

CONCEPT PLAN FOR WATERFOWL HABITAT PROTECTION

San Francisco Bay, California

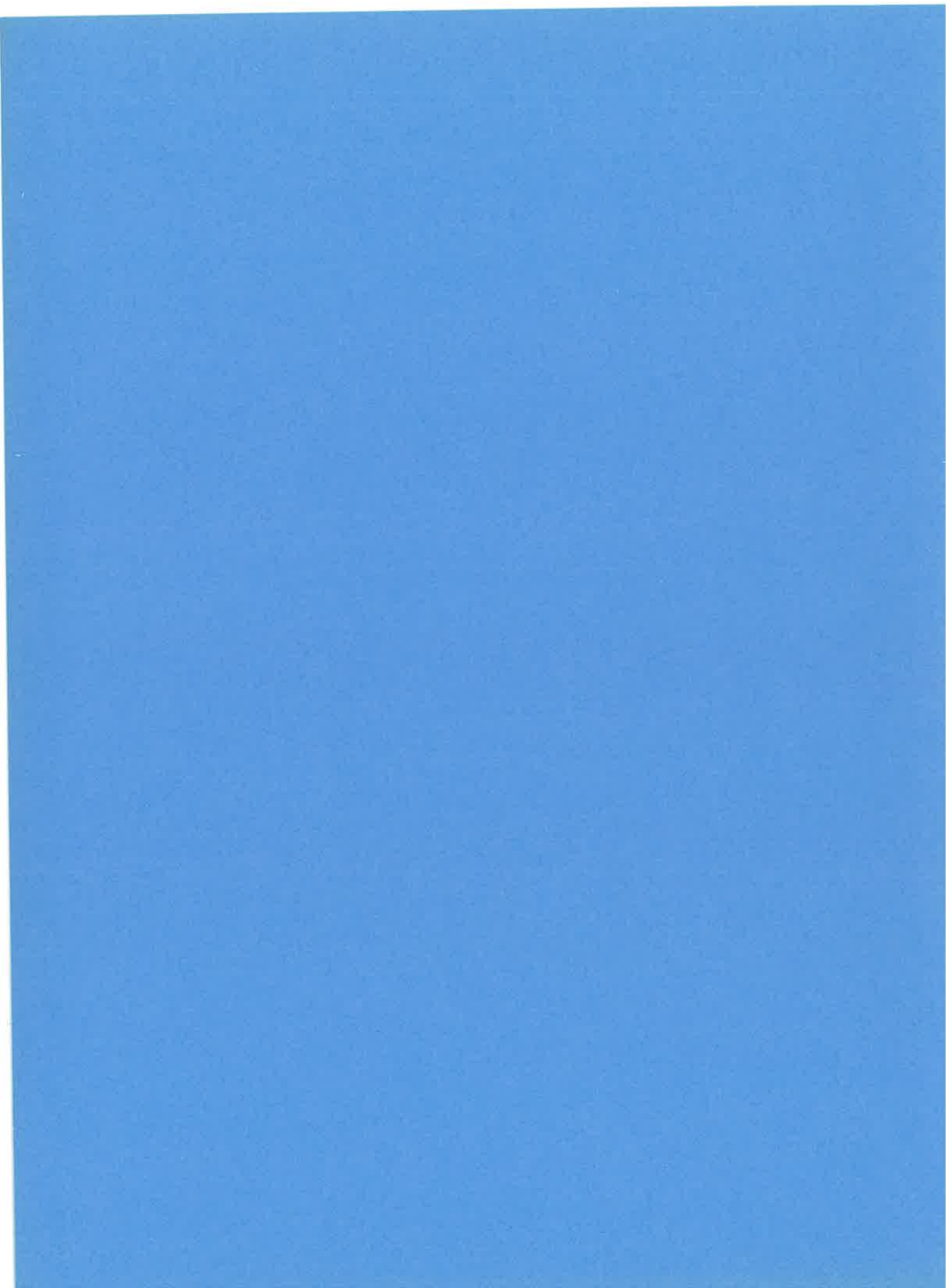


North American
Waterfowl Management Plan
Category 27



United States Department of the Interior
U.S. Fish and Wildlife Service

Portland, Oregon
November 1989



CONCEPT PLAN
FOR
WATERFOWL HABITAT PROTECTION

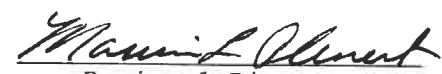
SAN FRANCISCO BAY, CALIFORNIA

PRIORITY CATEGORY 27

PREPARED BY

U.S. FISH AND WILDLIFE SERVICE

PORTLAND, OREGON


Regional Director

CONCEPT PLAN FOR WATERFOWL HABITAT PROTECTION
SAN FRANCISCO BAY, CALIFORNIA

NORTH AMERICAN WATERFOWL MANAGEMENT PLAN
CATEGORY 27

U.S. FISH AND WILDLIFE SERVICE
REGION 1
PORTLAND, OREGON

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"SOME FORTY YEARS AGO, A MAN NAMED ALDO LEOPOLD WROTE A BOOK SOME OF YOU MAY HAVE HEARD OF. IT WAS CALLED A SAND COUNTY ALMANAC. IN IT, HE TALKED ABOUT VALUES -- VALUES THAT I THINK YOU AND I SHARE. 'THAT LAND IS TO BE LOVED AND RESPECTED,' LEOPOLD WROTE, 'IS AN EXTENSION OF ETHICS.' THAT WAS FORTY YEARS AGO. SINCE THEN, MILLIONS OF ACRES OF WETLANDS, HABITAT FOR SO MANY PLANTS AND ANIMALS, HAVE DISAPPEARED. AND THEY CONTINUE TO VANISH AT AN ALARMING RATE -- SOME ONE-HALF MILLION ACRES A YEAR.

I WANT TO ASK YOU TODAY WHAT THE GENERATIONS TO FOLLOW WILL SAY OF US FORTY YEARS FROM NOW. IT COULD BE THAT THEY WILL REPORT THE LOSS OF MANY MILLION ACRES MORE. THE EXTINCTION OF SPECIES. THE DISAPPEARANCE OF WILDERNESS AND WILDLIFE.

OR THEY COULD REPORT SOMETHING ELSE. THEY COULD REPORT THAT, SOMETIME AROUND 1989, THINGS BEGAN TO CHANGE. THAT WE BEGAN TO HOLD ON TO OUR PARKS AND REFUGES. THAT WE PROTECTED OUR SPECIES. AND THAT, IN THAT YEAR, THE SEEDS OF A NEW POLICY ABOUT OUR VALUABLE WETLANDS WERE SOWN -- A POLICY SUMMED UP IN THREE SIMPLE WORDS: 'NO NET LOSS.' I PREFER THE SECOND VISION OF AMERICA'S ENVIRONMENTAL FUTURE."

President George Bush, speaking at the Sixth International Ducks Unlimited Waterfowl Symposium, Arlington, Virginia, June 8, 1989.

PREFACE

The continental population of waterfowl is in serious decline. The 1989 fall-flight index of ducks in North America is estimated at 64 million, substantially down from 66 million in 1988 and 74 million in 1987. These duck populations are well below the North American Waterfowl Management Plan objective of over 100 million. In 1989 the Pacific Flyway midwinter survey of ducks totalled 3.4 million, a record-low index, and 46 percent below the long-term average (1955-1988). A multitude of impacts, both in the breeding grounds and in nonbreeding habitats like San Francisco Bay, have created a bleak outlook for many species of waterfowl and other wetland-dependent wildlife.

In February 1979, the U.S. Fish and Wildlife Service developed the "Concept Plan for Waterfowl Wintering Habitat Preservation, California Coast," which included San Francisco Bay. This current effort updates the San Francisco Bay portion of the 1979 plan. The principal objectives of this Concept Plan for Waterfowl Habitat Protection are to (1) identify important waterfowl habitats occurring within the San Francisco Bay, California study area, (2) document other fish and wildlife species that utilize wetlands and associated habitats of the San Francisco Bay Area, (3) lay out a framework plan for the preservation, restoration, and enhancement of important wetland habitats critical to the perpetuation of the waterfowl resource of the Pacific Flyway, and (4) establish goals and strategies to achieve waterfowl and other fish and wildlife resource objectives for the study area.



WATERFOWL

This plan was developed under the guidance of the North American Waterfowl Management Plan. The North American Plan was signed by the Secretary of the Interior for the United States and by the Minister of the Environment for Canada, in May 1986. The North American Plan recognized that waterfowl are the most prominent and economically important group of migratory birds, as well as being critical indicators of a healthy environment. The North American continent has experienced a tremendous alteration of its varied wetland landscapes, and it is imperative that activities which destroy or degrade habitats for waterfowl and many other species of wildlife be reversed.

The North American Plan recognizes that although the conservation of habitat is the pressing imperative in maintaining and restoring waterfowl populations, other factors, also, must be addressed. Harvest management is clearly important, and governmental agencies must continue to ensure that regulations and enforcement adequately maintain abundance and diversity of waterfowl populations for all users. Environmental pollution can cause significant impacts to waterfowl and other wetland wildlife, whether it be through broad-scale degradation of habitats or through direct effect on birds, such as with oil spills or exposure to toxic chemicals. Additionally, control of predation and disease are important factors in population management.

