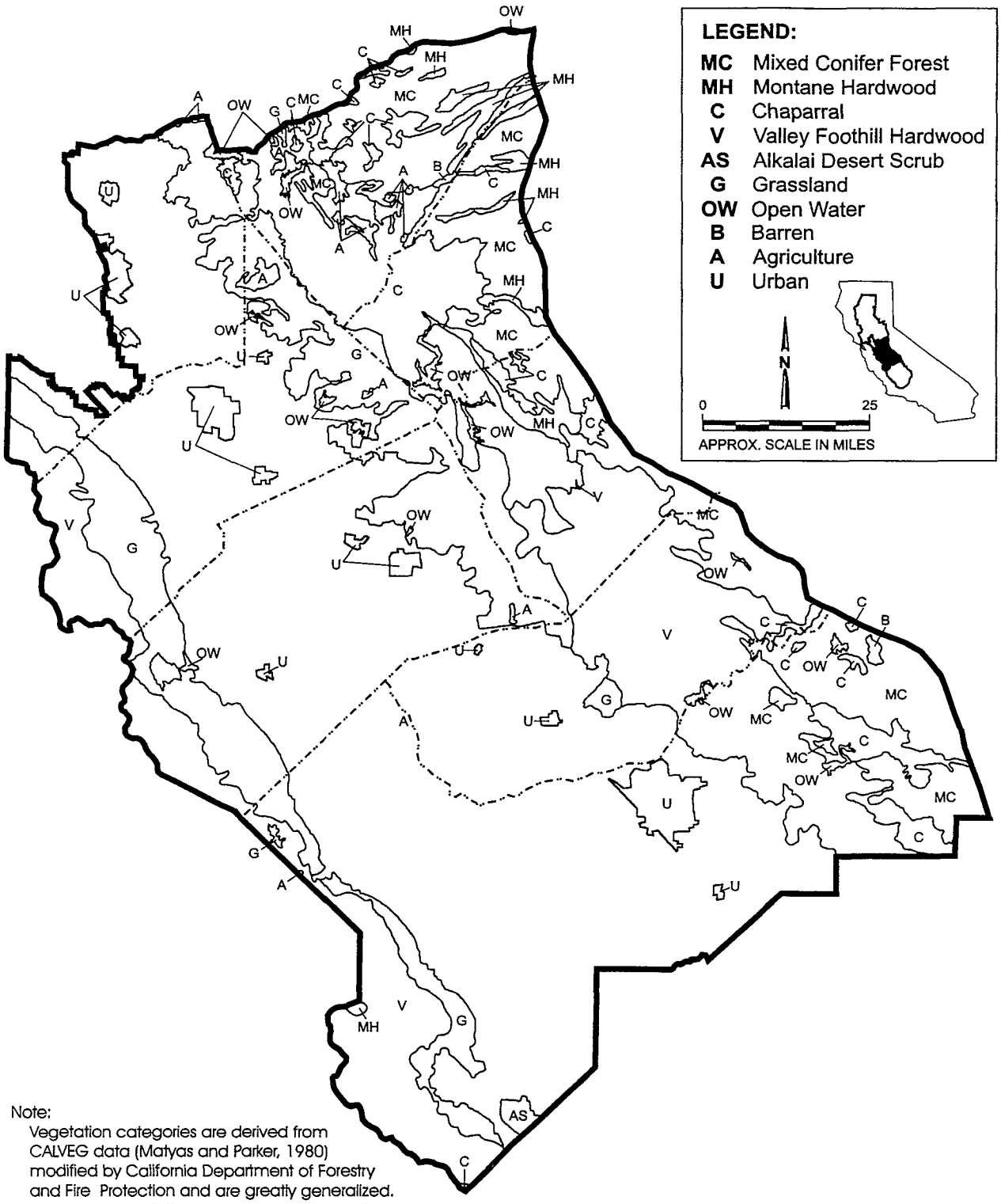
The lowland areas of the San Joaquin River Region are dominated by approximately 3.1 million acres of agricultural land. Crops include pasture, orchards and vineyards, vegetables, cotton, grains, and rice. Pasture and orchards and vineyards are the most abundant crops in the region, at 868,000 and 843,000 acres, respectively.

Riparian and Wetland Communities. Estimates of riparian and wetland vegetation acreage in the San Joaquin River Basin vary widely because each mapping effort covered different geographic areas and used different vegetation classifications or mapping criteria. An estimated 30,800 acres of riparian vegetation existed in the San Joaquin River Region in 1977 (Reclamation, 1990a). DFF data indicate the presence of approximately 15,000 acres of riparian vegetation in the San Joaquin River Region (estimate based on unpublished file data). Warner and Hendrix (1985) estimated that 64,000 acres of riparian vegetation occurred in the south part of the Central Valley, presumably at least half in the San Joaquin River Region. Frayer et al. (1989) estimated that 34,600 acres of "palustrine forested and scrub/shrub" (riparian wetlands) occur in the Central Valley; presumably, a third of this or less would have been in the San Joaquin River Region.

Approximately 138,000 acres of fresh emergent wetlands occur in the San Joaquin River Region (Table II-3), mostly in western Merced County. The CVHJV (1990) identified approximately 120,320 acres of wetlands in this region.

Rivers and Reservoirs. The major rivers of the region include the Mokelumne, San Joaquin, Stanislaus, Merced, Fresno, Tuolumne, and Chowchilla rivers. Eight reservoirs in the San Joaquin River Region that could be affected by implementation of the CVPIA are described in this technical appendix (Figure II-17). The total length of shoreline, relative percent of shoreline vegetation, and area of water are located in Table II-11.

Camanche Reservoir. Dabbling ducks, such as the American wigeon (1,000 individuals), mallard (1,000 individuals), and green-winged teal (300 to 400 individuals), are regular winter residents at Camanche Reservoir. The Canada goose is common during winter, and small numbers also breed there. (Yee, pers. comm.)



Note:
Vegetation categories are derived from CALVEG data (Matyas and Parker, 1980) modified by California Department of Forestry and Fire Protection and are greatly generalized. Numerous vegetation types occupying small areas are not shown because of map scale.

FIGURE II-16

GENERAL VEGETATION TYPES OF THE SAN JOAQUIN RIVER REGION

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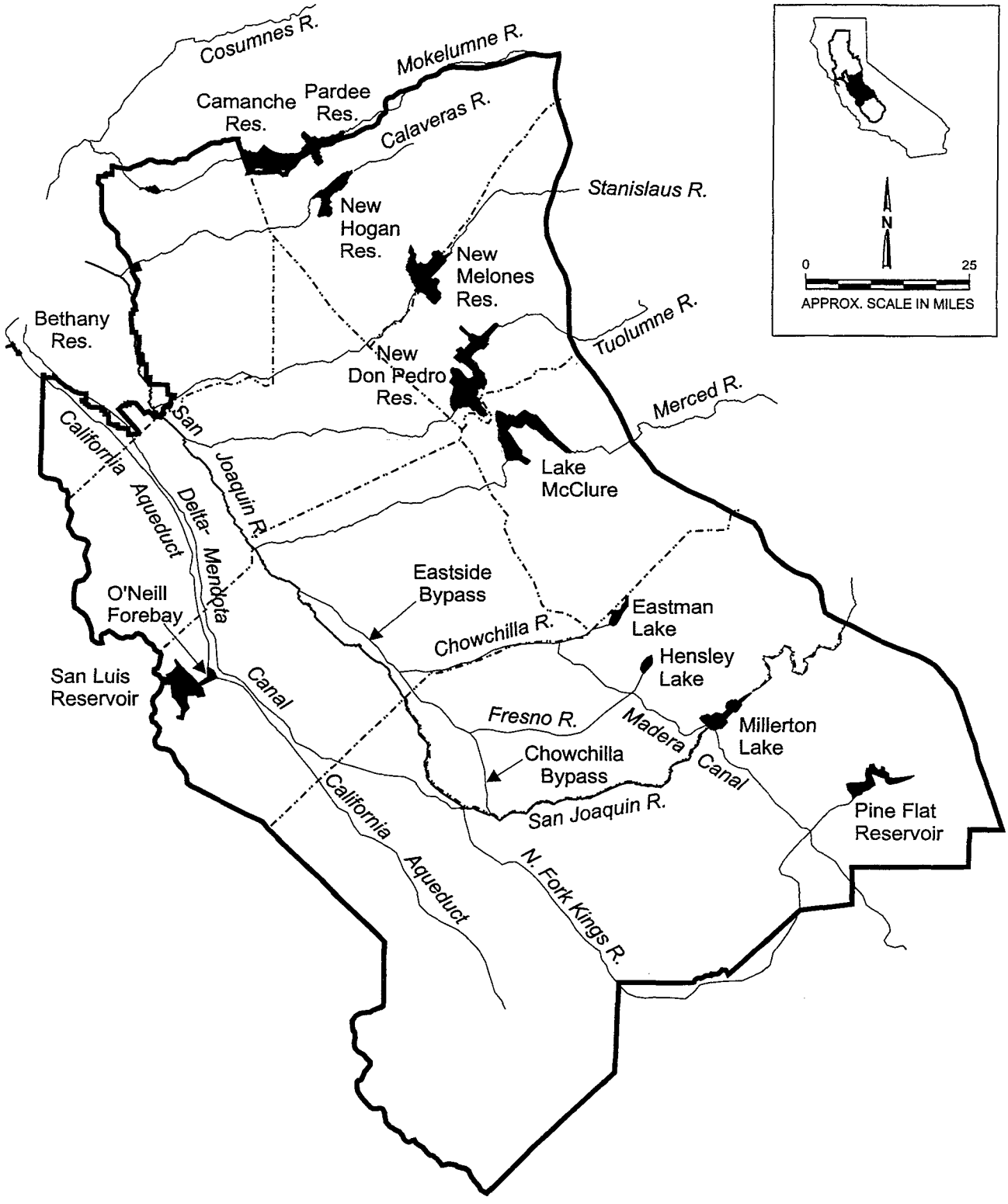

