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Appendix X. Vegetation and Wildlife: Historical Perspective and Cumulative Impact Tables

HISTORICAL PERSPECTIVE ON VEGETATION AND WILDLIFE

The Central Valley floodplain, which extends 400 miles from Red Bluff to Bakersfield, historically varied in width from 1 to 30 miles. In the past, natural flooding from the Sacramento and San Joaquin Rivers turned parts of the valley into a vast mosaic of wetlands and flooded areas. During the dry season this same area contained meandering sloughs, rivers, and streams bordered by extensive riparian forests and perennial wetlands. Poor soils of upland areas in the Central Valley supported grasslands and oak woodlands. The extent and character of the various communities changed with the season and patterns of rainfall and runoff.

The San Joaquin Valley included over 625,000 acres of open water and wetlands including Buena Vista and Kern Lakes, and vast riparian woodlands along its major rivers. The Sacramento Valley lacked perennial inland lakes but had extensive marshlands and riparian woodlands. The two major rivers of these valleys, the Sacramento and the San Joaquin, merged in the Delta forming more than 60 islands and over 700 miles of waterways. The vast acreage of marshlands in the Central Valley and Delta dampened peak runoff, increased the length of the runoff period, and brought tremendous volumes of organic nutrients to the Delta-Bay estuary.

Riparian Vegetation of the Sacramento Valley

Rivers of the Sacramento Valley and their heavily forested natural levees contrasted sharply with the flat and barren-appearing grasslands that surrounded them. The natural levee system formed by thousands of years of floodwater sediment deposition was an important feature of the valley because it controlled the patterns and rates of surface drainage and runoff.

Natural levees 4-5 miles wide, consisting of coarse-grained sediments elevated 5 - 20 feet above the floodplain, formed along the valley's major rivers (Thompson 1961). Except during periods of extremely high runoff, the levees formed dry corridors when the valley was flooded (Thompson 1961). The levees' proximity to water, their well-drained soils, and their lack of long-term winter-spring flooding allowed them to support magnificent riparian forests (U. S. Fish and Wildlife Service 1987).

Low-lying areas along either side of the river were generally inundated during winter and spring because the levees prevented flood waters from tributaries and overbank flow from entering the river, thus flooding large portions of the valley. Many creeks, including Putah, Cache, and Butte, did not flow directly into the river but collected in these low-lying basins forming extensive marshlands that remained flooded throughout the year (Katibah 1981).

The Sacramento River probably overflowed its banks in most years prior to flood control activities. Typical flood water volumes were four to eight times the capacity of the Sacramento River channel (Katibah 1984). Peak Sacramento River flows typically occurred between December and March. Late spring flows were also high because of snowmelt. Summer flows, in contrast, receded to "a mere trickle" (Katibah 1984).

Presettlement Condition and Extent

Historically, the Sacramento Valley floodplain supported extensive tracts of riparian vegetation. Accurate records of the presettlement condition and extent of riparian vegetation are not available; consequently, knowledge of this resource is based on descriptions by early explorers and reasoned assumptions by later scientists.

The presettlement extent of riparian vegetation along the Sacramento River was estimated to have ranged from 800,000 (Roberts et. al. 1977, Katibah 1984) to 1 million acres (Thompson 1961; U. S. Fish and Wildlife Service 1984, 1987). These estimates are considered low because the extensive forests of some tributaries were not included.

The tall, thickly wooded, multilayered forests were considered lush and impressive during the 1800s. A map submitted by Derby in 1849 (Thompson 1961) showed 4- to 5-mile-wide forests along the Sacramento River from Glenn to Clarksburg. Historic accounts describe the vegetation as continuous along the Sacramento River and discontinuous along its tributaries. The presettlement extent of the historic riparian forests is difficult to envision given our modern day perspective.

Historic accounts summarized by Thompson (1961) describe mixed forests but repeatedly refer to impressive stands of valley oak. The extensive riparian forests were a source of constant amazement to early travelers because of the nearly treeless condition of the rest of the Sacramento Valley. Dense, young-growth, willow-cottonwood forests grew in the river channel and along its bars. Low and high terraces lining the river channel supported luxuriant, mixed forests of cottonwood, willow, ash, sycamore, and white alder, overgrown with grape vines. Nearly all of the accounts emphasize the prevalence of the valley oak forests on higher terraces and the extensive natural levee system extending many miles from the channel. Marshes, oxbow lakes, and gravelly flood channels occurred throughout the upper terraces and levees.

Tributary drainages supported roughly the same type of riparian vegetation as the Sacramento River. The riparian vegetation of some creeks emanating from the Coast Ranges was relatively less dense because the creeks were dry or nearly dry during summer. In contrast, creeks of the Cascade and Sierra Ranges flowed year-round and supported wide, lush forests.

Declines Predating the CVP

The history of declines in the extent of riparian vegetation in the Sacramento Valley is closely associated with the history of settlement, flood control, reclamation, and agricultural and water development (Figure A). After two to three decades of Euro-American influence, riparian forest along the Sacramento River was reduced to a fraction of its historic extent (U. S. Fish and Wildlife Service 1984). In 1910 the noted botanist Willis Jepson began an account with the phrase "after the destruction of the riparian forests." Declines are chronicled by Thompson (1961), Kahrl (1981), Katibah (1981), Scott and Marquiss (1981), ESA/Madrone (1982), and U. S. Fish and Wildlife Service (1984).

Riparian forests were first impacted by woodcutting. By 1869, nearly all trees in Tehama, Sacramento, and Solano Counties were cleared to fuel boats navigating the Sacramento River and for construction materials (Thompson 1961). This rapid disappearance was exacerbated by a sudden increase in farming activities. The Arkansas Act of 1850, which promoted the reclamation of millions of acres of "swampland" throughout California, and the end of the Gold Rush during the 1860s, attracted farmers and ex-miners, who began clearing forests from the highly fertile riverbank levees.

Hydraulic mining during the gold rush contributed to further declines. Sediment from the watershed was deposited in the Sacramento River and its tributaries, causing significant flooding hazard and navigation problems. Consequently, the river was dredged, with the spoils being placed on riverine levees to increase their elevation and prevent flooding.

The increase in agricultural activity resulted in extensive population growth, and winter flooding rapidly became a serious threat to life and property. The Green Act (1868) and other measures were enacted to create levee and reclamation districts to fund the construction and maintenance of a levee system. Hence, much of the remaining riparian forests were cleared to accommodate new, higher levees. Increased flood protection promoted more conversion of natural land for agriculture and urban uses. Ongoing reclamation and flood control activities and structure maintenance continued to reduce the extent of riparian vegetation. Increases in the acreage of irrigated land are correlated with riparian forest acreage declines (Figure A). By 1944, the Sacramento Valley Flood Control Project was nearly complete with 980 miles of levees, 438 miles of channels and canals, and seven bypasses totaling 95 miles in length (Kahrl 1979).

Declines After Construction of the CVP

A sizable proportion of the original riparian vegetation was eliminated before the first facilities of the CVP were constructed. However, 80 percent of the riparian vegetation remaining at that time has since been eliminated.