The San Francisco Bay Area is one of 34 Waterfowl Habitat Areas of Major Concern (#27) in Canada and the United States identified in the North American Waterfowl Management Plan. The study area for this project is defined as the immediate watershed for San Francisco and San Pablo Bays as shown in Figure 1. The study area has been further subdivided into north and south units and a Bay Zone which rings the Bay. The San Francisco-Oakland Bay Bridge divides the north and south units (Figure 2). The Suisun Bay and Sacramento-San Joaquin Delta are not included in this study but are a part of the Central Valley (Sacramento and San Joaquin River Watershed) Habitat Area of Major Concern (#26). The Central Valley of California is one of the top priority areas for waterfowl habitat protection under the North American Plan. A Central Valley Waterfowl Habitat Joint Venture is currently being implemented. The California Coast north of San Francisco Bay is included in the Middle and Upper Pacific Coast Habitat Area of Major Concern (#29).

San Francisco Bay is a major, coastal, wintering area for Pacific Flyway waterfowl. The Bay Area is also a place where over 5,780,000 people live, work, and recreate. The Association of Bay Area Governments estimates that by the year 2000 the Bay Area's population will be over 6,450,000. The demands of this growing population and the needs of wildlife and other resources often conflict. As a result of the filling and diking of Bay Area wetlands and the conversion of wetlands to urban and agricultural uses, thousands of acres of seasonal wetlands, mudflats, and tidal marshes have been lost. Additionally, nine animal and plant species associated with San Francisco Bay wetlands are federally listed as endangered under the Endangered Species Act, and 28 plant and animal species associated with Bay Area wetlands are proposed or candidates for Federal listing. (See Appendices A and B).

This report presents objectives for maintaining and enhancing those wetlands currently protected (see Table 6) and sets forth the objectives for protecting and restoring additional wetland areas (see Table 8). Achievement of these objectives is necessary if the broader goals of the North American Plan are to be met.

The California Department of Fish and Game cooperated in the preparation of this plan through their Region 3 and Sacramento offices. Special thanks to Carl Wilcox and Jim Swanson of the California Department of Fish and Game, for their input during preparation of this plan.

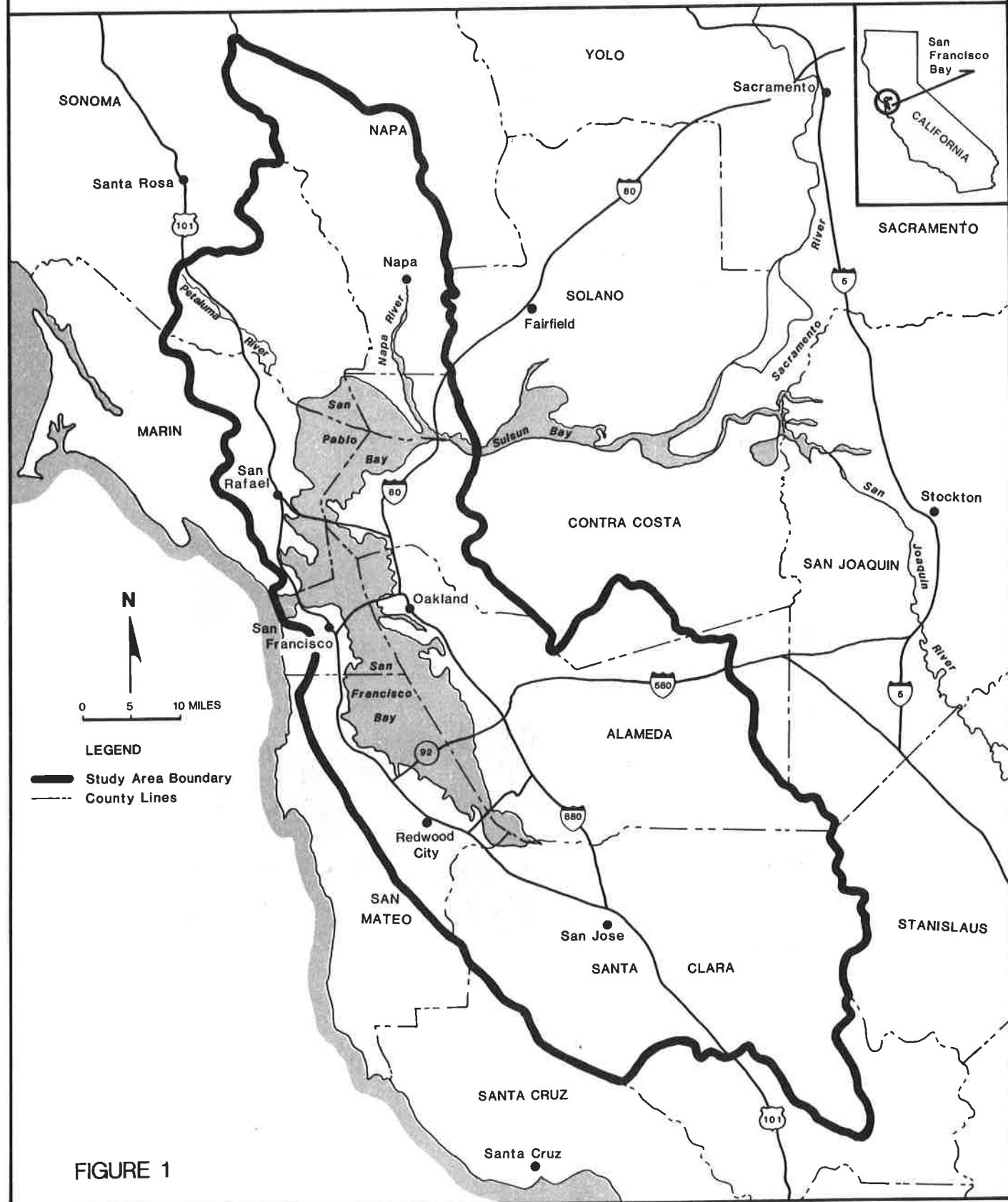
Additional information was provided by various groups and agencies through the review of an earlier draft of this report. These groups included: San Francisco Bay Chapter of the Sierra Club, Bay Area representatives of the National Audubon Society, California Waterfowl Association, Save San Francisco Bay Association, Pt. Reyes Bird Observatory, and East Bay Regional Park District.

Additional assistance in the preparation of this plan was provided by Louise Accurso, Dick Bauer, Richard Coleman, Carol Curtis, Larry DeBates, Robin Gebhard, Larry Handley, Rick Morat, Al Mozejko, Harry Ohlendorf, Dennis Peters, Mary Peterson, Ruth Pratt, Felix Smith, Pete Sorensen, Jean Takekawa, and Ron Weaver of the U.S. Fish and Wildlife Service.