FIGURE II-17

RIVERS AND RESERVOIRS OF THE SAN JOAQUIN RIVER REGION

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TABLE II-11

SHORELINE MILES, RELATIVE PERCENTAGES OF SHORELINE VEGETATION TYPES, AND TOTAL WATER ACREAGES AT SELECTED RESERVOIRS IN THE SAN JOAQUIN RIVER REGION

		Shoreline Vegetation Type						
Reservoir	Shoreline Miles	Mixed Conifer Forest	Montane Hardwood	Valley Foothill Hardwood	Chaparral	Grassland	Other	Total Water Acreage
Camanche Reservoir	*31			20%	10%		70%	*8,000
New Melones Reservoir	105			50%	50%			12,500
New Don Pedro Reservoir	73			40%	60%			*13,700
Lake McClure	*44		20%	30%	50%			*7,050
O'Neill Forebay	10					55%	45%	2,300
Los Banos Reservoir	12					100%		470
San Luis Reservoir	63			30%		70%		13,000
Millerton Lake	51			100%				4,915

NOTE:
Shoreline miles and total water acreage data were taken from Reclamation (1990a) except where denoted by an asterisk; these data were computed by planimetry of 1:500,000-scale USGS topographic maps.

Diving birds are common at Camanche Reservoir. Approximately 3,500 western and Clark's grebes, 2,500 to 3,500 common mergansers, and 10 to 15 common loons are regular winter residents in the area. During the freeze in December 1990, approximately 800 ring-necked ducks wintered at the lake. (Yee, pers. comm.)

The great blue heron rookery (40 to 50 nests) at the base of the dam is the largest heron rookery in San Joaquin County (Yee, pers. comm.). Five to 10 bald eagles and ospreys commonly winter in the area, and three ospreys nested for the first time in 1993 (Gifford and Yee, pers. comms.) at Camanche Reservoir.

Five to six thousand gulls, primarily ring-billed, herring, and California gulls, roost at the lake during winter (Yee, pers. comm.).

New Melones Reservoir. The New Melones Reservoir has little waterbird use, although small numbers of diving and dabbling ducks are expected to occur during winter. Two osprey and 10 bald eagles commonly winter at this reservoir. (Yee, pers. comm.)

New Don Pedro Reservoir. New Don Pedro Reservoir has little waterbird use (Yee, pers. comm.).

Lake McClure. Waterbird use at Lake McClure is considered low (Laymon, pers. comm.). Small numbers of western and eared grebes forage in the deep water; great egrets, mallards, and American coots forage in the shallow water and along the shoreline (Laymon, pers. comm.).

O'Neill Forebay. O'Neill Forebay supports more than 200,000 wintering waterbirds. Most of these birds are American coots, but northern pintails, ruddy ducks, and American wigeon are also abundant (Laymon, pers. comm.). O'Neill Forebay is also one of the three most important wintering areas in California for the Barrow's goldeneye (Laymon, pers. comm.).

Los Banos Reservoir. The Los Banos Reservoir (Los Banos Creek) is expected to support moderate numbers of dabbling ducks during winter.

San Luis Reservoir. The San Luis Reservoir supports small numbers of diving and dabbling ducks (Laymon, pers. comm.).

Millerton Lake. Hundreds of dabbling ducks (e.g., mallards and cinnamon teal) use Millerton Lake as a resting area after feeding in wetlands and ponds in the surrounding area. Bald eagles also visit this lake regularly during winter.

Special-Status Plants. Attachment F lists 30 special-status plant species that occur in the San Joaquin River Region. The largest number of special-status species (18) occurs in grassland. The second largest number of special-status species (16) occurs in valley foothill woodland (Table F-3).

Special-Status Wildlife. Attachment E identifies 24 special-status wildlife species that could occur in the San Joaquin River Region and their preferred habitats. Most of these species are associated with grasslands, freshwater emergent wetlands, desert scrub and alkali desert scrub, valley foothill riparian, lakes, and rivers that occur on the valley floor (Table E-3). Many of the species have been listed by federal and state wildlife agencies because of habitat loss associated with agricultural development and water projects. Grain crops do, however, provide important habitat for species such as Aleutian Canada goose, Swainson's hawk, and greater sandhill crane.

Significant Natural Areas. The 77 SNAs in the San Joaquin Valley are scattered throughout the region but are concentrated in the grasslands of the San Joaquin Valley in freshwater marsh, valley sink scrub, and grassland vernal pool habitats (Figure II-18). These areas are important to waterfowl and shorebirds that winter and nest in the San Joaquin Valley, as well as for several special-status species, including the giant garter snake, Swainson's hawk, tricolored blackbird, and Delta button celery. In the southwestern portion of the valley, several SNAs support special-status species (e.g., the giant kangaroo rat, blunt-nosed leopard lizard, Swainson's hawk, and San Joaquin antelope squirrel) and habitats (e.g., valley needlegrass grassland and northern vernal pool habitats). Along the eastern side of the valley, SNAs encompass native grasslands and vernal pool habitats, as well as alkali sink scrub, cismontane woodland, chaparral habitats, and grassland habitats. These habitats support special-status species such as Chinese camp brodiaea, tree anemone, and tricolored blackbird.

Waterfowl and Shorebirds. The 3,400-square-mile San Joaquin Basin is bounded on the north by the Delta and on the south by the San Joaquin River (Figure II-19). Historically, the basin was a large floodplain of the San Joaquin River that supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Almost 70 percent of the basin has been converted to irrigated agriculture, with wetland acreage reduced to 120,300 acres. Nevertheless,