Causes of decline in Sacramento River riparian vegetation occurring after construction of the first facilities of the CVP include:

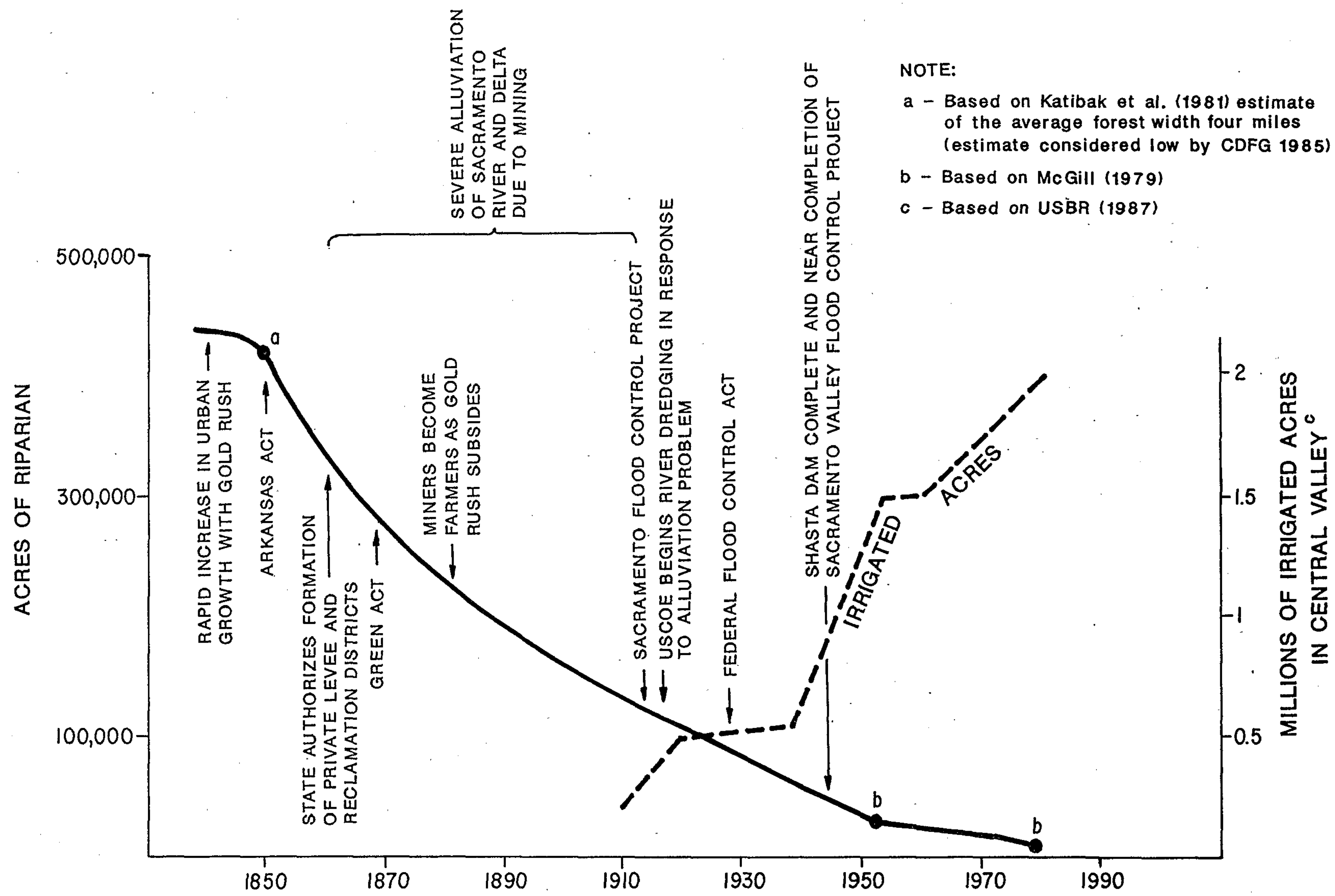

FIGURE A. CHANGES IN ACREAGE OF RIPARIAN VEGETATION ALONG THE MIDDLE SACRAMENTO RIVER AND IRRIGATED LAND IN THE SACRAMENTO VALLEY

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- o conversion of land to irrigated agricultural use, made possible in part through provision of CVP water, as well as provision of other supplemental surface water supplies, groundwater development, and flood protection;

- o flow regulation; and

- o construction and maintenance of levees, bank erosion, and bank protection projects. (See "Vegetation and Wildlife" section of Chapter 3.)

Through providing irrigation water, flood protection, and flow regulation, the CVP has played a role in contributing to declines in Sacramento River riparian vegetation, but it is not possible to clearly isolate and quantify impacts attributable to the CVP.

Table A shows increases in Sacramento Valley irrigated acreage. The 54-percent increase in the amount of irrigated land in the Sacramento Valley from 1944 to 1949 (Table A) contributed to reductions in riparian vegetation (McGill 1975).

State and federal water projects have eliminated riparian vegetation at impoundments and have also degraded riparian vegetation because of changes in flow volumes and seasonal timing of low and peak flows (Table B). It is not possible to quantify this effect because of a lack of knowledge of riparian forest dynamics, because riparian ecosystems along the affected rivers are still reequilibrating, and because the effects of state and federal projects and the effects of flow regulation cannot be separated from flood control requirements. Mechanisms responsible for the decline and degradation of riparian habitats discussed below are described in Chapter 4, "Vegetation and Wildlife."

Flow regulation along the Sacramento River has decreased the number and magnitude of winter peak flows and increased the frequency of flows that duplicate presumed average conditions (Katibah 1984, Buer et al. 1988). The peak runoff after storm events is reduced and extended over a longer period because of gradual reservoir releases. Presumably, the same effects have occurred on the lower American River. Summer flows along both rivers are higher than under natural conditions, and flow changes do not mimic natural fluctuations. Prior to CVP, flows declined gradually after snow melt throughout spring and summer. With regulated flows, water levels decline during late spring but increase again during mid-summer to late summer with increasing agricultural water needs. A final possible effect of CVP has been to decrease the amount of sediment deposition because most is trapped behind reservoirs. However, the effects of reduced sedimentation may be partially compensated for by the smaller floodplain along leveed rivers.

The effects of flow regulation on riparian vegetation must be viewed in the context of rivers confined to narrow floodplains by flood control levees. The finite floodplain limits the potential extent of riparian vegetation and habitat. Bank erosion has increased because of longer poststorm runoff and higher summer flows reducing the extent of high-terrace vegetation. Loss of high-terrace habitats is problematic in areas with a finite floodplain because losses may not balance gains. Researchers have documented acreage declines in high-terrace lands during the last 40 years (McGill 1979, Jones & Stokes Associates 1983). A second factor reducing the extent and vigor of riparian habitats involves the effects of reduced river meandering, point bar formation, and sediment deposition associated with regulated flows. Lower peak flows reduce the magnitude of these effects, which are

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Table A. Increases in Acreage of Irrigated Land in Sacramento Valley from 1944 to 1954

County	Total Irrigated Acres			Percent Increase in Irrigated Acres	
	1944	1949	1954	1944-1949	1949-1954
Butte	91,186	125,209	161,628	37	29
Colusa	79,794	97,347	138,929	22	43
Glenn	36,013	102,557	136,511	185	33
Sacramento	69,813	132,341	147,150	90	11
San Joaquin	245,598	388,326	430,565	58	11
Solano	32,519	55,150	79,971	70	45
Sutter	124,333	168,868	192,534	36	14
Tehama	29,850	38,850	50,766	30	31
Yolo	102,771	139,483	172,218	36	23
Total	811,877	1,248,131	1,510,272	54	21