GREATER SCAUP

CONCEPT PLAN FOR WATERFOWL HABITAT PROTECTION SAN FRANCISCO BAY STUDY AREA



SAN FRANCISCO BAY ZONE

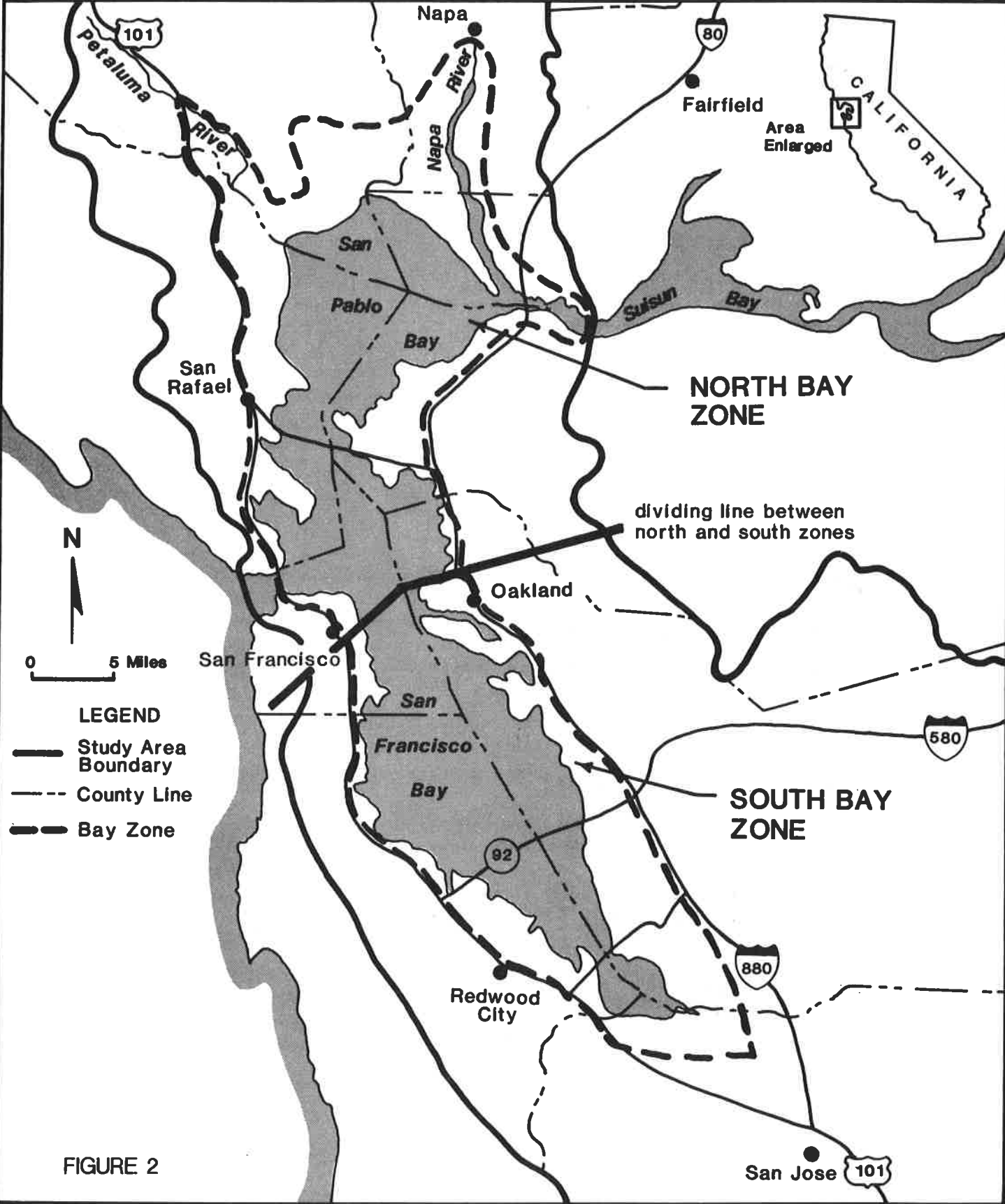


FIGURE 2

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DESCRIPTION OF WATERFOWL USE

The San Francisco Bay Area is one of the most important coastal wintering and migrational areas for Pacific Flyway waterfowl populations. Midwinter inventories of duck populations in the open water, salt ponds, tidal marshes, and seasonal wetland areas of the Bay have averaged 220,980 in recent years (Table 1). This average represents approximately 7.7 percent of all ducks in California (Table 1). Moreover, 41.7 percent of all diving ducks and 47.3 percent of all sea ducks recorded during the 1989 midwinter inventories in California were observed in the San Francisco Bay (Table 2).

San Francisco Bay is the most important wintering area for Pacific Flyway populations of canvasbacks (Figure 3). San Francisco Bay canvasback populations have averaged 18,466 during 1984-1989 midwinter inventories. Moreover, 66 percent of the canvasbacks recorded during the 1989 California midwinter inventory were observed in the San Francisco Bay Area. Other diving ducks and sea ducks observed in large numbers in the Bay include greater and lesser scaup, ruddy duck, scoter, and bufflehead. These ducks have averaged 73,761; 24,780; 29,667; and 3,907; respectively, during 1984-1989 midwinter inventories for San Francisco Bay. Northern shoveler, American wigeon, northern pintail, and gadwall are the most abundant dabbling ducks found in the area. These dabbling ducks have averaged 28,280; 14,912; 8,907; and 3,065; respectively, during 1984-1989 midwinter inventories for San Francisco Bay. Canada geese are observed in relatively small numbers around the Bay. However, large flocks of geese, numbering in the thousands, have been recorded around freshwater reservoirs within the study area. Swans are rare visitors to the area.

Table 1. MIDWINTER WATERFOWL INVENTORY DATA FOR PACIFIC FLYWAY, CALIFORNIA, AND SAN FRANCISCO BAY. NUMBERS REPRESENT TOTAL DUCKS COUNTED DURING AERIAL SURVEYS IN 1984 TO 1989.

YEAR	SAN FRANCISCO BAY*	CALIFORNIA	PACIFIC FLYWAY	SFB/CALIF PERCENTAGE**
1984	338,725	5,315,480	6,550,864	6.4%
1985	215,425	2,163,235	3,950,057	9.9%
1986	322,425	2,525,363	4,102,726	12.8%
1987	101,587	2,035,019	3,602,035	5.0%
1988	161,619	3,264,666	4,917,977	5.0%
1989	186,097	2,002,119	3,358,430	9.3%
AVERAGE 1984-1989	220,980	2,884,314	4,413,682	7.7%

* Does not include population surveys from Suisun Marsh or the Delta.

** San Francisco Bay as a percentage of the total California population.

Table 2. MIDWINTER WATERFOWL INVENTORY DATA FOR SAN FRANCISCO BAY, CALIFORNIA, AND PACIFIC FLYWAY IN 1989.

SPECIES	SAN FRANCISCO BAY*	CALIFORNIA	PACIFIC FLYWAY
Mallard	319	295,267	1,127,786
Gadwall	1,272	43,266	52,535
Wigeon	5,641	341,268	476,049
G-w Teal	151	206,670	257,439
B-w/Cin. Teal	23	4,558	4,620
Shoveler	30,379	209,793	213,533
Pintail	4,006	560,851	685,403
Wood Duck	0	258	562
Total Dabblers	41,791	1,661,931	2,817,927
Redhead	0	1,273	25,387
Canvasback	20,272	30,557	45,880
Scaup	62,728	108,982	143,363
R.-necked Duck	0	18,931	30,302
Goldeneye	231	1,034	34,327
Bufflehead	3,782	28,676	41,650
Ruddy Duck	23,170	74,444	80,832
Total Divers	110,183	263,897	401,749
Eider	0	0	2
Scoter	24,106	51,011	86,617
Oldsquaw	0	0	121
Harlequin	0	0	180
Total Seaducks	24,106	51,011	86,920
Merganser	67	7,489	29,633
Unidentified	9,950	17,791	22,201
Total Ducks	186,097	2,002,119	3,358,430
Total Geese	1	544,997	870,760
Total Swans	0	68,482	80,918
Coots	5,467	178,034	250,088
GRAND TOTAL	191,565	2,793,632	4,560,196

* Does not include population surveys from Suisun Marsh or the Delta. Freshwater reservoirs in the San Francisco Bay Area were not surveyed in the midwinter inventory.

CANVASBACKS COUNTED IN MID-WINTER INVENTORIES IN CALIFORNIA (1960-1989)