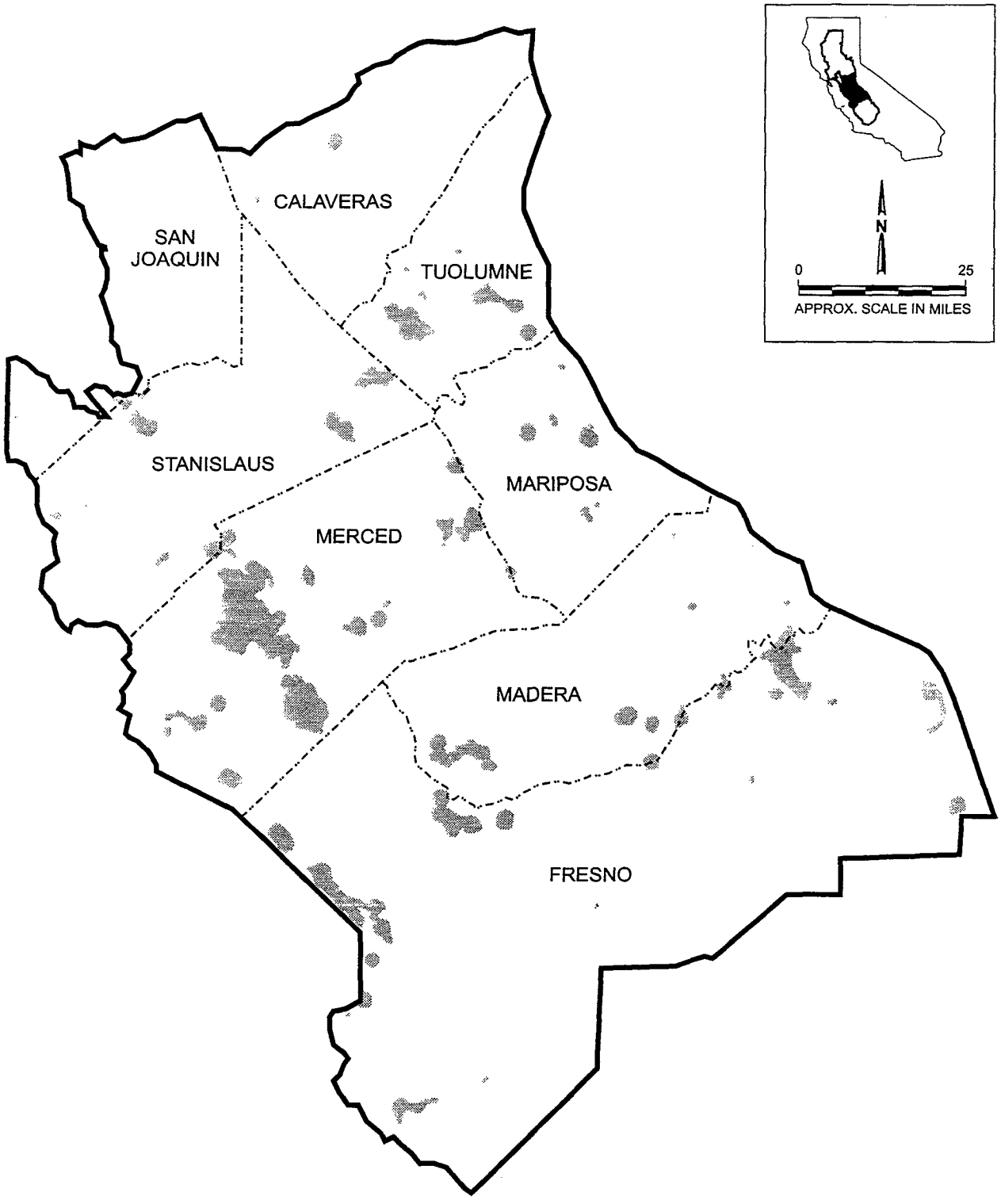
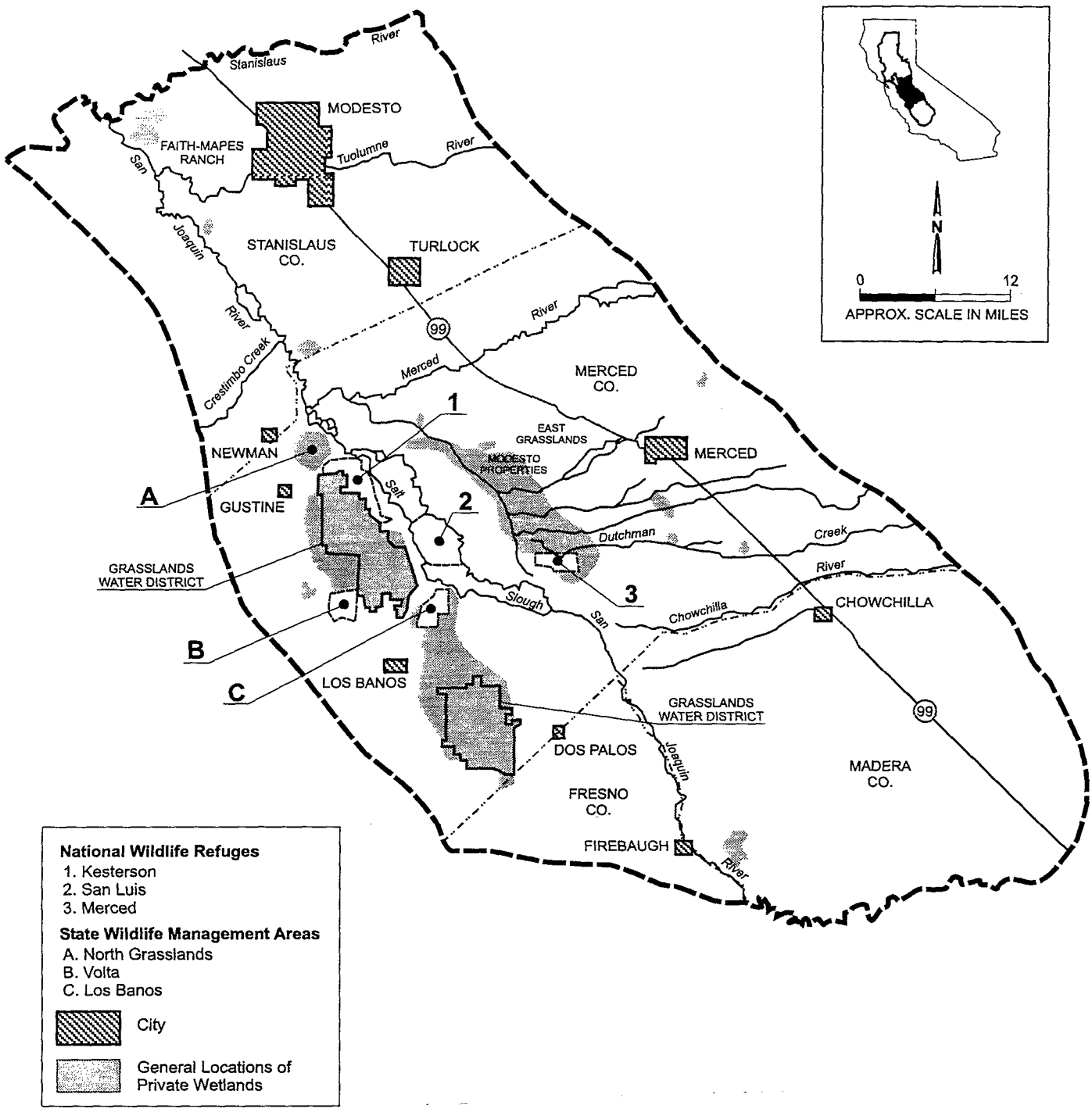


FIGURE II-18

LOCATION OF SIGNIFICANT NATURAL AREAS IN THE COUNTIES OF THE SAN JOAQUIN RIVER REGION



Source: U.S. Fish and Wildlife Service, 1978.

FIGURE II-19

LOCATION OF WINTERING WATERFOWL HABITAT IN THE SAN JOAQUIN RIVER REGION

C—082207

C-082207

the basin contains the largest contiguous block of wetland habitat in the Central Valley. (CVHJV, 1990.)

In combination with the adjacent uplands, this wetland complex is referred to as "the Grasslands" and consists of 160,000 acres of private and public lands (Marciochi, pers. comm.). Approximately 75,000 acres west of the San Joaquin River (West Grasslands) fall within the GRCD, with water delivery to private wetland management primarily through the Grasslands Water District (CVHJV, 1990). Approximately 53,300 acres of the Grasslands are permanently protected in state or federal wildlife refuges or in federal conservation easements (CVHJV, 1990).

The San Joaquin River Region supports approximately 25 percent of the Central Valley waterfowl and shorebird populations and up to 30 percent of the wintering duck population (CVHJV, 1990; Shuford et al., 1993). Winter shorebird numbers in 1992-1993 were estimated at 66,700 birds (Shuford, et al., 1993). Between 100,000 and 1 million birds were estimated during annual spring staging during 1988-1992 (Page et al., 1992).

More than 114,000 acres of private land are in the Grasslands. Within the West Grasslands, there are almost 68,000 acres of private land, of which 41,000 acres are managed as wetlands (Marciochi, pers. comm.). Most of the private wetlands are managed as duck clubs, with more than 200 clubs in the Grasslands (164 in the West Grasslands). Most of the private holdings in the West Grasslands are also within the Grasslands Water District, which was established to deliver CVP water to wildlife areas. More than 29,000 acres of private land in the West Grasslands are permanently protected through conservation easements (Marciochi, pers. comm.).