Table B. Probable Impacts of CVP Facilities on Wetland and Riparian Habitats

Division/Unit	Facility	Direct Impact Area[a]	Year Completed	Drainage Affected	Probable Effects on Wetlands[b]			Probable Effects on Riparian Vegetation[b]		
					Facility Site	Inundation Area	Downstream	Facility Site	Inundation Area	Downstream
American River Division	Folsom Dam and Reservoir	11,450 ac	1956	American River	X	X		X	X	X
	Nimbus Dam and Lake Natoma	540 ac	1955	American River	X	X		X	X	X
	Sly Park Dam and Jenkinson Lake	650 ac	1955	Sly Park Creek	X	X		X	X	X
	Camp Creek Diversion Dam	ND	1953	Camp Creek	X			X		X
	Camino Conduit	7 mi	1955	Sly Park Creek	X			X		
Auburn-Folsom South Unit	Sugar Pine Dam and Reservoir	142 ac	Ca. 1981	North Shirttail Canyon	X	X	X	X	X	X
	Folsom-South Canal	27 mi	1973	American River	X					
Delta Division	Delta Cross Channel	1.2 mi	1951	Sacramento River	X			X		
	Contra Costa Canal	48 mi	1948	Rock Slough	X			X		
	Delta-Mendota Canal	116 mi	1951	Sacramento River	X			X		
	Contra Loma Dam	81 ac	1967	Small Creek		X			X	X
	Martinez Dam	14 ac	1947	Sacramento River	X	X	X	X	X	X
	Clayton Canal	5 mi	1948	Rock Slough	X			X		
	Ygnacio Canal	5 mi	1948	Rock Slough	X			X		
Friant Division	Friant Dam and Millerton Lake	4,900 ac	1942	San Joaquin River	X	X	X	X	X	X
	Friant-Kern Canal	151 mi	1951	San Joaquin River	X			X		
	Madera Canal	36 mi	1945	San Joaquin River	X			X		

Table B. Continued

Division/Unit	Facility	Direct Impact Area[a]	Year Completed	Drainage Affected	Probable Effects on Wetlands[b]: Facility Site	Inundation Area	Downstream	Probable Effects on Riparian Vegetation[b]: Facility Site	Inundation Area	Downstream
Sacramento Canals Unit	Red Bluff Diversion Dam	ND	1964	Sacramento River				X		
	Corning Canal	21 mi	1959	Sacramento River	X			X		
	Tehama-Colusa Canal	66 mi	Ca. 1981	Sacramento River	X			X		
San Luis Unit	San Luis Dam and Reservoir	13,000 ac	1967	Sacramento-San Joaquin Delta	X	X	X	X	X	X
	O'Neill Dam and Forebay	2,250 ac	1967	San Luis Creek	X	X	X	X	X	X
	San Luis Canal	101 mi	1968	San Luis Creek	X			X		
	Coalinga Canal	12 mi	1973	San Luis Creek	X			X		
	Panoche Detention Dam	188 ac	1966	Little Panoche Creek	X	X	X	X	X	X
	Los Banos Detention Dam	470 ac	1965	Los Banos Creek	X	X	X	X	X	X
	O'Neill Forebay Inlet Channel	0.5 mi	1966	San Luis Creek	X			X		
	Pleasant Valley Intake Channel	2 mi	1969	San Luis Creek	X			X		
Shasta/Trinity River Division	Shasta Dam and Reservoir	29,740 ac	1945	Sacramento River	X	X	X	X	X	X
	Keswick Dam and Reservoir	640 ac	1950	Sacramento River	X	X	X	X	X	X
	Trinity Dam	16,535 ac	1962	Trinity River	X	X	X	X	X	X
	Lewiston Dam and Lake	750 ac	1963	Trinity River	X	X	X	X	X	X
	Whiskeytown Dam and Lake	3,220 ac	1963	Clear Creek	X	X	X	X	X	X

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Table B. Continued

Division/Unit	Facility	Direct Impact Area[a]	Year Completed	Drainage Affected	Probable Effects on Wetlands[b]			Probable Effects on Riparian Vegetation[b]		
					Facility Site	Inundation Area	Downstream	Facility Site	Inundation Area	Downstream
	Spring Creek Debris Dam and Reservoir	87 ac	1963	Spring Creek	X X	X	X	X X		
	Cow Creek Main Aqueduct	8 mi	1966	Cow Creek	X		X			
	Clear Creek South Main Aqueduct	9 mi	1967	Clear Creek	X			X		

ND = Not determined.

[a] Inundation area in acres if reservoir, length in miles if canal.

[b] Based on McKevitt pers. comm.

responsible for providing a constant source of new habitat (and hence vegetation) to replace less productive, senescent habitats and land lost to bank erosion. Without these rejuvenation processes, a long-term decline in the proportion of young, actively growing communities could reduce the net productivity and carrying capacity of riparian habitats.

Overview of Post-CVP Changes in Riparian Vegetation

From 1946 to 1980, riparian vegetation along the reach of the Sacramento River from Colusa to Red Bluff decreased by approximately 1,600 acres, from 12,000 to 10,400 acres within the 35,000-acre area that encompassed the presumed 50-year meander belt (Jones & Stokes Associates 1983). From 1952 to 1977, high- and low-terrace riparian vegetation was reduced in extent from 27,720 to 11,140 acres along the reach from Redding to Colusa (McGill 1979). Today, the current acreage of Sacramento River riparian vegetation represents about 2 percent of its historic extent (McGill 1979, McCarten and Patterson 1987). O'Brien, Puckett and Stone (1976) documented an average decline of 430 acres from 1972 to 1979 (McGill 1979). This rate slowed to 410 acres per year from 1972 to 1979 (McGill 1979). A recent survey documented 14,592 acres of riparian vegetation from Verona to Redding (McCarten and Patterson 1987). Riparian habitat acreage for the entire Central Valley (including tributary drainages) includes 53,000 acres of mature woodland and another 49,000 in a degraded condition (Katibah 1984).

Today, the Sacramento River retains little of its original character. The lower river, below its confluence with the Feather River, is channelized and confined by an artificial levee system. Vegetation is nonexistent in many areas and is represented by senescing, cottonwood forests and herbaceous-shrubby scrub. Point bars are nearly absent. Of the 60 river miles in this reach, about 15 support narrow bands of vegetation averaging 30 feet wide (Jones & Stokes Associates 1987).

Along the 85-mile-long middle Sacramento River above the Feather River confluence, levees closely border the channel except where they are set back across the bases of major meander loops. Although the channel no longer migrates along this reach, the processes of bank erosion and point bar formation continue. Vegetation occurs in narrow bands, with some wider tracts. Woody riparian vegetation is sparse along 19 miles and dense and relatively "natural" appearing along the remaining 76 miles (Jones & Stokes Associates 1987).

Along the upper river from Colusa to Red Bluff, the river meanders through alluvial deposits between widely spaced levees. Large tracts of riparian vegetation occur along this reach, although about 10 percent of the area has scant amounts of woody vegetative cover.

Riparian vegetation above Red Bluff is either confined by foothills to a narrow area bordering the channel or spread over wider floodplains where tributaries enter. The mostly natural vegetation is nearly continuous along this reach, although large areas were eliminated for agricultural uses between Cottonwood Creek and the town of Anderson.

Presettlement Condition

Some tributaries of the Sacramento River sustained changes directly or indirectly tied to the CVP; these include the American and Trinity Rivers and Clear Creek.

American River Historically, the American River floodplain supported a several-mile-wide tract of riparian vegetation, including extensive valley oak forests at and surrounding the City of Sacramento (Thompson 1962). Above the City of Folsom the riparian vegetation was confined to a considerably narrower area by canyon sideslopes.

Trinity River Riparian vegetation along the Trinity River was historically restricted to the narrow terraces adjacent to the inner floodplain and consisted primarily of upland forest species not dependent on water in the floodplain aquifer. Floodplain vegetation was precluded because the highly mobile gravel substrates were reworked and redeposited by winter floods that uprooted or pulverized in-channel vegetation (Frederickson Kamine & Associates Inc. 1980).