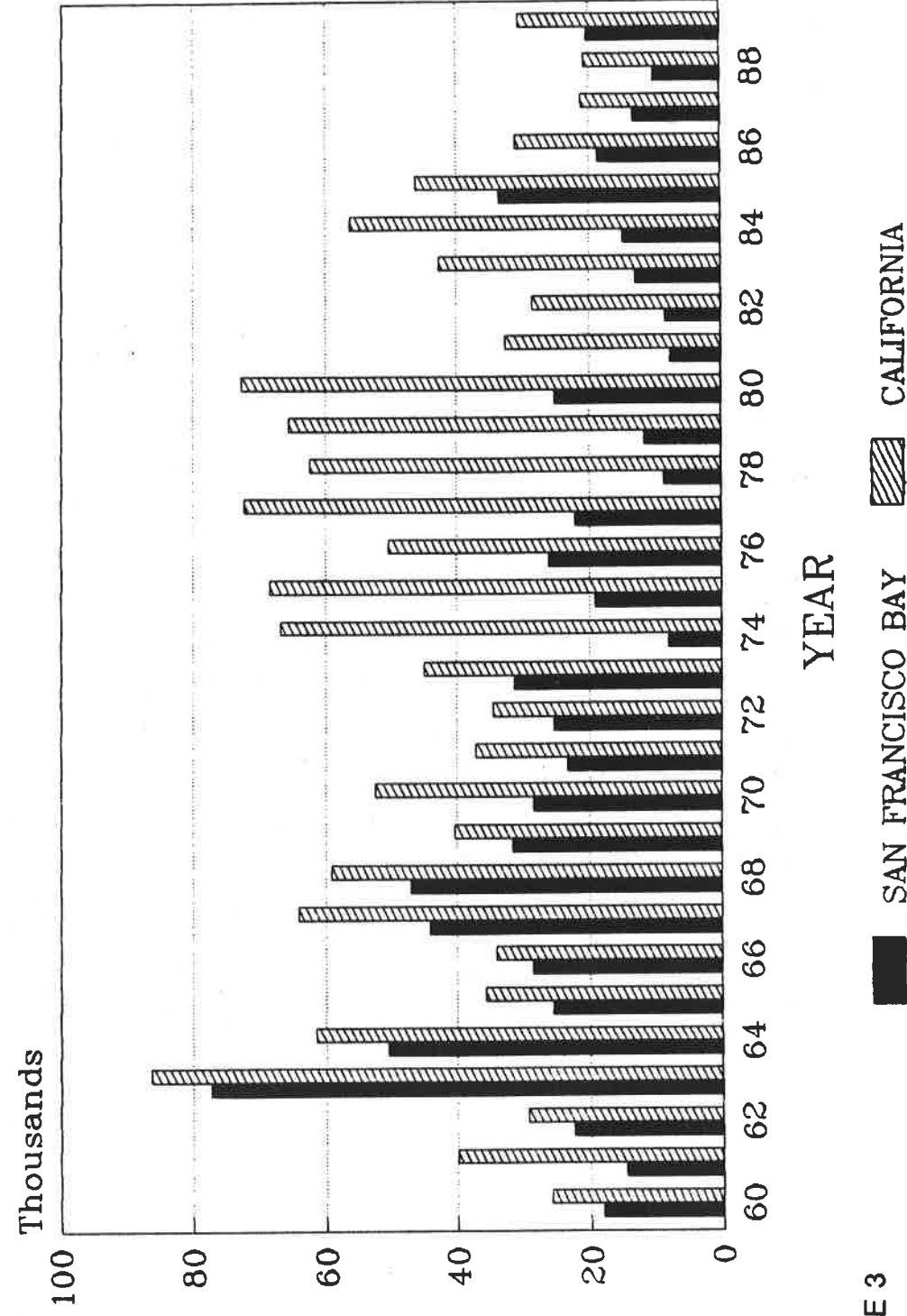


FIGURE 3

Wintering waterfowl make extensive use of the open water, salt ponds, and tidal marsh areas around the Bay. Seasonal wetlands around the Bay Area also provide essential foraging habitat for a number of waterfowl species. Most dabbling ducks are concentrated in salt ponds and seasonal wetlands, while most diving ducks and sea ducks utilize the lower salinity salt ponds and open-water areas of the Bay. Several species of waterfowl move between the various wetland habitats of San Francisco Bay as well as Suisun Bay, the Delta, and the Central Valley in response to changing seasons, weather, water conditions, and food availability.

Large staging concentrations of northern pintail (up to 30,000 birds) have been observed in North Bay salt ponds and open-water areas during September and October. The movement of pintail concentrations out of the area often coincides with the onset of heavy, winter rains. These large, early fall concentrations of northern pintail have not been observed in recent years. The majority of northern shovelers, American wigeons, and ruddy ducks winter in South Bay salt ponds. Canvasback populations are highest in the salt ponds and open-water areas of the North Bay early in the season and may shift to areas with more freshwater influence later in the season. Scaup and surf scoters are most numerous in the open-water areas throughout the Bay.

Waterfowl production in the San Francisco Bay Area is typically limited to small numbers of mallard, gadwall, northern pintail, cinnamon teal, and ruddy ducks. Tidal marshes, diked wetlands, and seasonal wetlands are of primary importance to nesting waterfowl. In addition, Canada geese have been observed nesting around the area in recent years.

San Francisco Bay is of particular importance to the future of canvasbacks and other diving duck populations along the Pacific Flyway. San Francisco Bay wetlands can play a significant role in meeting the overall objective of providing diverse habitats and spreading waterfowl populations over large geographical areas. The protection of stable wintering habitat in the Bay will help meet population goals and objectives outlined in the North American Waterfowl Management Plan for a number of species. Additional foraging and resting areas in the San Francisco Bay study area must be secured, and existing waterfowl habitat must be enhanced to meet the waterfowl population and habitat protection objectives of the North American Waterfowl Management Plan.

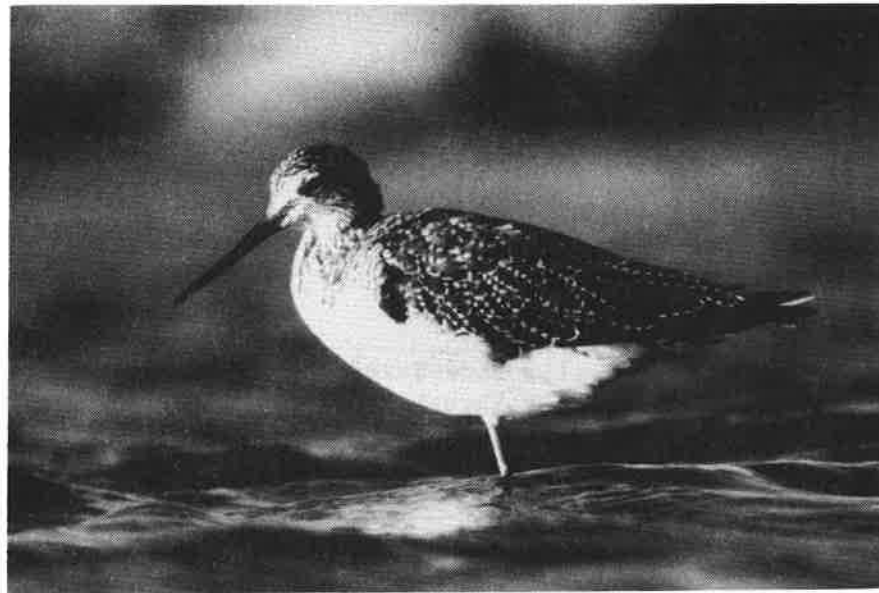
DESCRIPTION OF SPECIES OTHER THAN WATERFOWL

LISTED SPECIES

Wetlands and surrounding uplands within the San Francisco Bay study area provide habitat for 14 federally listed endangered species, and 2 threatened species (Table 3). Thirteen of these 16 federally listed species also are listed as endangered by the State of California. Probably the most prominent of the listed species are the California clapper rail, California least tern, and salt marsh harvest mouse. The California black rail is listed by the State as threatened and is currently a candidate for Federal listing. The majority of listed and proposed species in Table 3 are associated with Bay Area wetlands. Federal and State-listed species are described in Appendix A.

OTHER SPECIES OF CONCERN

Appendix B lists species that are currently candidates for Federal listing under the Endangered Species Act of 1973. Candidate species are not afforded legal protection under the Act. In the San Francisco Bay Area, 16 fish and wildlife species and 59 plant species are candidates, or proposed candidates, for endangered or threatened status. Of the fish and wildlife species, 15 of 16 candidates are associated with wetlands. However, of the 59 candidate plants, only 13 species are wetland inhabitants.



YELLOWLEGS

Table 3. ENDANGERED, THREATENED, AND RARE SPECIES IN THE SAN FRANCISCO BAY STUDY AREA.

Species	Status*	Habitat Type	Location**
<u>Birds</u>			
Aleutian Canada goose	E,SE	Wet/Upl***	N,S
American peregrine falcon	E,SE	Wet/Upl	N,S
California brown pelican	E,SE	Wetland	N,S
California clapper rail	E,SE	Wetland	N,S
California least tern	E,SE	Wet/Upl	N,S
California black rail	ST	Wetland	N,S
<u>Mammals</u>			
Salt marsh harvest mouse	E,SE	Wet/Upl	N,S
<u>Reptiles</u>			
San Francisco garter snake	E,SE	Wet/Upl	S
<u>Fish</u>			
Winter-run chinook salmon	T,SE****	Open Water	N,S
<u>Invertebrates</u>			
Bay checkerspot butterfly	T	Upland	S
San Bruno elfin butterfly	E	Upland	S
Mission blue butterfly	E	Upland	N,S
California freshwater shrimp	E,SE	Wetland	N
<u>Plants</u>			
San Mateo thornmint	E,SE	Upland	S
Large-flowered fiddleneck	E,SE	Upland	S
Presidio manzanita	E,SE	Upland	N
Palmate-bracted bird's-beak	E,SE	Wetland	S
Mason's quillwort	SR	Wetland	N

* Status: E - Federally Endangered SE - State Endangered
T - Federally Threatened ST - State Threatened
SR - State Rare

** Location Within Study Area: N - North Bay, S - South Bay

*** Wet/Upl - Wetland/Upland

**** Emergency Listed Effective August 4, 1989 - April 2, 1990

The State of California also maintains lists of species-of-special-concern. Several Federal candidate species are included in this State list. Like Federal candidate species, State species-of-special-concern are not afforded protection under the California Endangered Species Act. The State species-of-special-concern list is intended for use as a management tool. When land use decisions are made, these species should be given special consideration. Appendix C lists State species-of-special-concern that occur within the San Francisco Bay study area.

OTHER IMPORTANT FISH AND WILDLIFE RESOURCES

In addition to waterfowl and endangered, threatened, and rare species, the San Francisco Bay study area supports numerous other wildlife species. Probably the most obvious group found throughout the North and South Bays is wintering and migratory shorebirds which use the extensive intertidal mudflats, salt ponds with their associated levees, and diked, seasonal wetlands of the Bay. The Pt. Reyes Bird Observatory counted an estimated 600,000 to 1,200,000 shorebirds during an April 1988 survey of San Francisco Bay (Stenzel and Page 1988). Over 70 percent of these shorebirds were found in the South Bay. The Pt. Reyes Bird Observatory also conducted a shorebird census in September 1988. Although the fall count for the San Francisco Bay Area was 45% of the April 1988 survey (375,966 birds), 76% of all birds counted in this Northern and Central Coast survey were in the San Francisco Bay Area (Stenzel *et al.* 1989). A second springtime shorebird survey was conducted by the Observatory in April 1989; over 930,000 shorebirds were observed along the tidal mudflats and adjacent wetland areas (Page *et al.* 1989). Nesting species include the black-necked stilt, American avocet, killdeer, and snowy plover.