In the San Joaquin Valley, more than 37,700 acres are managed by the state and federal governments, including Kesterson, San Luis, and Merced NWRs; North Grasslands, Los Banos, and Volta WMAs; and San Joaquin Basin Action Plan lands. The number of habitat types on the public refuges is shown in Table II-12.

Kesterson National Wildlife Refuge. The Kesterson NWR encompasses 5,900 acres of land in the GRCD (Frazier, pers. comm.; Reclamation, 1992). Established in 1970 by the Service and enlarged with the acquisition of the Freitas unit, the refuge contains more than 1,530 acres of wetlands and 3,800 acres of grassland (Frazier, pers. comm.) (Figure II-19).

The refuge is part of a complex of wetlands in the San Joaquin River Region that provides habitat for migratory and wintering waterfowl and shorebirds. Kesterson NWR provides permanent and seasonally flooded wetland, moist soil plants, and upland areas. From 1987 to 1989, duck use-days averaged 4.5 million and geese use-days averaged 13,500. Additionally, the refuge provided 2.7 million shorebird use-days.

San Luis National Wildlife Refuge. The 7,340-acre San Luis NWR is in the GRCD. The refuge is a complex of wetland, upland, and riparian habitat, with approximately 2,700 acres of wetlands managed for moist soil plant production (Fulton, pers. comm.) (Figure II-19). Of the 3,940 acres of grasslands, 145 acres of native grassland are preserved as a rare ecological community (Fulton, pers. comm.).

TABLE II-12

ACREAGE OF HABITAT TYPES ON FEDERAL AND STATE WILDLIFE REFUGES IN THE SAN JOAQUIN RIVER REGION

Refuge	Wetlands	Moist Soil Plants	Riparian	Uplands	Agriculture
Kesterson NWR	628	900	-	3,800	-
San Luis NWR	-	2,690	200	3,940	-
Merced NWR	503	729	54	660	550
North Grasslands WMA	162	1,107	614	2,011	1,662
Los Banos WMA	774	2,400	75	1,903	430
Volta WMA	177	285	3,257	373	-

From 1987 to 1989, the refuge provided 10.7 million duck use-days and 270,000 geese use-days annually. The area is important for shorebirds, providing 2.38 million shorebird use-days. The refuge also supports tule elk, providing 10,100 use-days by the elk and other endangered species. (Reclamation, 1992.)

Merced National Wildlife Refuge. The Merced NWR was established in 1951 to alleviate crop depredation and provide waterfowl habitat. The 2,562-acre refuge is one of the most important wintering areas in California, supporting up to 30,000 snow and Ross' geese and up to 10,000 lesser sandhill cranes (Reclamation, 1992). The refuge maintains approximately 1,232 acres of wetlands, of which approximately 730 acres are in moist soil plant management (Fulton, pers. comm.) (Figure II-19). A total of 550 acres is in cereal grain production, primarily alfalfa and corn (Fulton, pers. comm.).

The refuge provided an average of 4.11 million duck use-days and 1.87 million geese use-days annually from 1987 to 1989 (Reclamation, 1992). It also provided more than 1.5 million shorebird use-days.

Los Banos Wildlife Management Area. The Los Banos WMA, created in 1929, was the first waterfowl refuge established in California (Reclamation, 1992). The refuge encompasses approximately 5,586 acres of the San Joaquin River floodplain (Gerstenberg, pers. comm.). It maintains approximately 3,200 acres of seasonal and permanent wetlands and 213 acres of alkali sink habitat (Gerstenberg, pers. comm.) (Figure II-19).

The Los Banos WMA provides habitat for a variety of bird species. Average annual bird use on the refuge in 1987-1989 included 12 million duck use-days, 2.5 million geese use-days, 8 million shorebird use-days, 1 million coot use-days, 250,000 wading bird use-days, and 18,000 crane use-days (Reclamation, 1992). Pintails made up approximately 52 percent of the duck population during 1991 mid-winter waterfowl surveys. The goose population was made up almost entirely (94 percent) of lesser snow geese.

Shorebirds are found in numbers ranging from 1,000 to 10,000 on the refuge during fall, winter, and spring (Page et al., 1992). Swainson's hawks are known to nest near the refuge and to use

the refuge for foraging. Other special-status species known to occur on the refuge include the giant garter snake and button celery.

Volta Wildlife Management Area. The Volta WMA is leased from Reclamation and managed by DFG. The 3,000-acre refuge is in the GRCD. The refuge maintains more than 1,800 acres of wetlands, including 1,400 acres of moist soil plants (Gerstenberg, pers. comm.), and 720 acres of alkali sink habitat are preserved on the refuge as a rare ecological community (Gerstenberg, pers. comm.) (Figure II-19).

The Volta WMA provides habitat for a variety of bird species. From 1987 to 1989, average annual bird use on the refuge included 3.5 million duck use-days, 300,000 geese use-days, 20 million shorebird use-days, 1 million coot use-days, and 200,000 wading bird use-days (Reclamation, 1992). Shorebird numbers during surveys in 1988-1992 were between 1,000 and 10,000 during fall and winter and between 10,000 and 100,000 in spring (Page et al., 1992). Shorebird species were dominated by black-necked stilts, sandpipers, dunlins, and dowitchers.

San Joaquin Basin Action Plan Lands. Additional acquisitions of the San Joaquin Basin Action Plan described in this technical appendix are the East Gallo Unit, West Gallo Unit, and the China Island and the Salt Slough units (North Grasslands WMA). They are located near existing wetland habitat areas in the north San Joaquin Valley region and are managed separately by the Service or DFG. Most of these lands are not currently managed as wildlife habitat, and their values to wildlife are generally reduced compared with adjacent refuge lands. Similarly, compared with refuge lands, site-specific information on the occurrence of waterfowl and special-status species on these lands is incomplete (Zahm, pers. comm.).

East Gallo Unit. The East Gallo Unit encompasses approximately 4,000 acres, including 300 acres of seasonal wetlands and 100 acres of permanent wetlands (Reclamation, 1992). Habitat area for the unit was purchased by the Service and TNC (which in turn sold its lands to the Service). Habitat areas include natural grasslands, vernal pools, riparian floodplain, and irrigated pastures. The unit is managed by the Service as part of the San Luis NWR.

West Gallo Unit. The West Gallo Unit encompasses 3,892 acres located adjacent to and north of the San Luis NWR. The San Joaquin River forms the eastern border of the unit. The unit was purchased by the Service in 1993 and is managed by the Service as part of the San Luis NWR (Zahm, pers. comm.).

Although it continues to receive heavy grazing pressure, the southern portion of the West Gallo Unit retains its natural topography; several flooded swales and other wetlands are contiguous with the San Luis NWR and provide wetland habitat values (Zahm, pers. comm.). The West Gallo Unit has 364 acres of seasonal marsh and vernal pools and 14 miles of riparian habitat along the San Joaquin River and Salt Slough. Habitats on the unit include natural grasslands, seasonal marshes, vernal pools, riparian areas, and agricultural lands. The unit provides potential habitat for special-status species, including San Joaquin kit fox, Swainson's hawk, colonial nesting birds, and California tiger salamander (Woolington, pers. comm.).

North Grasslands Wildlife Management Area. The North Grasslands WMA was purchased by the State of California in April 1990 and is managed by DFG. The management

area consists of two units: China Island and Salt Slough. The two units contain 5,556 acres of primarily agricultural land and pasture, but also have extensive river and slough channels with riparian edge (U.S. Department of the Interior and DFG, 1993). Salt Slough does not have a firm historical water supply (U.S. Department of the Interior and DFG, 1993); however, approximately 300 acres of new seasonal wetlands at Salt Slough recently were developed by DFG for waterfowl habitat management (Beam and Howard, pers. comms.). North Grasslands WMA provides habitat for a variety of wildlife species. Ducks are the most common waterbirds using the refuge, but sandhill cranes and geese, including the Aleutian Canada goose, are also common. The refuge provided an estimated average of 5,295,000 duck use-days and 1,500 geese use-days annually in 1995 (Howard, pers. comm.). It also provided an estimated 483,000 shorebird use-days.

Tulare Lake Region

Natural and Agricultural Communities. The natural terrestrial community types in the Tulare Lake Region occupy approximately 3.4 million acres of a total land area of 6.3 million acres (Figure II-20). The natural communities are mixed conifer forest, montane hardwood, pinyon-juniper, valley foothill hardwood, montane riparian, valley foothill riparian, chaparral, desert scrub and alkali desert scrub, grassland, and freshwater emergent wetland. Table II-3 summarizes the area of each of these habitat types to the nearest 1,000 acres.