Clear Creek The upper portion of Clear Creek supported a narrow, nearly continuous band of riparian vegetation that lined the river banks within the narrow floodplain of the foothill canyon in which it flowed. Vegetation along the upper reach consisted of a mix of riparian forest (e.g., willows, cottonwoods, alders, sycamores) with upland forest species (e.g., Douglas fir, interior live oak, big-leaf maple).

The lower portion of the river where it enters the Sacramento Valley had a relatively wide floodplain that supported wide belts of riparian forest similar to that of the Sacramento River. Point bars and low terraces supported willow-cottonwood vegetation, while upper terraces had valley oak or mixed riparian forests.

Declines Along Tributary Drainages Predating the CVP

American River Riparian vegetation along the American River suffered the same fate as that described above for the Sacramento River. During the late 1800s, gold mining caused extensive losses. Dredge-style gold mining continued into the twentieth century and combined with urban and agricultural expansion and construction of flood control levees to eliminate a considerable amount of the remaining acreage. Substantial losses during the later part of the twentieth century resulted from dam construction and impoundment at the present site of Folsom Lake and gravel mining of old dredge tailings. By the 1940s riparian vegetation was reduced to a narrow band along the river corridor.

Trinity River and Clear Creek Riparian vegetation was not common on the Trinity River and Clear Creek. These streams do not have extensive floodplains with deep, fertile soils. Dredger mining essentially eliminated riparian vegetation along portions of Clear Creek. Although the vegetation never fully recovered, riparian forests have developed on the dredge tailings.

Declines After Construction of the CVP

Information documenting declines or changes along tributary drainages after the CVP is limited.

American River Construction of the Folsom and Nimbus Dams inundated extensive riparian habitat and vegetation (Table B). During 1962, the American River Parkway was established, which provided protection for the remaining riparian vegetation. The extent of riparian vegetation along the lower American River has increased since the 1960s, but increases are mostly attributable to recovery from earlier gravel mining and the protection afforded by the American River Parkway.

Trinity River and Clear Creek The CVP had major effects on flow regimes in Trinity River, substantially reducing peak winter flow volumes and maintaining relatively constant summer flows. Under natural conditions the intense winter floods prevented the establishment of riparian-dependent vegetation along the river channel. Following construction of Clair Engle Reservoir, riparian vegetation encroachment was documented along the gravel bars in the river channel. Today, extensive willow-scrub vegetation lines most of the river, presumably establishing and persisting because of reduced flood intensity and the increased availability of summer water (Fredrickson Kamine & Associates, Inc. 1980). Construction of impoundments behind Trinity Dam, Lewiston Dam, and Wiskeytown Dam also eliminated riparian vegetation (Table B).

Historically, Clear Creek had peak flows during winter and early spring. Late-summer flows were marginal or nonexistent (Boyle Engineering 1986, Pelzman 1973).

Riparian Vegetation of the San Joaquin Valley Bottomland

The San Joaquin Valley was a region of bountiful resources. Reaches of the valley received runoff from surrounding mountains, and lush hardwood forests, riparian and marsh vegetation flourished. Outside the influenced of runoff and marsh areas, dryland communities occurred with grasslands and various types of shrublands. A study of the Tulare Basin in the southern half of the San Joaquin Valley (California Nature Conservancy, 1983) concluded that the current areal extent of native vegetation on the valley floor represents less than 5 percent of its historic distribution. Some remnants of native habitat may still be present along water courses.

Lakes, marshes, and sloughs once covered 5,000 square kilometers of the San Joaquin Valley. Before flood control activities, seasonal flooding occurred along streams, creating extensive wetlands.

The Grasslands Resource Conservation District area was an arid plain, dominated by grasses and low shrubs. In lowlands adjacent to the San Joaquin River large permanent native marshes existed. During the wet season, much of the area flooded, supporting a multitude of waterfowl and other wildlife. (Grasslands Water District 1986).

Tulare Lake, originally one of the largest lakes in California, occupied the southeastern portion of Kings County. It is recreated in flood years, such as 1983, when the lake bed grew to over 100 square miles. Several rivers drained to Tulare Lake; they included: the Kings, Tule, and Kern and Cross Creek and Avenal Creek. The lake had no natural outlet to the ocean and would overflow and drain to the San Joaquin River only in flood years. (Soil Conservation Service 1986). The lake provided an abundant water supply for wildlife and supported several riparian and marsh plant species. The Tulare Lake basin was and remains an important wintering area for ducks and shore birds.

Riparian vegetation in the valley consisted of wet soil plants in the marshes and along the sloughs. Plants of alkali sink, vernal pool, and prairie associations were present. Marshes in the valley supported large areas of bulrush or tule and cattail. trees and shrubs, including cottwood, willow, western sycamore, wild rose, California blackberry, and valley oak, grew along many of the streams and rivers. Vegetation the southern reaches of the valley were adapted to marsh and prairie habitat.

Presettlement Condition and Extent

Historically the valley supported vast communities of grassland, marsh, and riparian vegetation. Valley grasslands supported large herds of elk, antelope, and wild horses. Accurate records of the presettlement condition and extent of riparian vegetation are not available.

Declines Predating the CVP

The history of the decline of riparian vegetation in the San Joaquin Valley is closely associated with the history of settlement, flood control, reclamation, and agricultural and water development. By the early 1800's the natural landscape of the valley began to change rapidly. Early farms were dry farming enterprises which raised grain and cattle. Vast herds of feral livestock grazed so heavily in the Tulare Basin that native wildlife diminished as a result of habitat destruction, competition with domestic species, hunting, and extermination. Overgrazing permanently altered many basin habitats. Native bunch grasses disappeared and European grasses spread. (Pixley National Wildlife Refuge Master Plan 1984).

Irrigated agriculture began in the valley in the 1850's spurred by relatively inexpensive land available under the reclamation of tule lands because of the Arkansas Act of 1850. U. S. Bureau of Reclamation 1987). Water was diverted, trees were removed, and wildflower fields were plowed. By 1890, the impacts were significantly adverse.

The extent of Tulare Lake and its surrounding marshlands were radically altered, and the lake's salinity increased greatly. Saline water from irrigation return thus ruined the lake which had supported a large commercial fishing enterprise. By 1900, few fish survived in the saline water. (Pixley National Wildlife Refuge Master Plan 19984). The agricultural land boom continued through the 1920's. Irrigation using groundwater was introduced in Pleasant Valley area during this time and, since then, most of the land has been continuously cultivated. (Pleasant Valley Water District 1988).

The increase in agricultural activity resulted in extensive population growth. Increase flood protection along Tulare Lake, and the rivers of the San Joaquin Valley promoted additional conversion or natural land for agriculture and urban uses.

Declines After Construction of the CVP

A sizeable portion of the original riparian vegetation was eliminated before the first facilities of the CVP were constructed. Causes of decline in San Joaquin Valley riparian vegetation occurring after construction of the first facilities include:

- conversion of land to irrigated agricultural use, made possible in part through provision of CVP water, as well as provision of other supplemental surface water supplies, groundwater development, and flood protection;
- flow regulation; and
- construction of maintenance levees, bank erosion, and bank protection projects. (See "Vegetation and Wildlife" section of Chapter 3.)

Through improving irrigation water, flood protection, and flow regulation, the CVP has played a role in contributing to declines in San Joaquin River riparian vegetation, but it is not possible to clearly isolate and quantify the impacts attributable to the CVP alone.

Federal water projects (including projects by the Corps of Engineers) have also degraded riparian vegetation because of changes in flow volumes and seasonal timing of low and peak flows. (See Chapter 4, "Vegetation and Wildlife".)