San Francisco Bay has recently been designated as a Hemispheric Site by the Western Hemisphere Shorebird Reserve Network (Network). The Network is a voluntary collaboration of government and private organizations that are committed to shorebird conservation. The Hemispheric Site designation gives international recognition to San Francisco Bay as a critically important, shorebird habitat and promotes the cooperative management and protection of the area as an integral part of an international reserve network.

Numerous other wetland-associated wildlife species occur in the study area. Colonial nesting birds include the snowy egret, great egret, black-crowned night-heron, great blue heron, western gull, California gull, Forster's tern, Caspian tern, and double-crested cormorant. The most important marine mammal associated with wetlands and deepwater habitats of the study area is the harbor seal. This species uses tidal salt marshes and mudflats for breeding and hauling grounds, and deepwater habitats for foraging. Wetland-associated raptors include the northern harrier, red-tailed hawk, short-eared owl, black-shouldered kite, and burrowing owl.

Wetlands and deepwater habitats of the study area also provide important habitat for a wide variety of fish and shellfish. Salt marshes and shallow-water areas provide habitat for larvae, young, juvenile and adult fishes, and shellfish; included are shiner perch, top smelt, staghorn sculpin, striped bass, and bay shrimp. Intertidal and subtidal areas of the North Bay, in particular, provide spawning substrate for the Pacific herring. Important commercial or sport fishes that utilize deepwater habitats include northern anchovy, starry flounder, striped bass, king salmon, sturgeon, steelhead, and American shad.

DESCRIPTION OF HABITAT

HABITAT TYPES AND VALUES

Most of the important wetland habitats of the San Francisco Bay study area occur within what has been identified as the "Bay Zone" (Figure 2). The Bay Zone was first delineated in a wetland trend analysis currently being prepared by the Service (U.S. Fish and Wildlife Service 1988). The Bay Zone is bounded by major highways and railroads, and includes approximately 85 percent of the contiguous wetlands around the Bay. All of these wetland habitats support essential needs such as forage, cover, and resting and nesting sites for waterfowl and other migratory birds. This section defines the wetland habitat types of the Bay Area, their extent, and their habitat values.

Eight wetland and deepwater habitat types have been delineated for the San Francisco Bay Zone. These are: (1) open water of the Bay (i.e. estuarine subtidal); (2) lakes, rivers, and ponds; (3) intertidal mudflats (i.e. estuarine intertidal, not vegetated, not diked); (4) tidal salt marsh (i.e. estuarine emergent, not diked); (5) seasonal wetlands (i.e. estuarine emergent, diked and nonestuarine wetlands); (6) farmed wetlands; (7) riparian habitat (i.e., palustrine, woody vegetation); and (8) salt ponds. Acreages for each of these habitat types in North and South San Francisco Bay are listed in Table 4. The distribution of these habitat types is shown in Figures 4 and 5 for the North and South Bays, respectively.

Most of the acreage of wetland and deepwater habitats within the San Francisco Bay Zone is about equally divided between the North and South Bays with the exception of tidal salt marsh, farmed wetlands, and salt ponds (Table 4). Over 16,000 acres of tidal salt marsh occur in the North Bay compared to 8,600 acres in the South Bay. Major salt marshes in the North Bay include Petaluma Marsh, the Napa Marshes, and San Pablo Bay marshes. Tidal marshes of Gallinas Creek, Corte Madera, Wildcat and San Pablo Creeks, and Southampton Bay also provide significant habitat for wildlife. In the South Bay, however, tidal salt marshes are more fragmented and generally confined to narrow bands of vegetation bordering tidal sloughs. A few larger salt marsh blocks remain, including portions of Bair Island, Greco Island, the mouth of Mt. Eden Creek, the Cooley Landing-Palo Alto Baylands area, Mowry Slough, and Dumbarton Point.

In the North Bay, over 25,000 acres of farmed wetlands occur primarily north of San Pablo Bay and provide seasonal habitat for waterfowl and other migratory birds. In the more densely urbanized South Bay, only about 1,300 acres of this habitat type remain. By contrast, the South Bay contains over 27,000 acres of salt ponds (formerly tidal salt marsh) compared to approximately 9,000 acres of salt ponds in the North Bay.

Table 4. SAN FRANCISCO BAY ZONE DEEPWATER HABITATS AND WETLANDS*

=====			
-----Acreage-----			
Habitat Type	North Bay	South Bay	Total
Deepwater Habitats:			
Open water	101,994	93,220	195,214
Lakes, reservoirs & ponds	<u>2,374</u>	<u>2,262</u>	<u>4,636</u>
Subtotal	104,368	95,482	199,850
Wetlands:			
Intertidal mudflats	28,008	30,379	58,387
Tidal salt marsh	16,333	8,600	24,933
Seasonal wetlands**	9,611	8,902	18,513
Farmed wetlands	25,828	1,317	27,145
Riparian wetlands	103	171	274
Salt ponds	<u>9,027</u>	<u>27,497</u>	<u>36,524</u>
Subtotal	88,910	76,866	165,776
Grand Total	193,278	172,348	365,626

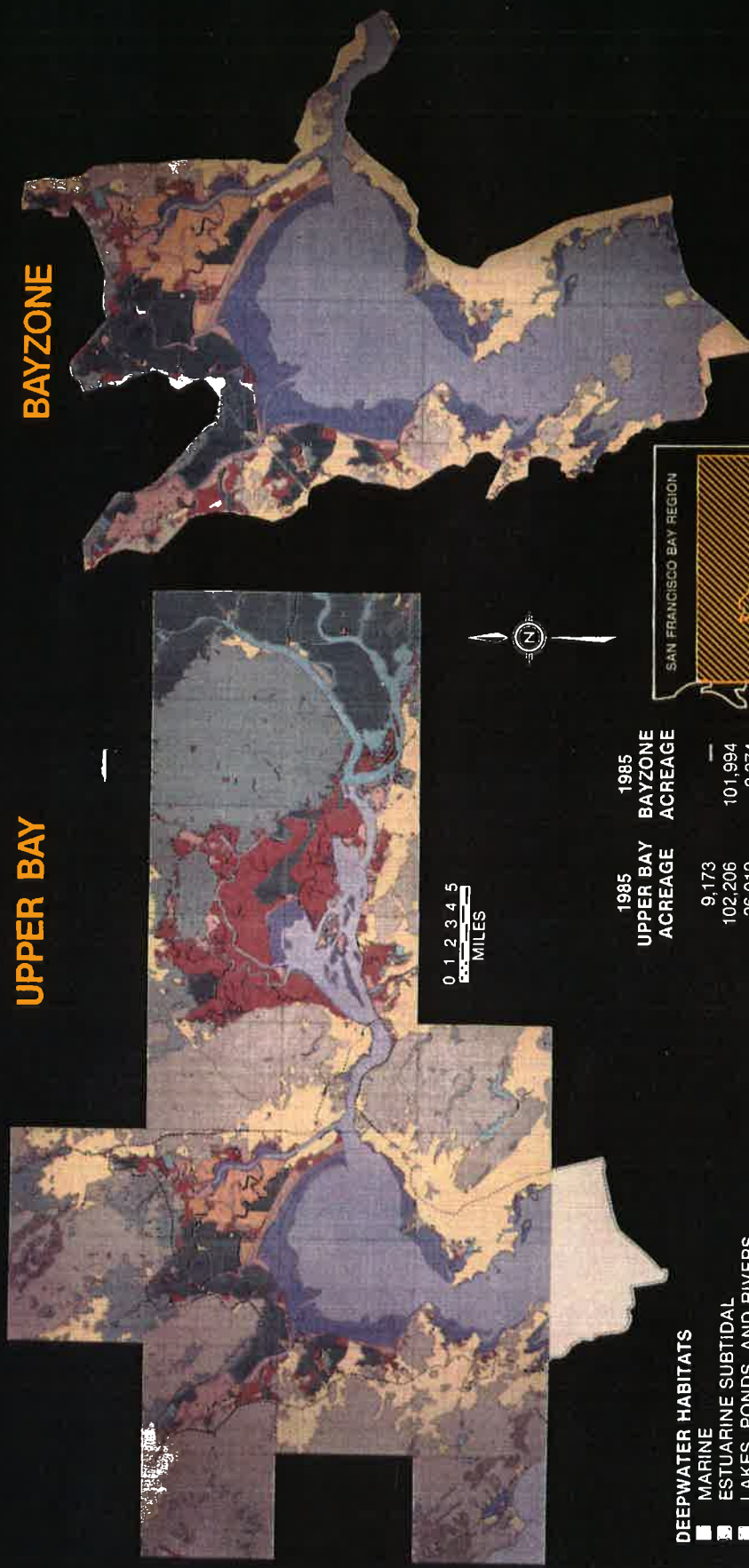
* Source: U.S. Fish and Wildlife Service (1988).