Grassland is the most abundant natural community in this region, occupying 950,000 acres of the perimeter of the valley portion of the region. Mixed conifer forest dominates the higher elevation eastern portion, occupying 599,000 acres, and mid-elevation and low-elevation slopes are dominated by valley foothill hardwood, occupying 591,000 acres (Table II-3).

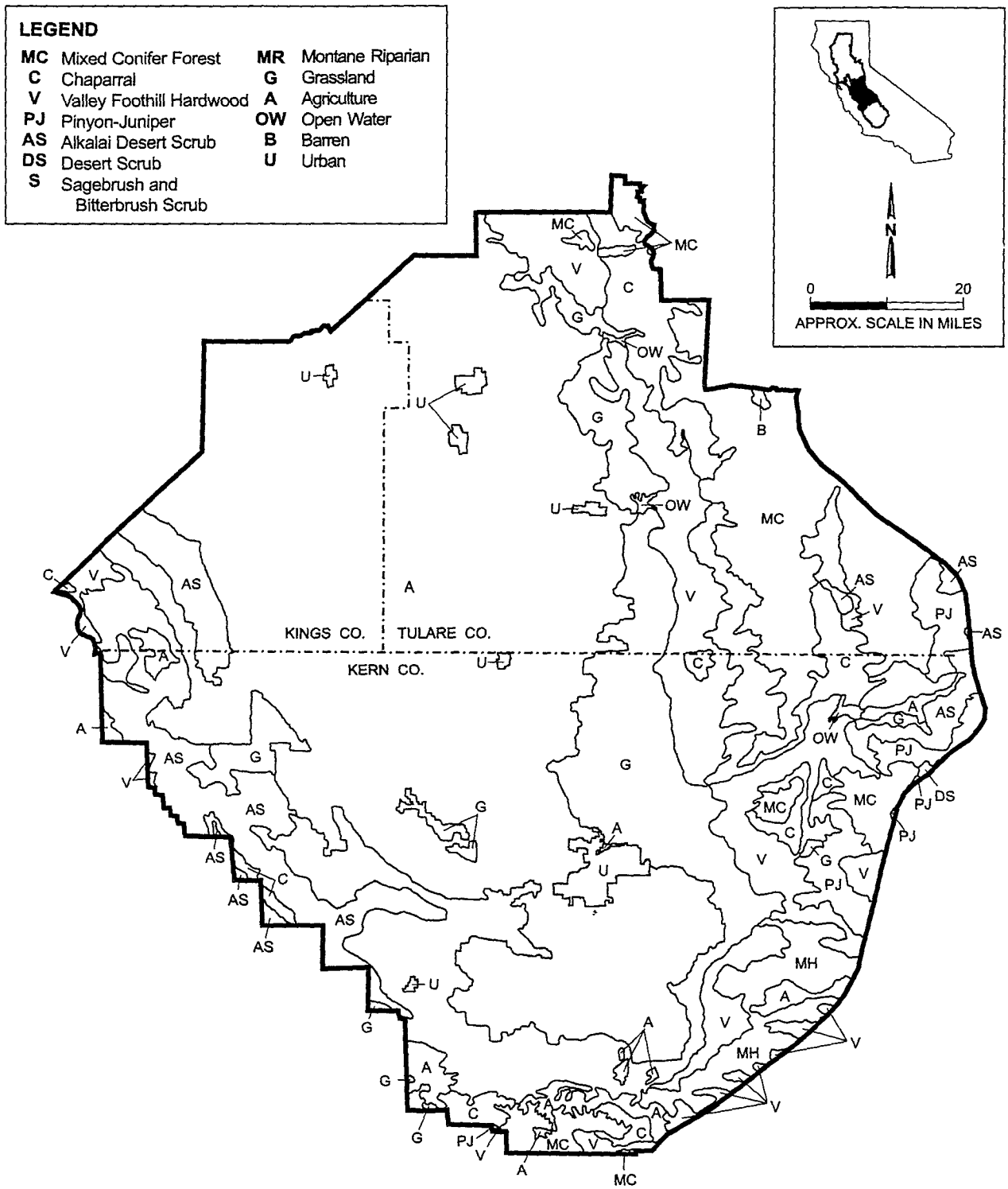
The lowland areas of the Tulare Lake Region are dominated by agricultural land, occupying approximately 2.2 million acres. Agricultural crops in the Tulare Lake Region include cotton, pasture, orchards and vineyards, grains, vegetables, and rice. Cotton and pasture are the most abundant crops in the region, at 701,000 and 525,000 acres, respectively.

Riparian and Wetland Communities. Estimates of riparian and wetland vegetation acreage in the Tulare Basin vary widely because of variations in geographic coverage and mapping criteria. DFF data indicate that approximately 14,000 acres of riparian vegetation occur in the Tulare Lake Region (estimate based on unpublished file data).

Approximately 32,000 acres of wetlands occur (Table II-3), the majority being freshwater emergent wetlands that are managed waterfowl habitat.

Rivers and Reservoirs. The major rivers of the Tulare Lake Region are the Kings, Kaweah, Tule, and Kern. Each river is controlled by one or more reservoirs (Figure II-21).

Special-Status Plants. Attachment F lists 17 special-status plant species that occur in the Tulare Lake Region. The largest number of special-status species (13) occurs in grassland, which includes vernal pools. The second largest number of special-status plant species (6) occurs in valley foothill hardwood (Table F-4).



SOURCES:
Vegetation categories are derived from CALVEG data (Matyas and Parker, 1980) modified by the DFF and are greatly generalized. Numerous vegetation types occupying small areas are not shown because of map scale.