Tributary Drainages of the San Joaquin River

Some tributaries of the San Joaquin River sustained changes directly or indirectly tied to the CVP; these include the Kings, Chowchilla, Fresnō, and Merced rivers. The riparian vegetation of the San Joaquin River also continues through several sloughs in the Grassland Resource Conservation District area. These are Mariposa, Mud, and Salt sloughs.

Riparian vegetation was common along the San Joaquin River and its tributaries before the advent of irrigated agriculture and flood control activities. Channelization and flood control has removed much of the natural vegetation along the rivers and sloughs. The rivers remain dry throughout most of the summer except for conveyance of timed agricultural irrigation flows. Natural vegetation and riparian forests occur along the upper reaches of the San Joaquin, Kings, Chowchilla, Fresno, and Merced rivers; however, the vegetation decreases or is non-existent where the rivers enter the valley trough. Dams and storage/flood control reservoirs have been constructed on the San Joaquin River (Millerton Lake), Chowchilla River (Buchhanan), Fresno River (Hidden), Merced River (Lake McClure), and Kings River (Pine Flat). The construction of these facilities has significantly altered river flow regimes. (U. S. Bureau of Reclamation 1987)

Riparian Vegetation of the San Francisco, San Pablo, and Suisun Bays and San Joaquin-Sacramento Delta

Presettlement Extent

Natural levees formed along the edges of many of the Delta's tule islands and supported woody riparian vegetation (Thompson 1961). Historic navigation charts show tall trees and shrubs along the banks of major channels of the Delta (Atwater and Hedel 1976). These same navigation charts do not show riparian trees in the tidal marshes of the Suisun, San Pablo, and San Francisco Bays. Presumably high salinity and poor soil aeration prevented establishment (Atwater and Hedel 1976). Scattered willows or cottonwoods may have been present, however.

Declines Predating the CVP

Presumably most of the woody riparian vegetation that existed in the Delta was eliminated early in California's settlement history to provide waterfront access farmland, and wood for fuel and construction.

Declines After Authorization of the CVP

No evidence exists of recent changes in the extent of riparian vegetation in the Bay and Delta areas.

Wetland Habitats in the Central Valley

Wetlands are water-dependent habitats that typically form the transition from open water to terrestrial habitats. Wetlands contain specific soil types that form in anaerobic conditions; support a prevalence of vegetation that habitually occurs in wetlands; and are permanently, or seasonally, inundated or have saturated soils. Marshes, vernal pools, and meadows are types of wetlands. The USFWS has attempted to standardize wetlands classifications (Cowardin et al. 1979) and is currently inventorying the extent of wetlands in California.

Presettlement Extent and Condition

Accurate delineation of historic wetlands in California is difficult because of a lack of authentic records. Estimates of the extent of California's historic wetlands range from 2 to 5 million acres of marsh and open-water wetlands (Figure B) (ESA/Madrone 1982, California Department of Fish and Game 1983). Presumably, the Central Valley supported 4 of the 5 million wetland acres that historically occurred in the state (ESA/Madrone 1983).

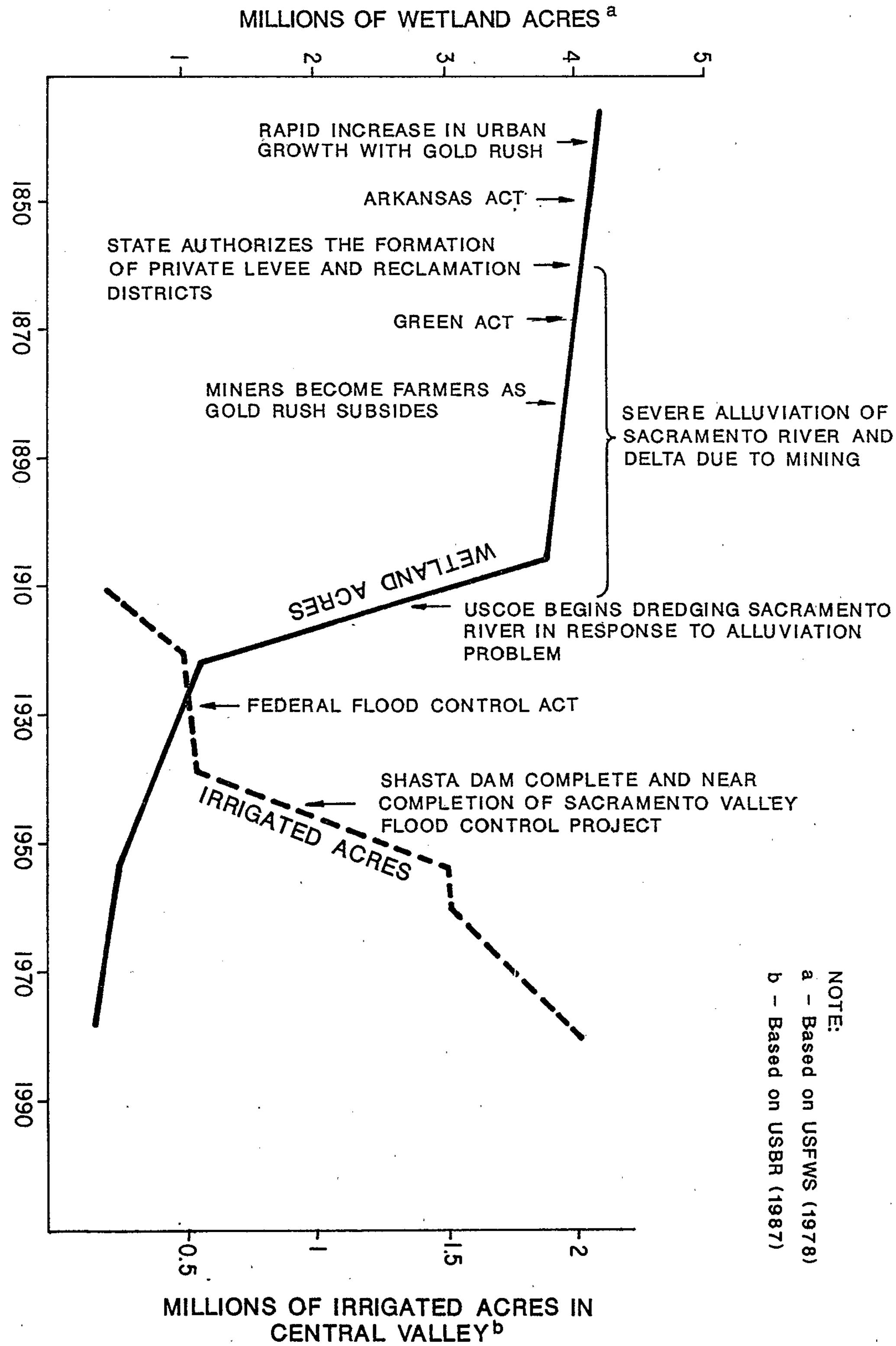

FIGURE B. CHANGES IN THE ACREAGE OF WETLANDS IN CALIFORNIA AND IRRIGATED LAND IN THE SACRAMENTO VALLEY

During years with normal rainfall, vast portions of the Central Valley became an inland sea as winter and spring runoff collected in lowland areas and slowly flowed toward the Delta. This unique condition caused the formation of extensive wetlands in low-lying areas such as the Butte Creek sink, Colusa basin, the Delta, and the Tulare Lake basin. Extensive marshlands formed behind the natural river levees throughout the Central Valley, and most of the Delta islands were marshy, some having a shrub overstory (California Department of Fish and Game and U. S. Fish and Wildlife Service 1980). The Central Valley supported 500,000 acres of marsh (Kahrl 1979), 300,000 of which occurred in the Delta with its more than 60 islands and over 700 miles of waterways (California Department of Fish and Game 1983). An additional area of the Central Valley was described as overflow lands because the area was flooded by winter and spring runoff. In 1871, the Secretary of the Interior accepted the State of California's claim of 2,192,506 acres of marsh and overflow lands under the Arkansas Act; a large proportion of this acreage occurred in the Central Valley (Thompson 1961). This claim was considered to be overstated.