** Seasonal wetlands include diked, former tidelands and seasonally inundated wetlands outside the historic bay margin.

NORTH SAN FRANCISCO BAY HABITATS — 1985

UPPER BAY

BAYZONE



11

- DEEPWATER HABITATS**
- MARINE
- ESTUARINE SUBTIDAL
- LAKES, PONDS, AND RIVERS
- WETLANDS**
- ESTUARINE INTERTIDAL, NON-VEGETATED, NOT DIKED
- ESTUARINE EMERGENT, NOT DIKED, AND AQUATIC BEDS
- ESTUARINE EMERGENT, DIKED, AND NON-ESTUARINE WETLANDS
- FARMED WETLANDS
- PALUSTRINE WOODY VEGETATION
- SALT PONDS
- UPLANDS**
- URBAN
- UPLAND AGRICULTURE
- UPLAND FOREST
- UPLAND RANGE

	1985 UPPER BAY ACREAGE	1985 BAYZONE ACREAGE
Marine	9,173	—
Estuarine Subtidal	102,206	101,994
Lakes, Ponds, and Rivers	26,019	2,374
Estuarine Intertidal, Non-vegetated, Not Diked	34,111	28,008
Estuarine Emergent, Not Diked, and Aquatic Beds	26,990	16,333
Estuarine Emergent, Diked, and Non-estuarine Wetlands	62,902	9,611
Farmed Wetlands	78,008	25,828
Palustrine Woody Vegetation	1,578	103
Salt Ponds	9,027	8,999
Urban	149,165	46,454
Upland Agriculture	131,236	4,418
Upland Forest	13,461	324
Upland Range	257,627	18,072



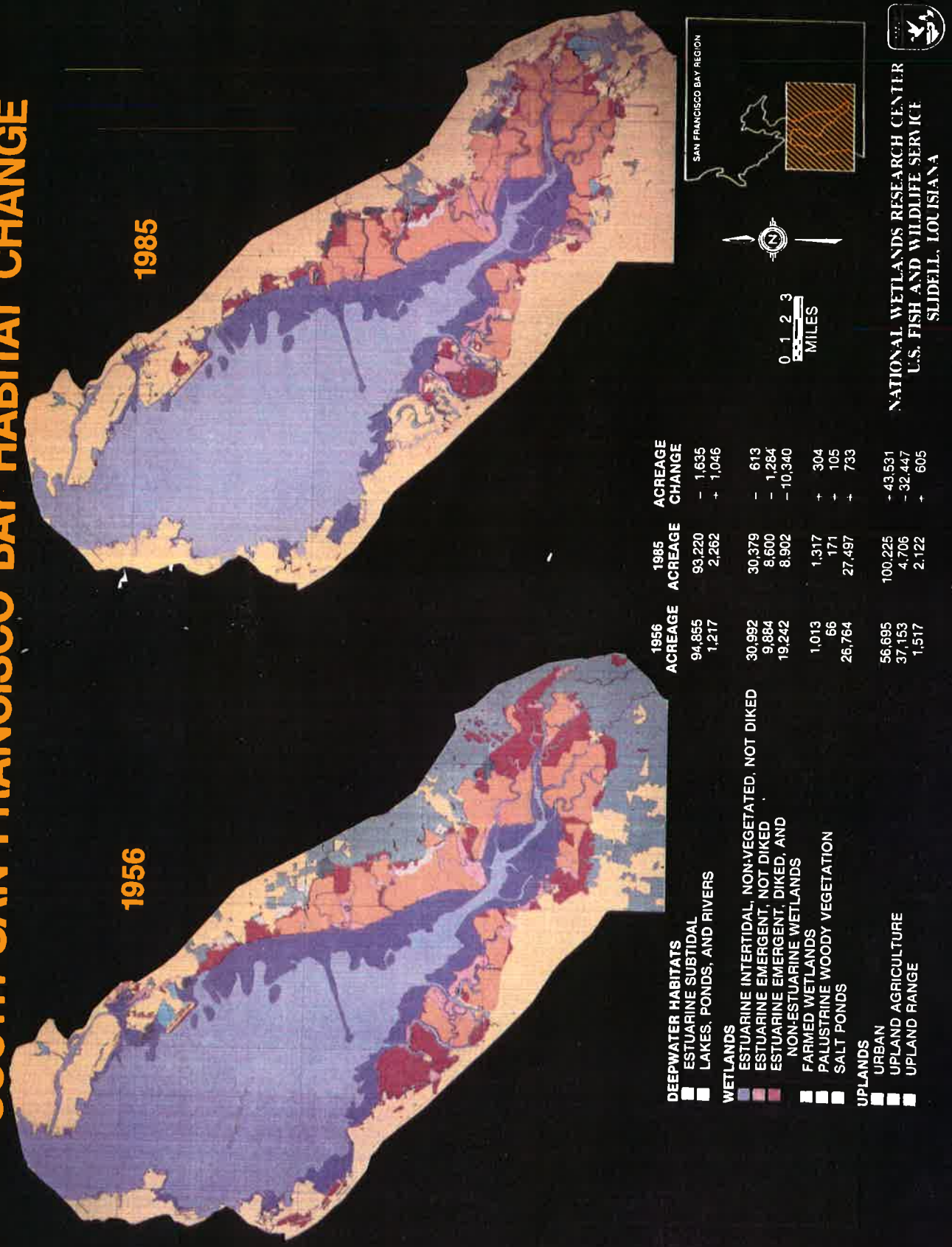
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NATIONAL WETLANDS RESEARCH CENTER
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SLIDELL, LOUISIANA

Figure 4

SOUTH SAN FRANCISCO BAY HABITAT CHANGE

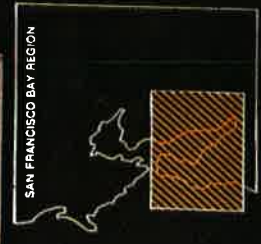


1956

1985

- DEEPWATER HABITATS**
- ESTUARINE SUBTIDAL
 - LAKES, PONDS, AND RIVERS
- WETLANDS**
- ESTUARINE INTERTIDAL, NON-VEGETATED, NOT DIKED
 - ESTUARINE EMERGENT, NOT DIKED
 - ESTUARINE EMERGENT, DIKED, AND NON-ESTUARINE WETLANDS
 - FARMED WETLANDS
 - PALUSTRINE WOODY VEGETATION
 - SALT PONDS
- UPLANDS**
- URBAN
 - UPLAND AGRICULTURE
 - UPLAND RANGE

	1956	1985	ACREAGE CHANGE
ESTUARINE SUBTIDAL	94,855	93,220	- 1,635
LAKES, PONDS, AND RIVERS	1,217	2,262	+ 1,046
ESTUARINE INTERTIDAL, NON-VEGETATED, NOT DIKED	30,992	30,379	- 613
ESTUARINE EMERGENT, NOT DIKED	9,884	8,600	- 1,284
ESTUARINE EMERGENT, DIKED, AND NON-ESTUARINE WETLANDS	19,242	8,902	- 10,340
FARMED WETLANDS	1,013	1,317	+ 304
PALUSTRINE WOODY VEGETATION	66	171	+ 105
SALT PONDS	26,764	27,497	+ 733
URBAN	56,695	100,225	+ 43,531
UPLAND AGRICULTURE	37,153	4,706	- 32,447
UPLAND RANGE	1,517	2,122	+ 605



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SLIDELL, LOUISIANA

Figure 5

Of the eight wetland and deepwater habitat types found in the San Francisco Bay Zone, all habitat types, with the exception of deepwater ponds and lagoons associated with urban development, provide significant or unique habitat for waterfowl and other migratory birds. San Francisco Bay subtidal habitat (i.e., open water) supports surf scoters as well as the majority of diving ducks that frequent San Francisco Bay in winter or during migration. Large numbers of scaup and canvasbacks are drawn to the Bay to feed on abundant invertebrates such as clams, mussels, barnacles, mud snails, and worms.

Intertidal mudflats of San Francisco Bay provide essential habitat for thousands of wintering shorebirds. The majority of the shorebirds observed by Stenzel and Page (1988) occurred in the South Bay despite the nearly equivalent acreage of intertidal mudflats in the North Bay. Intertidal mudflats are also used extensively by dabbling ducks and by diving ducks during incoming, outgoing, and high tides.

Tidal salt marshes of the Bay also provide significant habitat for both migratory birds and resident wildlife. Salt marshes provide habitat for marsh birds such as the endangered California clapper rail, Virginia and sora rails, the threatened California black rail, the salt marsh song sparrows, salt marsh yellowthroats, and wading birds such as the black-crowned night-heron. Salt marshes are also used by waterfowl, shorebirds, and other wading birds. In drought years, salt marshes of the Bay as well as intertidal mudflats and open water take on added significance to migratory waterfowl, because reduced habitat inland forces birds to the coastal environment. Tidal salt marshes of the Bay also provide habitat for the endangered salt marsh harvest mouse. Almost the entire population of California clapper rails occurs in the San Francisco Bay Area. Moreover, 80 percent of the total California clapper rail population occurs in South Bay marshes.

Seasonal wetlands and farmed wetlands provide additional habitat for waterbirds, when heavy rains begin in winter. This increase in available habitat corresponds with the time of year when the Bay must support a much larger bird population. Dabbling ducks such as northern pintails, American wigeons, and northern shovelers, and shorebirds, wading birds, and a variety of upland species frequent these habitat types. In the South Bay, where shorebird use is extensive in winter, seasonal wetlands provide critical, high-tide, roosting and foraging habitat. Sizable populations of the endangered salt marsh harvest mouse also have been found in diked salt marshes and adjacent transitional habitat.