FIGURE II-20

GENERAL VEGETATION TYPES OF THE TULARE LAKE REGION

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C-082212

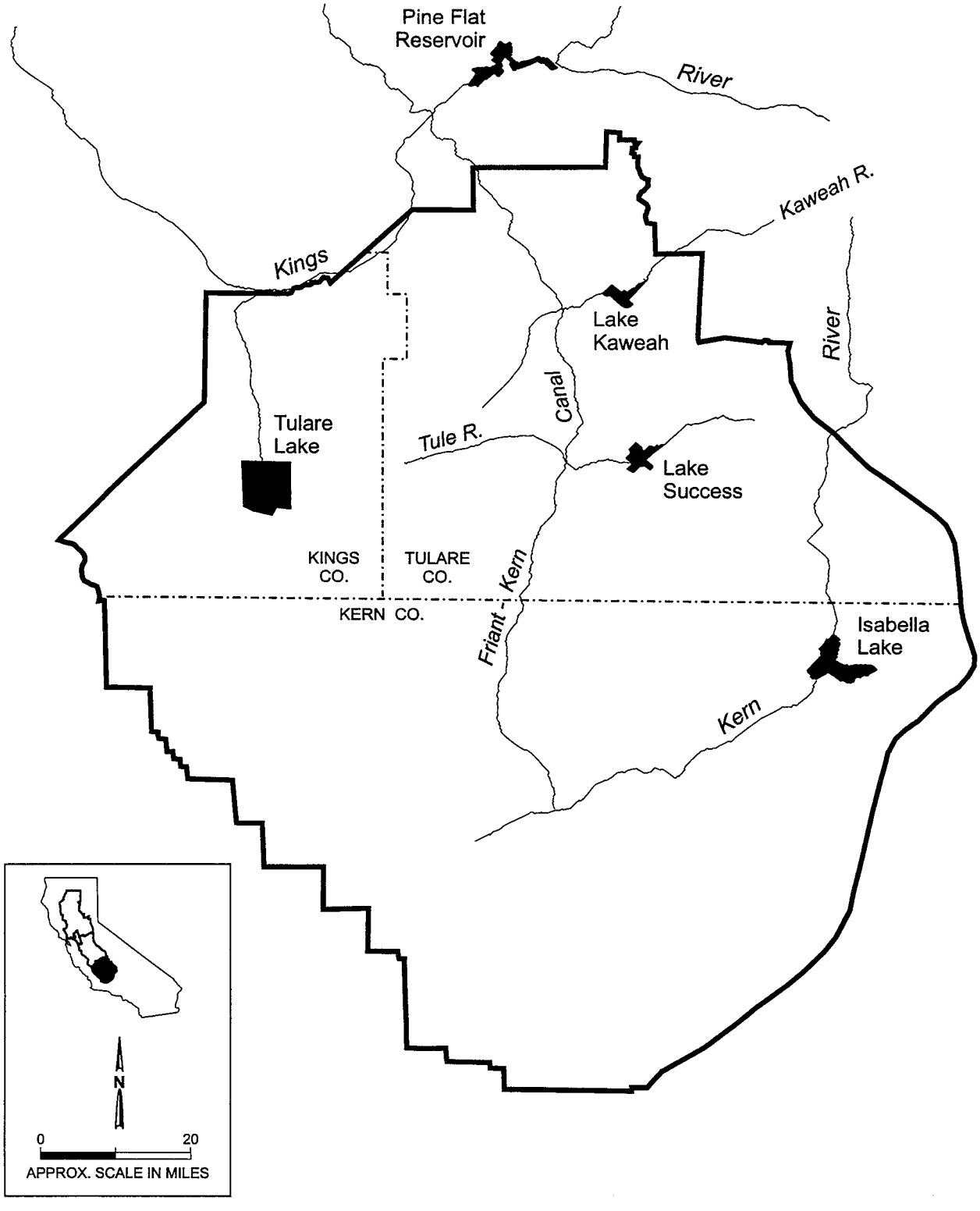


FIGURE II-21

RIVERS AND RESERVOIRS OF THE TULARE LAKE REGION

C—082213

C-082213

Special-Status Wildlife. Attachment E identifies 18 special-status wildlife species that could occur in the Tulare Lake Region and their preferred habitats. Most of these species are associated with the grasslands, freshwater emergent wetlands, valley foothill riparian, desert scrub and alkali desert scrub, and open water habitats that occur on the valley floor (Table E-4). Species associated with these habitats, such as fairy shrimp, San Joaquin antelope squirrel, and giant kangaroo rat, have been listed by federal and state wildlife agencies because of conversion of habitat to agricultural land.

Significant Natural Areas. The Tulare Lake Region contains 106 SNAs (Figure II-22). In the eastern region, SNAs primarily encompass foothill and mountain communities, including chaparral, oak woodland, pinyon-juniper woodland, and coniferous habitats. These areas provide habitat for a variety of special-status plant and animals species, including the Springville clarkia, Kaweah brodiaea, and Kern Canyon slender salamander. Central and western SNAs in the Tulare Lake Region are in valley bottom habitats, including chenopod scrub, valley saltbrush scrub, valley sacaton grassland, Great Valley mesquite scrub, and valley sink scrub. These habitats support many special-status plant and animal species, including San Joaquin woolly-threads, Hoover's eriastrum, Kern mallow, Tipton kangaroo rat, blunt-nosed leopard lizard, giant kangaroo rat, and Swainson's hawk.

Waterfowl and Shorebirds. The Tulare Lake Region is the southernmost region in the Central Valley. It is bounded on the east, west, and south sides by foothill habitats and on the north by the San Joaquin River (CVHJV, 1990) (Figure II-23). The 5,700-square-mile basin is the driest region of the Central Valley; nonetheless, historically it contained the largest single block of wetland habitat present in California (CVHJV, 1990). The region acts as a sink, with water from the Sierra Nevada filling shallow basin lakes that included Tulare, Kern, Goose, and Buena Vista lakes.

Historically, Tulare Lake Region contained approximately 260,000 acres of permanent wetland and 260,000 acres of seasonally flooded scrubland (CVHJV, 1990). Diversion of water for agricultural and urban uses resulted in the draining and reclamation of the lake and associated wetlands. Less than 1 percent of the freshwater lake habitat and 4 percent of the wetland habitat (San Joaquin Valley Drainage Program, 1990), with approximately 36,300 acres of seasonal wetlands, remain in the region (CVHJV, 1990).

The region provides habitat for approximately 5 percent of the waterfowl in the Central Valley (CVHJV, 1990). It is an important shorebird area, supporting approximately 10 percent of the shorebirds in the Central Valley in winter (Shuford et al., 1993). Wintering shorebird numbers were estimated at nearly 26,000 birds in 1992-1993 (Shuford et al., 1993). Spring shorebird numbers were estimated from 41,000 to 410,000 during 1988-1992 (Page et al., 1992).

Private duck clubs provide approximately 2,500 acres of seasonal wetlands in the region (Smith, pers. comm.), of which approximately 900 acres are permanently protected through conservation easements. Lake Woolomes Park and Buena Vista Recreation Area provide an additional 1,400 acres of protected waterfowl habitat. (CVHJV, 1990.)

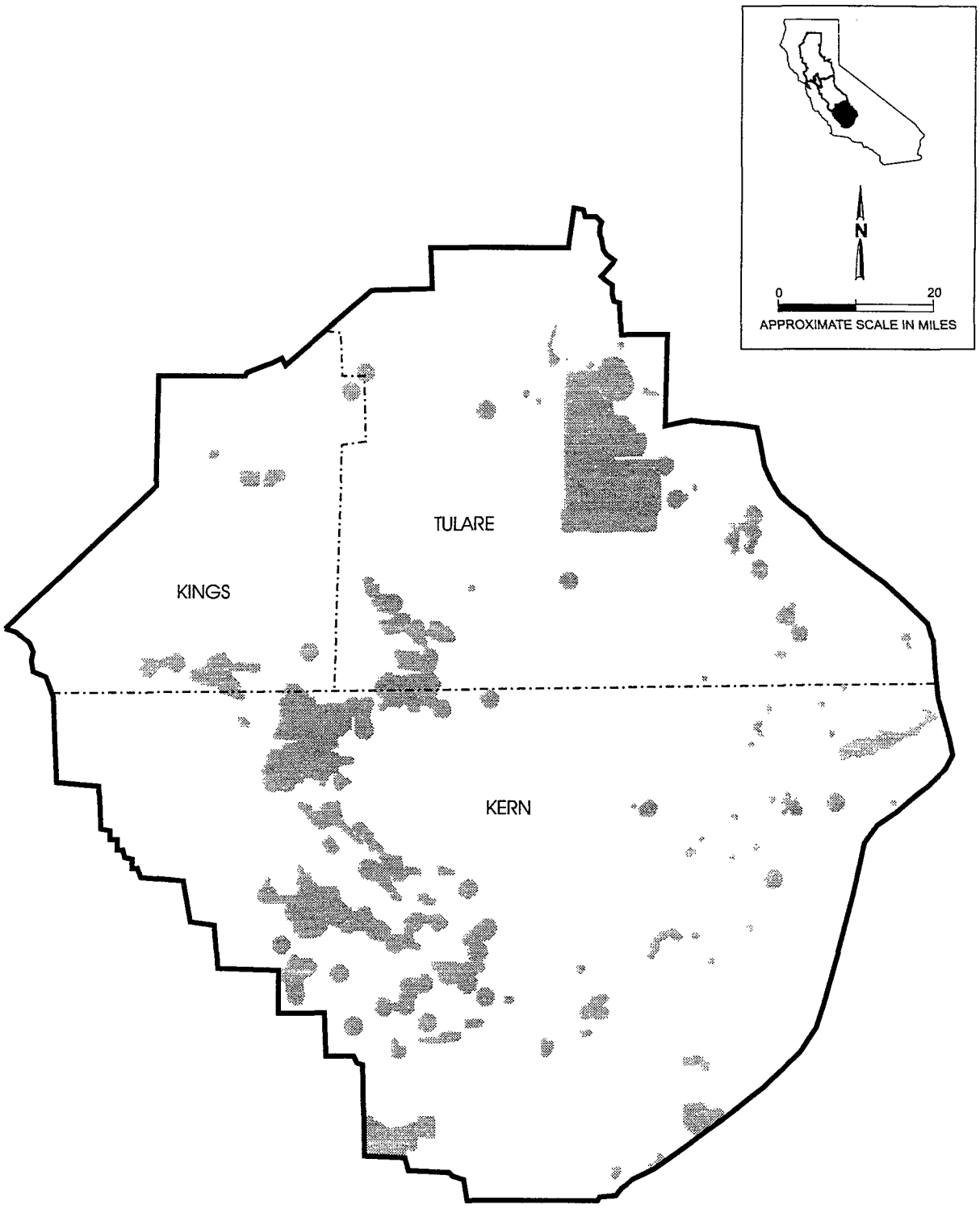
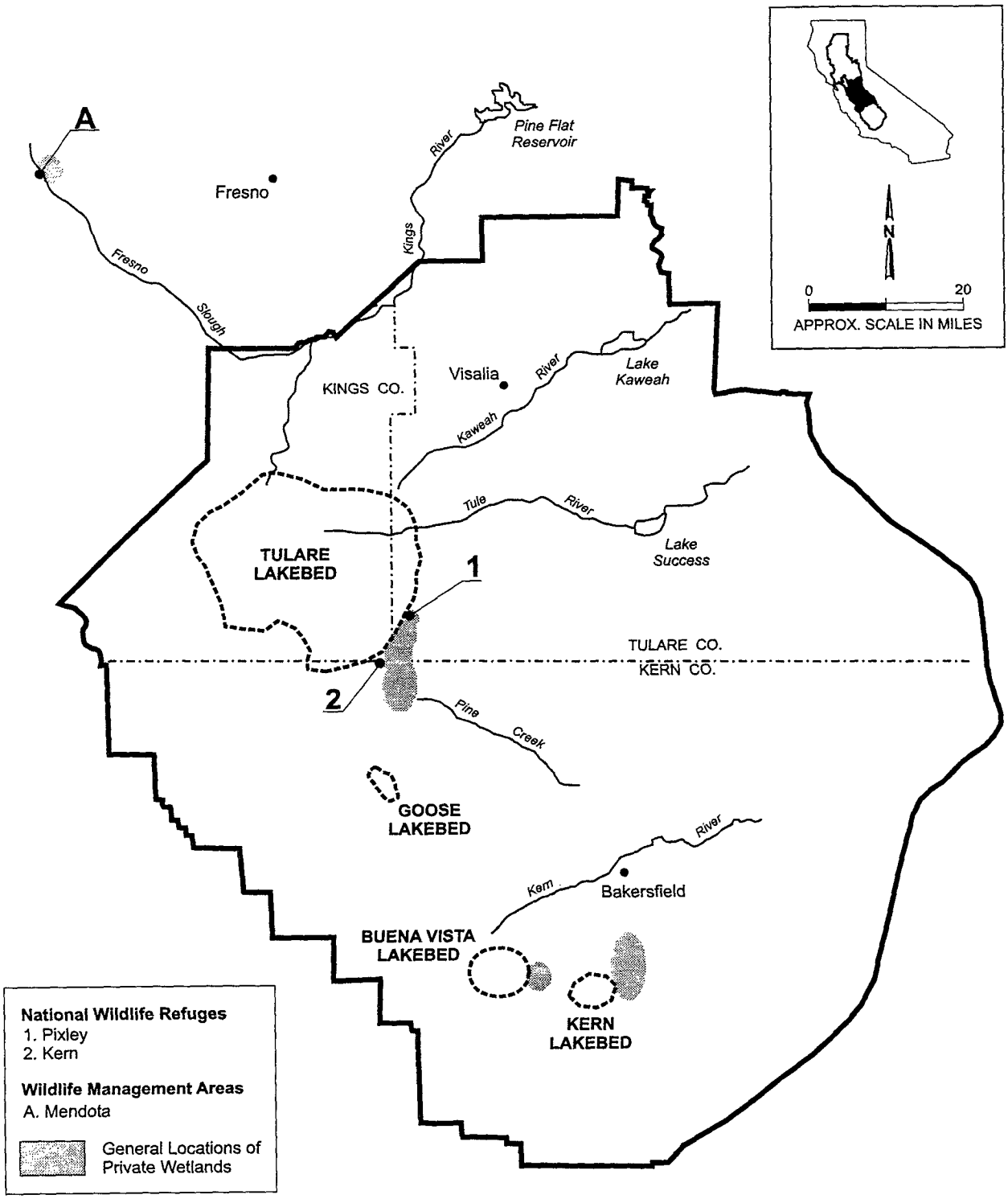