Numerous other types of wetlands also existed within the CVP service area. Montane meadows were common in canyon bottoms along rivers and creeks. Seasonal wetlands such as vernal pools, alkali meadows, and valley sink scrub developed in the Sacramento Valley. Historic acreage figures for these habitats were never determined and were likely not included in the original estimates (U. S. Fish and Wildlife Service 1987).

Wetland Declines

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

About 2.5 million wetland acres were lost from 1906 to 1922 (ESA/Madrone 1982). The reasons for decline are numerous and parallel those described above for riparian habitats. The largest declines were induced by reclamation efforts spurred by the Arkansas and Green Acts, which stimulated growth and agricultural development in the late 1800s.

Flood control became a priority as population increased. Natural flooding, and that caused by sedimentation resulting from hydraulic mining, created the need for construction of artificial levees. These levees significantly altered the hydrology of the Sacramento Valley and Delta, eliminating the conditions that created wetlands.

Flood control, increased availability of summer water, the creation of extensive water delivery systems, the end of the Gold Rush, and the Arkansas Act spawned a dramatic increase in agriculture. A large proportion of the historic marshes and other wetland types were converted to farmland by the early 1900s. However, the unregulated construction of poorly designed levees, restrictions of rivers by alluvial debris from mines, and frequent flooding probably resulted in the creation of new wetlands that were good habitat for waterfowl and other wildlife.

The acreage of wetlands in the Central Valley declined steadily until the 1950s after authorization of the CVP (Figure B). Since the 1950s, the rate of loss has declined because of the perceived value and need to preserve marshlands. Today, the State of California supports about 450,000 acres of marsh-wetlands (U. S. Fish and Wildlife Service 1977), and the Central Valley about 294,000 acres (ESA/Madrone 1982). Seasonal wetlands are not included in this figure. Holland (1978) estimates that 5-30 percent of California's original vernal pools (a seasonal wetland) still remain.

Wetland Habitats in the Bay and Delta

Presettlement Extent and Condition

The San Francisco, Suisun, and San Pablo Bays historically supported about 313 square miles of estuarine and saltwater marsh and about 476 square miles of open water (ESA/Madrone 1982). The 84,000-acre Suisun Marsh is the largest freshwater marsh in California (California Department of Fish and Game 1983).

Wetland Declines

A major factor that reduced marshland acreage in the San Francisco and San Pablo Bays was increased urban growth. These areas were the sites of major shipping ports and rapid urbanization. Waterfront property was quickly developed, and marshes were diked for agriculture and salt mining. Further losses resulted from marshland filling and encroachment into the bays to accommodate population growth, military facilities, and housing needs (ESA/Madrone 1982).

Bay and Delta marshlands have also been impacted by hydraulic mining and Delta water exports. Mining caused the deposition of sediment through the area, which increased elevation of many marshes, probably changing their vegetation in the process (ESA/Madrone 1982). Delta water exports and upstream water removal reduced the volume of freshwater inflow, causing a gradual inward shift in the location of the saltwater/freshwater interface. Salinity directly influences the floristic composition of marshes (Atwater and Hedel 1976). Certain plant species are intolerant of saltwater and could have been eliminated locally by salinity changes.

In the San Francisco, San Pablo, and Suisun Bays, the extent of tidal wetlands has been reduced by 188 square miles (60 percent). This figure includes the addition of 79 square miles created by sedimentation and the artificial wetlands (ESA/Madrone 1982). If the original tidal marshes are considered, only 59 square miles (25 percent) exist today (ESA/Madrone 1982). It is not possible to clearly isolate or quantify the role of the CVP in causing these declines.

Historical Declines of Waterfowl

Changes Before CVP

Accounts of early settlers and explorers indicated that wetlands of the Central Valley supported a significantly larger and more dispersed waterfowl population than in recent times (California Department of Fish and Game 1983, U. S. Fish and Wildlife Service 1978, Jones & Stokes Associates 1987). Extensive reductions in wetlands and increases in market hunting contributed to a significant decline in these populations prior to 1900 (California Department of Fish and Game 1983). A survey conducted in 1913 estimated that duck populations had declined by 50 percent and goose populations by 75 percent from historic levels (California Department of Fish and Game 1983).

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 (U. S. Fish and Wildlife 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 mid-winter waterfowl population was estimated at 1.5 million in 1936 (Figure C).

Central Valley waterfowl populations increased rapidly for the next 20 years (Figure C). This increase resulted from several factors including favorable weather patterns on the Canadian breeding grounds and a reduction in hunters during World War II. 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, 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 to minimize crop depredation (California Department of Fish and Game 1983).

Changes Since CVP

By 1945, most of California's natural wetlands had been lost (Figure B). Concurrently, rice production increased from 240,000 acres in 1945 to approximately 555,000 acres in 1980 (California Department of Fish and Game 1983). Wintering waterfowl populations in the state increased until 1957, when drought conditions on the Canadian breeding grounds again reduced their populations (Figure C). 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 has plummeted since 1980, however, due to recent drought conditions on the Canadian prairies (Connelly pers. comm.).