Riparian habitat, representing only 0.2 percent of wetland habitat in the San Francisco Bay Zone, is considered a rare and unique plant community in the Bay Area. Statewide, less than 2 percent of the historic riparian habitat remains. Riparian habitat often supports the greatest variety and density of resident and migratory wildlife. Although this type of habitat around the Bay does not support large numbers of migratory waterfowl, a variety of other migratory and

resident birds, mammals, reptiles, and amphibians utilize available riparian habitat.

Salt ponds with salinities less than 180 ppt around San Francisco Bay provide significant foraging, roosting, and nesting habitat for migratory and resident birds. Total numbers of dabbling and diving ducks observed in South Bay salt ponds commonly exceed 75,000 individuals in winter. Salt ponds in San Francisco Bay have also enhanced breeding and wintering populations of several species of waterbirds, many of which were historically uncommon in the Bay. Significant population increases have occurred in species such as the eared grebe, American white pelican, snowy plover, Wilson's phalarope, California gull, black-necked stilt, and American avocet. Abandoned salt ponds and salt-pond levees provide nesting habitat for Forster's and Caspian terns, endangered California least terns, California gulls, American avocets, and black-necked stilts. Salt ponds also provide high-tide roosting habitat for large shorebirds, such as the marbled godwit and dowitcher, and essential high-tide foraging habitat for the smaller western and least sandpipers.

Outside the Bay Zone limited, but important, wetlands provide habitat for a variety of species, including waterfowl. Predominant are the freshwater reservoirs (Table 5) and riparian, or streamside, woodlands and associated habitat. At this time, little information is available on species' use of these areas. Further research and censusing is highly recommended.



PETALUMA RIVER

Table 5. SAN FRANCISCO BAY STUDY AREA RESERVOIRS

Reservoir	Maximum Surface Area (Acres)	County	Source of Information
San Pablo	866	Contra Costa	EBMUD
Briones	725	Contra Costa	EBMUD
Lafayette	126	Contra Costa	EBMUD
Upper San Leandro	794	Contra Costa/Alameda	EBMUD
Lake Chabot	340	Alameda	EBMUD
San Antonio	826	Alameda	SFWD
Calaveras	1,435	Alameda/Santa Clara	SFWD
Almaden	59	Santa Clara	SCVWD
Anderson	1,244	Santa Clara	SCVWD
Calero	347	Santa Clara	SCVWD
Coyote	637	Santa Clara	SCVWD
Guadalupe	79	Santa Clara	SCVWD
Lexington	475	Santa Clara	SCVWD
Pacheco	205	Santa Clara	SCVWD
Stevens Creek	92	Santa Clara	SCVWD
Vasona	58	Santa Clara	SCVWD
Crystal Springs	1,492	San Mateo	SFWD
Pilarcitos	112	San Mateo	SFWD
San Andreas	550	San Mateo	SFWD
Bell Canyon	80	Napa	COSH
Lake Hennessey	600	Napa	CON
Milliken	120	Napa	CON
Rector	100	Napa	VHOC
Stafford Lake	250	Marin	NMWD
TOTAL ACRES	11,612 (Maximum)		

* Source of Information:

- EBMUD - East Bay Municipal Utilities District
- SFWD - San Francisco Water District
- SCVWD - Santa Clara Valley Water District
- CCSF - City and County of San Francisco
- COSH - City of St. Helena
- CON - City of Napa
- VHOC - Veterans Home of California
- NMWD - North Marin Water District

ADDITIONAL WETLAND VALUES

In addition to providing essential habitat for migratory waterfowl and other waterbirds, wetlands can serve other valuable functions worth preserving. These include flood control, groundwater recharge and discharge, shoreline anchoring and dissipation of erosive forces, maintenance of water quality, and recreational uses.

Wetland depressions, such as many of the diked wetlands around San Francisco Bay, are capable of storing water; thus, they play a role in flood control. Several large flood-control basins around San Francisco Bay provide flood protection in addition to valuable wildlife habitat. Wetlands associated with streams provide flood storage, slow flood waters, reduce flood peaks, and increase the duration of flow (Sather and Smith 1984).

The role that wetlands play in groundwater recharge is unclear. In the San Francisco Bay study area, it is unlikely that most wetlands, other than riparian wetlands, play an important part in groundwater recharge. This is because the soils underlying most Bay wetlands are relatively impermeable. Ground water discharge occurs in some diked salt marshes in the South Bay. This freshwater influence is an attractive feature to waterfowl and other waterbirds.

Wetland vegetation plays three major roles in shoreline erosion control: (1) it binds and stabilizes substrates; (2) it dissipates wave and current energy; and (3) it traps sediments. Tidal, salt-marsh vegetation has been planted successfully at a site in the North Bay to control levee erosion. Use of this technique in the South Bay is currently being investigated, particularly on the eastern side of the South Bay where wind and wave fetch have accelerated shoreline erosion.

Wetlands are believed to play a valuable role in the maintenance of water quality, because they function as filters for removing pollutants. In the San Francisco Bay study area, the only project involving wetland treatment of urban wastewater (200 acres) is located in the city of Hayward in the South Bay. Long-term studies of this recently established, wastewater-treatment system are being conducted by the Union Sanitary District to assess its pollutant-removal capabilities as well as its impact on the biota. Another experimental project in the South Bay has utilized wetlands to treat urban stormwater runoff. Monitoring showed that the marsh effectively reduced suspended solids, inorganic nitrogen, phosphorus, cadmium, and lead (Assoc. of Bay Area Governments 1986).

The socioeconomic or recreational values of wetlands are numerous and include waterfowl hunting, nature study, education, bird watching, hiking, bicycling, picnicking, aesthetic enjoyment, scientific research, and photography. The demand for recreational opportunities adjacent to the Bay is high and is evident by the extensive use of existing trails and park facilities.

ASSESSMENT OF HABITAT PROTECTION NEEDS

Prior to the late 1800's, San Francisco Bay (excluding Suisun Marsh) contained roughly 150,000 acres of tidal salt marsh and 270,000 acres of open water and intertidal mudflat. Seasonal wetlands undoubtedly occurred in the South Bay and in portions of the North Bay, but no historic accounting of this habitat type is known. The gold rush and statehood for California in the mid 1800's accelerated changes in the Bay Area as well as in the Central Valley--changes that had direct and indirect effects on the Bay ecosystem. Tidal marshes and unvegetated portions of the Bay were diked and filled for urban development, salt production, and agriculture. Hydraulic mining for gold in the Sierra Nevada Mountains resulted in rapid sedimentation in San Francisco Bay. As urban development around the Bay and agricultural development in the Central Valley expanded, freshwater sources for the Bay were diverted to meet these needs.

All of these historic modifications have resulted in approximately an 83 percent reduction in the acreage of tidal marshes around San Francisco Bay and a six percent reduction in water surface area of the Bay. Not all of the tidal marshes diked around the turn-of-the-century, however, were filled. A major portion was converted to salt ponds which still provide valuable, although altered, habitat for migratory birds. Other areas of diked salt marsh and mudflats were never filled and today function as seasonal and farmed wetlands. Seasonal wetlands that occurred outside the historic Bay margin have been replaced, mostly by urban development. Existing, diked, seasonal wetlands provide some of the values that historic seasonal wetlands, occurring further inland, provided for waterfowl.

HABITAT PRESERVATION

Of the more than 365,000 acres of wetland and deepwater habitat remaining in the San Francisco Bay Zone, approximately 62,000 acres (17 percent) are preserved for fish and wildlife (Table 6). Roughly 58 percent of preserved, wetland habitat occurs in the North Bay; 42 percent is located in the South Bay. Figure 6 shows the general location of protected wetland and deepwater habitats in the study area. As would be expected, over 81 percent of preserved habitat is owned, leased, or managed by the U.S. Fish and Wildlife Service or the California Department of Fish and Game. The largest Federal land holdings are the San Francisco Bay National Wildlife Refuge (18,219 acres) in the South Bay and the San Pablo Bay National Wildlife Refuge (11,634 acres) in the North Bay. The majority of California Department of Fish and Game holdings are in the North Bay, including the San Pablo Bay (10,637 acres), Napa-Sonoma Marsh (2,486 acres) and Petaluma Marsh (2,544 acres) Wildlife Areas. In the South Bay, the largest State Ecological Reserve is at Bair Island (1,048 acres) in San Mateo County.

Table 6. PROTECTED WETLAND AND DEEPWATER HABITAT IN SAN FRANCISCO BAY

Map #	Ownership	Approximate Acreage		Combined North & South
		North Bay	South Bay	
Federal				
1	U.S. Fish and Wildlife Service			
	Fee Title	434	16,157	16,591
	Lease /Easement	11,200	2,062	13,262
			Total FWS	29,853
2	Other Federal	1,101	1,070	2,171
			Total Federal	32,024
State				
3	Department of Fish and Game			
	Fee Title	3,490	0	3,490
	Leased	14,424	1,200	15,624
			Total Fish & Game	19,114
4	Department of Parks and Recreation	582	142	724
5	Other State*	360	320	680
			Total State	20,518
Local Government				
6	East Bay Regional Park District	2,692	2,465	5,157
7	Counties	849	92	941
8	Cities	258	1,413	1,671
9	Other	55	1,050	1,105
			Total Local Government	8,874
Private				
10	All Private**	1,157	167	1,324
	TOTAL	36,602	26,138	62,740

* The State Lands Commission holds additional title or public trust easement over submerged Bay lands and portions of diked lands.