FIGURE II-22

LOCATION OF SIGNIFICANT NATURAL AREAS IN THE TULARE LAKE REGION



SOURCE:
Service, 1978.

FIGURE II-23

LOCATION OF WINTERING WATERFOWL HABITAT IN THE TULARE LAKE REGION

C—082216

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Evaporation Ponds. In addition to duck clubs and parks, evaporation ponds on private land provide habitat in the Tulare Lake Region. Evaporation ponds provide a means of disposing of subsurface agricultural wastewater in the Tulare Lake Region because it is a closed hydrologic system and agricultural drainage water cannot be easily exported. Consequently, almost all (96 percent) of the evaporation ponds in the Central Valley are located in the Tulare Lake Region. In 1990, 25 evaporation ponds covered approximately 7,400 acres in the region, with individual pond size ranging from 1 to 1,890 acres. (San Joaquin Valley Drainage Program, 1990.)

Evaporation ponds are usually shallow, warm, and nutrient-rich, representing an attractive oasis for many wildlife species. Waterfowl, shorebirds, and wading birds that historically used the extensive wetlands in the region are particularly attracted to the surface water of evaporation ponds in a landscape now dominated by intensively developed agriculture (San Joaquin Valley Drainage Program, 1990). Waterfowl use of the ponds exceeded 8 million use-days in 1988, primarily by pintail, northern shoveler, mallard, green-winged teal, gadwall, ruddy duck, and redhead (San Joaquin Valley Drainage Program, 1990). Shorebirds also are attracted to the ponds, which often have more nesting shorebirds than the wildlife refuges in the region (Bradford et al., 1989). Black-necked stilts and American avocets are the most common shorebirds. Surveys in 1988-1992 estimated that between 14,000 and 140,000 shorebirds used the ponds in fall, 4,000 to 40,000 shorebirds were present in winter, and 15,000 to 150,000 shorebirds were present in spring (Page et al., 1992). Shorebird use may be higher during summer, when numbers peak during the June through August breeding season (San Joaquin Valley Drainage Program, 1990).

The drainage water from irrigated lands on the west side of the San Joaquin Valley often has high concentrations of salts and trace minerals, such as selenium, arsenic, boron, cadmium, and mercury (Skorupa and Ohlendorf, 1991). When this contaminated water is stored in evaporation ponds, wildlife species, especially ducks and shorebirds, have high potential to be exposed to toxic levels of the minerals and salts, especially selenium. Safe levels of waterborne selenium are 0.5-20 parts per billion (ppb). Selenium concentrations in the Tulare Lake Region evaporation ponds average around 50 ppb. The minerals and salts have all been found in abnormally high levels in wildlife using evaporation ponds, and high levels of selenium have caused serious problems in waterfowl and shorebirds using evaporation ponds (Bradford et al., 1989; Skorupa and Ohlendorf, 1991). Selenium toxicity has caused reproductive defects, sterility, and death (Skorupa and Ohlendorf, 1991; Lemly and Smith, 1987). There is evidence that substantial numbers of waterfowl and shorebirds are exposed to significant contamination from the evaporation ponds (Bradford et al., 1989). High selenium concentrations have been found in the livers and eggs of American avocets inhabiting evaporation ponds, and there is a high incidence of severe deformities among shorebirds (50 percent) and ducks (30 percent) nesting near evaporation ponds (Bradford et al., 1989).

Several methods have been examined to decrease the attractiveness of the evaporation ponds to waterfowl and shorebirds, including changing the physical structure and operation procedures, implementing water treatment methods and wildlife exclusion devices, and evaluating the location of the ponds in relation to other habitats (Bradford et al., 1991). The recommended methods that have the highest potential to decrease the exposure to waterfowl and shorebirds with minimal negative environmental effects include deepening the ponds, eliminating wind

breaks, and controlling levee vegetation to make the ponds less attractive to the birds (Bradford et al., 1991). Additional methods that may prove to be effective include steepening the side slopes; using herbicides to treat the pond water; and using wildlife deterrence techniques, including hazing and shoreline netting (Bradford et al., 1991).

Approximately 16,000 acres are preserved in federal and state refuges, including Kern and Pixley NWRs and the Mendota WMA. The acreage of habitat types on the public refuges is shown in Table II-13.