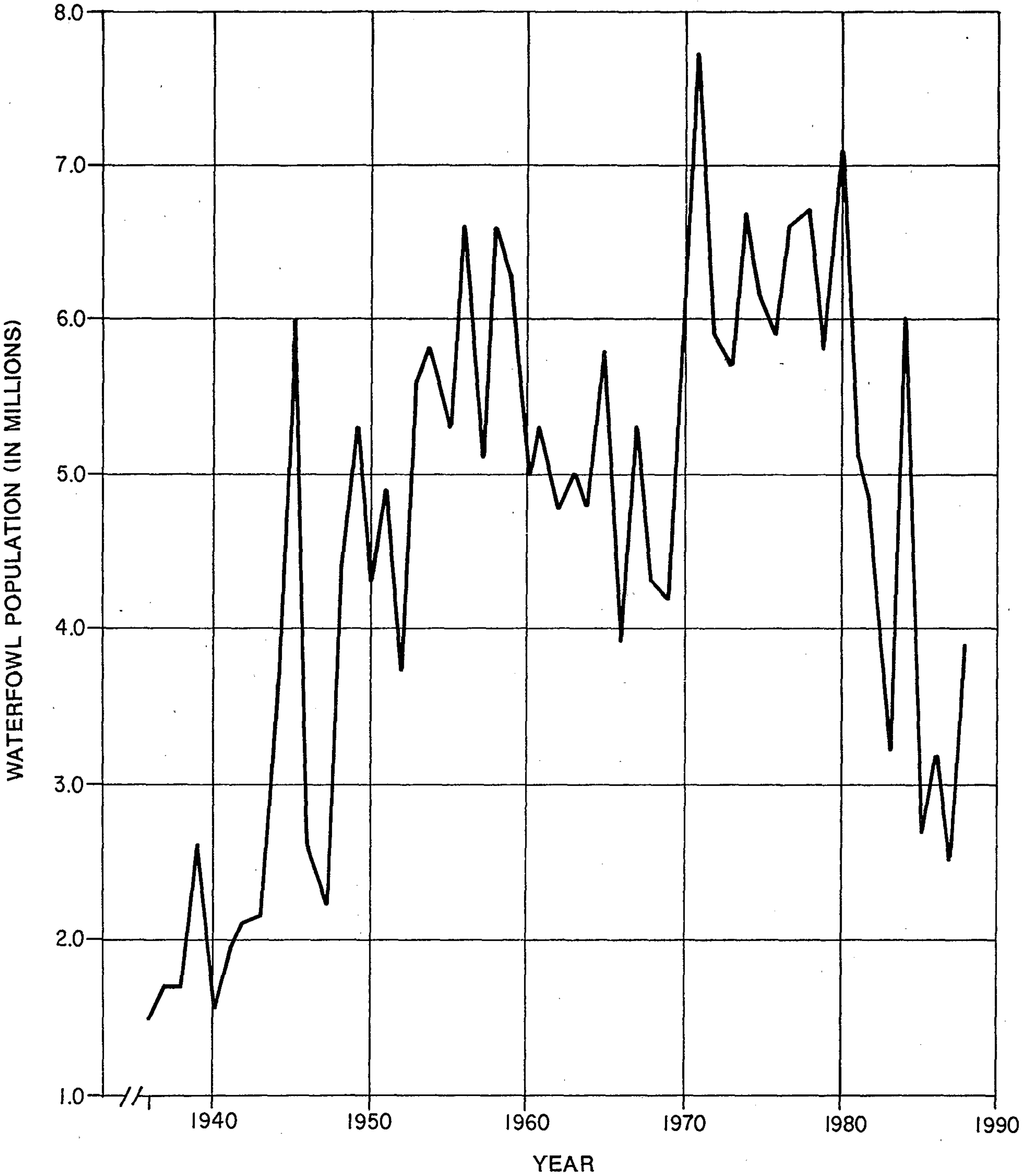

FIGURE C. NUMBER OF WATERFOWL IN CALIFORNIA DURING MID-WINTER SURVEYS

Source: DFG 1988, Connelly pers. comm.

Approximately 96 percent of the Central Valley's wetlands have been destroyed (see preceding section on "Wetland Habitats"), and many of the remaining areas are in degraded condition. Winter habitat for waterfowl 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 (U. S. Fish and Wildlife Service 1978). An additional 700,000 acres of wetlands may be available to waterfowl during high flood years (U. S. Bureau of Reclamation 1988).

The most dramatic loss of Central Valley waterfowl populations occurred prior to development of the CVP. The CVP played some role in contributing to more recent losses in Central Valley wetland habitat necessary for waterfowl, but this role cannot be isolated or quantified. (See preceding "Wetland Habitat" section.)

Special-Status Species

Of the special-status plant and wildlife species that occurred historically in the Central Valley, some were naturally rare. Others occurred in specialized, relatively uncommon habitats such as vernal pools or alkali meadows. A third group of special-status species was historically widespread in the Central Valley but rare today because previously common habitats have been substantially reduced due to land conversions for agricultural and urban uses.

A variety of special-status plant and wildlife species in the CVP service area are threatened with extinction or significant curtailment of their range. A number of factors contributed to declines in population.

Considering the types of habitats that have been inundated and the distribution of special-status species near CVP reservoirs, some direct losses have probably resulted from siting of CVP facilities or flow modifications. Additional populations may have been eliminated by reservoir or conveyance facility construction in the CVP system. These types of direct impacts are probably minimal compared to the effects of land conversions (e.g., creating new agricultural and urban areas) made possible by flood protection and increased water supplies.

Land conversions throughout the Central Valley have destroyed habitat for many plant and wildlife species.s Naturally rare species and those associated with specialized habitats probably suffered the most substantial declines. Loss of widespread habitats such as annual grasslands and oak woodland probably affected a smaller number of species and populations. This loss may have created rare species from historically common ones.

Many other factors (e.g., grazing, land conversions not associated with the CVP) have contributed to historical declines in Central Valley species populations. It is not possible to clearly isolate or quantify the role of the CVP in causing such declines.

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Cumulative Impacts on Vegetation and Wildlife

The following tables summarize cumulative impacts of water contracting alternatives in all three service areas on vegetation and wildlife resources.

Table C: Potential Cumulative Impacts to Natural Plant Communities in all Agencies (Excluding Refuges) as Compared to the No-Action Alternative. *

Plant Communities Resource/Service Area	No-Action **	Alternative 1-Option A	1-Option B	2	3	4A/B	4C/D	5	6	7
Riparian Habitat (linear feet)										
SRSA	-651,000	-445,950	-445,950	-378,950	-445,950	-378,950	NI	NI	-378,950	NI
ARSA	P	P	P	P	P	P	NI	NI	P	NI
DESA	P	NI	P	NI	P	P	P	NI	P	NI
Freshwater/Alkali Marsh (acres)										
SRSA	-1,098	-1,074	-1,074	-1,074	-1,074	-1,074	NI	NI	-1,074	NI
ARSA	P	P	P	P	P	P	NI	NI	P	NI
DESA	P	NI	P	NI	P	P	P	NI	P	NI
Open Water (acres)										
SRSA	-514	-105	-105	-105	-105	-105	NI	NI	-105	NI
ARSA	P	P	P	P	P	P	NI	NI	P	NI
DESA	P	NI	P	NI	P	P	P	NI	P	NI
Vernal Pools										
SRSA	P	P	P	P	P	P	NI	NI	P	NI
ARSA	P	P	P	NI	P	P	NI	NI	NI	NI
DESA	P	P	P	NI	P	P	P	NI	P	NI
Alkali meadows										
SRSA	P	P	P	P	P	P	NI	NI	P	NI
ARSA	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
DESA	P	NI	P	NI	P	P	P	NI	P	NI
Terrestrial (acres)										
SRSA	-39,080	-23,910	-23,910	-21,680	-23,910	-21,680	NI	NI	-21,680	NI
ARSA	P	P	P	P	P	P	NI	NI	P	NI
DESA	P	P	P	NI	P	P	P	NI	P	NI

Note: P = potential impact to unmeasured acreage.
NI = no impact.

SRSA = Sacramento River Service Area; ARSA = American River Service Area;
DESA = Delta Export Service Area

* All potential impacts are in addition to changes identified under the No-Action Alternative.

** Changes under the No-Action Alternative, these are not considered CVP-induced impacts.

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Table D: Potential Cumulative Impacts to Natural Plant Communities on Federal and State Refuges as Compared to the No-Action Alternative. *

Plant Community / Refuge	No-Action **	Alternative: 1-Option A	1-Option B	2	3	4A/B	4C/D	5	6	7
Riparian Habitat (linear feet)										
Colusa	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
Delevan	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
Gray Lodge	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
Sacramento	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
Sutter	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
DESA Refuges	P	NI	NI	NI	NI	NI	NI	NI	NI	NI
Freshwater/Alkaline Marsh (acres)										
Colusa	-2815	+2815	+2935	NI	+2815	+2935	+2815	+2935	+2815	+2935
Delevan	-3723	+3723	+4646	NI	+3723	+4646	+3723	+4646	+3723	+4646
Gray Lodge	-800	+2300	+3300	NI	+2300	+3300	+2300	+3300	+2300	+3300
Sacramento	-6745	+6745	+7145	NI	+6745	+7145	+6745	+7145	+6745	+7145
Sutter	-1912	+1912	+2092	NI	+1912	+2092	+1912	+2092	+1912	+2092
GRCD	0	0	0	0	0	0	0	0	0	0
Volta	0	0	50	0	0	50	0	50	0	50
Los Banos	- 1,000	+1,000	1,150	0	1,000	1,150	1,000	1,150	1,000	1,150
Kesterson	0	0	770	0	0	770	0	770	0	770
San Luis	-2,950	2,950	3,400	0	2,950	3,400	2,950	3,400	2,950	3,400
Merced	-680	680	1,140	0	680	1,140	680	1,140	680	1,140
Mendota	0	0	5,328	0	0	5,328	0	5,328	0	5,328
Tranquility	-80	80	80	0	80	80	80	80	80	80
Pixley	0	0	950	0	0	950	0	950	0	950
Kern	-2,800	2,800	4,200	0	2,800	4,200	2,800	4,200	2,800	4,200
Subtotal	-23,505	+25,005	+37,186		+25,005	+37,186	+25,005	+37,186	+25,005	+37,186
Open Water (acres)										
Colusa	-455	+455	+455	NI	+455	+455	+455	+455	+455	+455
Delevan	-53	+53	+53	NI	+53	+53	+53	+53	+53	+53
Gray Lodge	-2200	+2200	+2200	NI	+2200	+2200	+2200	+2200	+2200	+2200
Sacramento	-115	+115	+115	NI	+115	+115	+115	+115	+115	+115
Sutter	-73	+73	+73	NI	+73	+73	+73	+73	+73	+73
GRCD	0	0	0	0	0	0	0	0	0	0
Volta	0	0	150	0	0	150	0	150	0	150
Los Banos	-384	384	500	0	384	500	384	500	384	500
Kesterson	0	0	160	0	0	160	0	160	0	160
San Luis	-80	80	150	0	80	150	89	150	80	150
Merced	-20	20	60	0	20	60	20	60	20	60
Mendota	0	0	0	0	0	0	0	0	0	0
Tranquility	0	0	0	0	0	0	0	0	0	0
Pixley	0	0	0	0	0	0	0	0	0	0
Kern	0	0	0	0	0	0	0	0	0	0
Subtotal	-3380	+3380	+3916		+3380	+3916	+3389	+3916	+3380	+3916
Vernal Pools										
Colusa	NC	NI	P	NI	NI	P	NI	P	NI	P
Delevan	NC	NI	P	NI	NI	P	NI	P	NI	P
Gray Lodge	NC	NI	P	NI	NI	P	NI	P	NI	P
Sacramento	NC	NI	P	NI	NI	P	NI	P	NI	P
Sutter	NC	NI	P	NI	NI	P	NI	P	NI	P
Alkali meadows										
Colusa	NC	NI	P	NI	NI	P	NI	P	NI	P
Delevan	NC	NI	P	NI	NI	P	NI	P	NI	P
Gray Lodge	NC	NI	P	NI	NI	P	NI	P	NI	P
Sacramento	NC	NI	P	NI	NI	P	NI	P	NI	P
Sutter	NC	NI	P	NI	NI	P	NI	P	NI	P
All Refuges except:	NC	NI	NI	NI	NI	NI	NI	NI	NI	NI
Pixley	NC	NC	P	NC	NC	P	NC	P	NC	P
Kern	NC	P	P	NI	P	P	P	P	P	P
Terrestrial (acres)										
Colusa	NC	NI	P	NI	NI	P	NI	P	NI	P
Delevan	NC	NI	P	NI	NI	P	NI	P	NI	P
Gray Lodge	NC	NI	P	NI	NI	P	NI	P	NI	P
Sacramento	NC	NI	P	NI	NI	P	NI	P	NI	P
Sutter	NC	NI	P	NI	NI	P	NI	P	NI	P
GRCO	NC	P	P	NI	P	P	P	P	P	P
Volta	NC	NC	P	NI	NC	P	NC	P	NC	P
Los Banos	NC	P	P	NI	P	P	P	P	P	P
Kesterson	NC	NC	P	NI	NC	P	NC	P	NC	P
San Luis	NC	P	P	NI	P	P	P	P	P	P
Merced	NC	P	P	NI	P	P	P	P	P	P
Mendota	NC	NC	P	NI	NC	P	NC	P	NC	P
Tranquility	NC	P	P	NI	P	P	P	P	P	P
Pixley	NC	NC	P	NI	NC	P	NC	P	NC	P
Kern	NC	P	P	NI	P	P	P	P	P	P

Note: P = potential impact to unmeasured acreage.

NC = no change

NI = no impact

SRSA = Sacramento River Service Area; ARSA = American River Service Area;
DESA = Delta Export Service Area.

* All potential impacts are in addition to changes identified under the No-Action Alternative.

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Table E: Potential Cumulative Impacts to Special Status Plant and Wildlife Species (Excluding Refuges) as Compared to the No-Action Alternative.*

Special-Status Species	No-Action **	Alternative 1-Option A	1-Option B	2	3	4A/B	4C/D	5	6	7
Plants										
SRSA	24	5	5	5	5	5	0	0	5	0
ARSA	19	5	5	5	5	5	0	0	5	0
DESA	13	0	0	0	0	13	13	0	13	0
Wildlife										
SRSA	19	5	5	4	5	4	0	0	4	0
ARSA	10	0	0	0	0	0	0	0	0	0
DESA ***	14	1	1	1	1	14	14	0	14	0

Note: Cell entries specify the number of species potentially affected.

SRSA = Sacramento River Service Area
ARSA = American River Service Area
DESA = Delta Export Service Area.

* All potential impacts are in addition to changes identified under the No-Action Alternative.

** Changes under the No-Action Alternative, these are not considered CVP-induced impacts.

Table F: Potential Cumulative Impacts to Special Status Plant and Wildlife Species in State and Federal Wildlife Refuges.

Special-Status Species	No-Action *	Alternative 1-Option A +	1-Option B #	2 ^	3 +	4A/B #	4C/D +	5 #	6 +	7 #
Plants										
Colusa	10	0	6	0	0	6	0	6	0	6
Delevan	10	0	7	0	0	7	0	7	0	7
Gray Lodge	9	0	6	0	0	6	0	6	0	6
Sacramento	10	0	7	0	0	7	0	7	0	7
Sutter	2	0	0	0	0	0	0	0	0	0
Volta	1	3	3	0	3	3	3	3	2	3
Los Banos	1	3	3	0	3	3	3	3	2	3
Kesterson	1	3	3	0	3	3	3	3	2	3
San Luis	1	3	3	0	3	3	3	3	2	3
Merced	1	3	3	0	3	3	3	3	2	3
Mendota	1	4	7	0	4	7	4	7	4	7
Pixley	0	4	4	0	4	4	4	4	4	4
Kern	1	4	4	0	4	4	4	4	4	4
Wildlife										
Colusa	9	0	0	0	0	0	0	0	0	0
Delevan	9	0	0	0	0	0	0	0	0	0
Gray Lodge	9	0	0	0	0	0	0	0	0	0
Sacramento	9	0	0	0	0	0	0	0	0	0
Sutter	9	0	0	0	0	0	0	0	0	0
Volta **	4	2	2	0	2	2	2	2	2	2
Los Banos **	3	1	1	0	1	1	1	1	1	1
Kesterson **	8	5	5	0	5	5	5	5	5	5
San Luis **	7	3	3	0	3	3	3	3	3	3
Merced **	6	3	3	0	3	3	3	3	3	3
Mendota **	4	1	1	0	1	1	1	1	1	1
Pixley **	3	6	6	0	6	6	6	6	6	6
Kern **	4	6	6	0	6	6	6	6	6	6

Note: Cell entries specify the number of species potentially affected.

* The No-Action Alternative assumes no wetland acreage in the refuges.
+ Assumes wetland acreages in the refuges would be maintained at 1985 base conditions (Alternative 1 - Option A, 3, 4C/D, and 6).
^ Compared to the No-Action Alternative, no new impacts to special-status species would occur.
# Assumes some existing uplands acreage would be converted to new wetlands (Alternative 1-Option B, 4A/B, 5, and 7).
** Invertebrates not included.