TABLE II-13

ACREAGE OF HABITAT TYPES ON FEDERAL AND STATE WILDLIFE REFUGES IN THE TULARE LAKE REGION

Refuge	Permanent Wetlands	Semi-Permanent Wetlands	Seasonal Wetlands	Moist Soil Plants	Uplands
Kern NWR	-	-	1,200	-	9,000
Pixley NWR	-	-	-	-	5,442
Mendota WMA	889	631	-	6,796	3,354

Kern National Wildlife Refuge. The Kern NWR encompasses 10,618 acres of land, approximately 35 miles northwest of Bakersfield (CVHJV, 1990) (Figure II-23). It was established in 1961 and is managed by the Service. The refuge is a complex of seasonal wetlands and upland habitats. Water is available to flood approximately 3,800 of the 7,500 acres of potential seasonal wetlands; however, only 1,200 acres were flooded during the drought (Clay, pers. comm.). Approximately 2,500 acres of the refuge are also protected as a rare ecological community (Clay, pers. comm.).

During August and September, the refuge provides habitat for thousands of early migrant pintail ducks and other winter waterfowl and endangered species. The Kern NWR provided annual averages of 14,000 goose use-days, 5.8 million duck use-days, and 716,000 waterbird use-days in 1987-1989 (Reclamation, 1992). During mid-winter waterfowl surveys in 1991, an estimated 10,740 ducks used the refuge. Northern shovelers, green-winged teal, and pintails made up approximately 94 percent of the population.

The protected upland habitats support populations of Tipton kangaroo rats, blunt-nosed leopard lizards, and San Joaquin kit fox (Clay, pers. comm.). The annual average use-days for endangered species was 661,000 in 1987-1989 (CVHJV, 1990).

Pixley National Wildlife Refuge. The Pixley NWR was established in 1959 and now encompasses 5,992 acres of grassland and wetland habitats (Figure II-23). The refuge could provide up to 950 acres of seasonal wetlands if water were available (Clay, pers. comm.).

Although the land was originally purchased for waterfowl habitat, it now primarily provides grassland habitat for endangered species (Clay, pers. comm.). Approximately 4,400 acres provide habitat for the federally endangered blunt-nosed leopard lizard and livestock grazing opportunities (CVHJV, 1990). The federally threatened San Joaquin kit fox and the Tipton kangaroo rat also occur on the refuge. The refuge provided an annual average of 6,000 use-days for endangered species in 1987-1989 (CVHJV, 1990).

The refuge may be an important staging area for sandhill crane (Clay, pers. comm.). During 1992 mid-winter waterfowl surveys conducted by DFG, an estimated 400 sandhill cranes were present on the refuge.

Mendota Wildlife Management Area. The 12,425-acre Mendota WMA is the largest publicly owned and managed wetland in the San Joaquin Valley (CVJHV, 1990). Established between 1954 and 1966, the refuge is adjacent to the Fresno Slough and adjacent to the 900-acre Alkali Sink Ecological Reserve (Reclamation, 1992). Approximately 8,300 acres of wetlands are maintained on the refuge, including almost 6,800 acres of seasonal wetlands (Figure II-23).

The refuge provided an annual average of 2.3 million duck and geese use-days and 300,000 use-days by other waterbirds during 1987-1989 (CVHJV, 1990). During 1991 mid-winter waterfowl surveys, an estimated 23,800 ducks used the refuge. Green-winged teal, pintails, and northern shovelers made up approximately 68 percent of the duck population. No geese were present during the survey.

An annual average during 1988-1992 of between 4,400 and 44,000 shorebirds used the refuge in fall and between 10,000 and 100,000 shorebirds in winter and spring during 1988-1992 (Page et al., 1992). Giant garter snakes have been observed on the refuge; however, none have been observed recently (Huttleson, pers. comm.).

Central Coast Region

The Central Coast Region includes all of Santa Cruz and San Benito counties and portions of Monterey and San Luis Obispo counties. It is not known how the CVPIA may affect the Central Coast Region; therefore, the region is described in a general fashion, as used in describing the San Francisco Bay Region.

The natural communities occurring in the Central Coast Region include mixed conifer and montane hardwood forest; valley foothill hardwood and valley foothill riparian forests and woodlands; chaparral, coastal scrub, and desert alkali scrub habitats; coastal beaches and cliffs; and grassland, freshwater emergent wetland, and open water on reservoirs, lakes, and rivers.

Special-status plants and wildlife are listed in Attachments I and J.

San Francisco Bay Region

The San Francisco Bay Region receives CVP water; however, it is not known how, when, and where the water will be obtained. Therefore, biological resources in this region is described in very general terms.

The San Francisco Bay Region includes all or portions of six counties surrounding San Francisco Bay and receives waters through the Delta, draining 40 percent of the state. This 3,500-square-mile region includes the San Francisco Bay, San Pablo Bay, the Carquinez Strait, Suisun Bay, and the Sacramento River below the confluence of the Sacramento and San Joaquin rivers. Historically, tidal marshes bordering these bays probably exceeded 200,400 acres (Association of Bay Area Governments et al., 1991). At present, an estimated 25,500 acres of tidal marshes remain, most of which are fragmented into small, isolated parcels (Association of Bay Area Governments et al., 1991).

Natural Communities. Natural communities in the San Francisco Bay Region include mixed conifer forest, montane hardwood, valley foothill hardwood, valley foothill riparian, chaparral, coastal scrub, inland dunes, coastal beaches and cliffs, grassland, and fresh and emergent wetlands. Chaparral is the most abundant natural community type in the San Francisco Bay Region.

Special-status plants and wildlife are listed in Attachments I and J.

Waterfowl and Shorebirds. The San Francisco Bay Region is an important waterfowl area that may contain more than 1 million birds during migration with more than 70 percent of the waterfowl on the Pacific Flyway moving through this area (Service, 1989). Mid-winter waterfowl surveys in 1991 estimated nearly 268,700 waterfowl in the San Francisco Bay Region, including approximately 265,000 ducks, primarily scaups, scoters, canvasbacks, ruddy ducks, and pintails.

The San Francisco Bay Region is a particularly important area for shorebirds, supporting more shorebirds than all other California coastal wetlands combined (Page et al., 1992). An estimated 300,000 to 400,000 shorebirds in fall and 600,000 to 1 million shorebirds in spring can be found in this region (Page et al., 1992). Other important coastal wetlands in California include Humboldt Bay, Elkhorn Slough, Mugu Lagoon, and Morro and Tomales bays (Page et al., 1992).

The San Francisco Bay Region provides habitat for six bird species and one mammal listed as threatened or endangered by DFG or the Service and three birds and two mammals identified as federal candidates for listing. The salt marsh harvest mouse, clapper rail and, to a lesser extent, the black rail, occur primarily in the region's salt marsh habitats. The salt marsh yellowthroat and salt marsh song sparrow subspecies use the tall emergent vegetation that grows in the more brackish areas.

The 112,900-acre Suisun Marsh contains more than 10 percent of the remaining wetlands in California and is one of the largest contiguous brackish marshes in the United States (DWR, 1984). The marsh is in Solano County, west of the confluence of the Sacramento and San Joaquin rivers (Figure II-8).

Approximately 85,000 acres of marshes and waterways include tidal marshes, leveed marshlands, and some seasonal wetlands in higher fringe areas. Approximately 89 percent (52,300 acres) of the wetlands consist of leveed marshlands that support brackish marsh vegetation, primarily saltgrass, pickleweed, alkali bulrush, and tules. Adjacent to the marshes are 27,900 acres of uplands. These higher areas contain grassland, shrubland, riparian, and eucalyptus grove habitats as well as cultivated crops. (DWR, 1984.)

Suisun Marsh is a key waterfowl wintering area, particularly in fall, when suitable waterfowl habitat is scarce in interior valleys (DWR, 1984). Surveys have revealed that the marsh may contain up to 28 percent of the waterfowl in California during fall of dry years (DWR, 1984). During mid-winter waterfowl surveys in 1991, an estimated 80,400 waterfowl were present. Of these, 60,000 were ducks, primarily pintails and northern shovelers. During peak use in fall, the marsh may support up to 1 million ducks (DWR, 1984).

The San Francisco Bay NWR was established in 1972 along the southern shores of the San Francisco Bay. It protects approximately 19,000 acres, of which more than 14,000 acres are salt ponds and 3,400 acres are tidal marshes. Although this area provides important waterfowl and shorebird habitat, specific use data were not available for the refuge.

Several special-status species occur on the refuge, including the California clapper rail, salt marsh harvest mouse, peregrine falcon, California brown pelican, snowy plover, California least tern, and harbor seal.

The 11,700-acre San Pablo NWR was established in 1970 in northern San Pablo Bay. The refuge is nearly all estuarine habitat and supports a diversity of wildlife species, including the special-status California clapper rail, salt marsh harvest mouse, and California brown pelican.