** Private Holdings: Audubon Society, The Nature Conservancy, Marin Conservation League, and Peninsula Open Space Trust (See Figure 6).

SAN FRANCISCO BAY ZONE

PROTECTED WETLANDS AND DEEP-WATER HABITATS

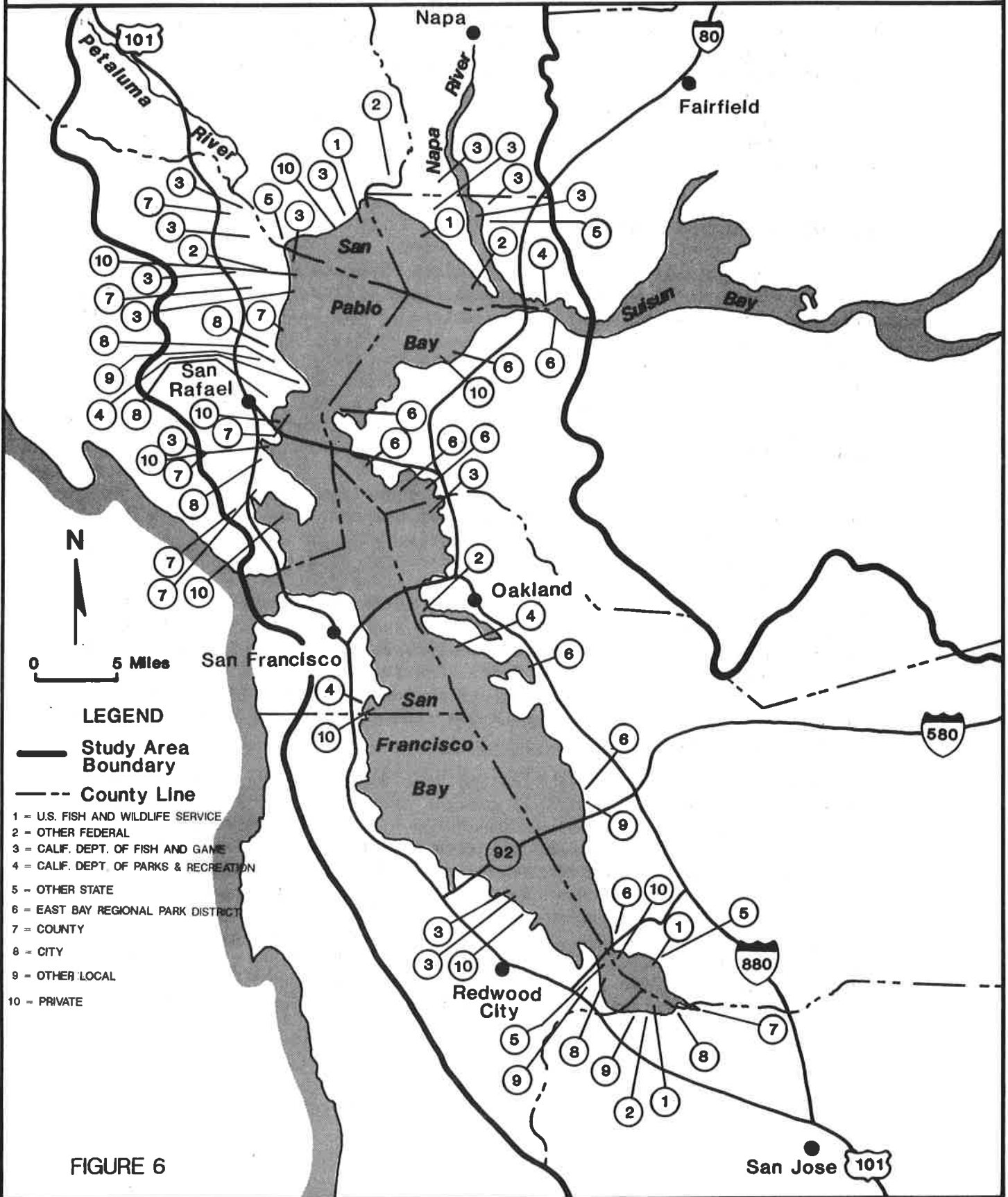


FIGURE 6

Substantial additional wetland acreage (about 11,000 acres) is controlled by other Federal, State, and local agencies and jurisdictions. The East Bay Regional Park District owns and leases over 5,000 acres of wetland and deepwater habitat on the eastern shores of the North and South Bays. The largest private holding is the 900 acre Richardson Bay Preserve of the National Audubon Society. Approximately 302,000 acres, or 83 percent, of wetland and deepwater habitats of San Francisco Bay are not preserved. About 52 percent of the unprotected acres are in the North Bay, and 48 percent are in the South Bay.

WETLAND PROTECTION THROUGH REGULATIONS

The Fish and Wildlife Service, through its Fish and Wildlife Enhancement Program administered by the Sacramento Field Office, reviews proposals for work and activities in or affecting waters of the United States that are permitted, assisted, or constructed by the Federal Government. This review function, delegated to the Service by the Secretary of the Interior, is prescribed by the Fish and Wildlife Coordination Act, the Department of Transportation Act, the Federal Aid Highway Act, the Airport and Airway Development Act of 1970, the Watershed Protection and Flood Protection Act, and the Endangered Species Act.

Proposals involving dredging or filling in navigable waters of the United States are regulated by the Army Corps of Engineers under Section 10 of the Rivers and Harbors Act of 1899. The Corps, with Environmental Protection Agency oversight, also regulates the discharge of dredged or fill material in coastal and inland waters and wetlands under Section 404 of the Clean Water Act. Discharge of pollutants into wetlands is regulated under Section 402 of the Clean Water Act. This regulatory function is carried out in the study area by the San Francisco Bay Region of the California Regional Water Quality Control Board. At the local level, the Bay Conservation and Development Commission, established in 1965, regulates all dredging and filling activities in San Francisco Bay and within a 100-foot band of shoreline.

The California Department of Fish and Game has an active role in the review of proposals for work in wetland areas. The Department's Environmental Services Division reviews and comments on proposals submitted to the Corps as required under the Fish and Wildlife Coordination Act and the Bay Conservation and Development Commission as the State trustee agency for fish and wildlife resources. The Department comments on projects affecting wetland and associated resources which require review under the California Environmental Quality Act. Projects affecting streams, rivers and lakes require an agreement with the Department as mandated under Section 1600 of the Fish and Game Code. It is the Department's policy that projects should result in no net loss of either wetland acreage or habitat value.

THREATS

Despite public ownership of a portion of the Bay's wetlands and deepwater habitats and regulations to protect wetlands, wetland loss and habitat degradation are continuing in the San Francisco Bay study area. The most significant threats to waterfowl and other migratory and resident wildlife that depend on San Francisco Bay wetlands are: (1) continued wetland filling or degradation on private property; (2) contaminants, including oil spills; (3) reduction of freshwater inflow into the Bay; and (4) sewage effluent discharge, particularly in the South Bay. Additional possible threats to waterfowl habitat may result from increased marsh erosion brought on by a combination of a rise in sea level, land subsidence, and the weakening of mud banks by the burrowing isopod (Sphaeroma quoyana).

Wetland Filling and Destruction

A trend analysis has been conducted for South San Francisco Bay, and focuses on more recent losses in wetland and deepwater habitat types (USFWS 1988). Results of the analysis comparing 1956 and 1985 wetland and deepwater habitat acreages are shown on Figure 5 and in Table 7. The most significant change revealed is the loss of over 11,000 acres or 60 percent of seasonal wetlands within the last 29 years. The average loss of seasonal wetlands over the study period was about 400 acres per year. Losses of open-water habitat, intertidal mudflats, and tidal salt marshes also were realized over this time period. Conversely, urban development increased by 77 percent between 1956 and 1985.

Although a trend analysis has not yet been conducted for the North Bay, wetland losses over this same time period are not expected to be as high as in the more densely urbanized South Bay. A North Bay trend analysis, however, is needed to verify this assumption.

Granholm (1989) conducted a cumulative-impacts analysis focusing on seasonal wetlands of the San Francisco Bay Area. Seasonal wetland acreage in 1975 was compared to recent and expected, future impacts due to proposed developments. Granholm found that of the approximate 11,300 acres of seasonal wetlands in their South San Francisco Bay study area, and about 10,000 acres of seasonal wetlands in the North Bay study area, 4 percent had been filled; 9 percent had been converted to other wetland types; and 10 percent had been degraded through diking, draining, and/or planting with nonwetland plants by 1988.

Wetland filling and degradation in the South San Francisco Bay represented an average loss of over 300 acres per year during the study period. From 1975 through 1988 approximately 4,000 acres of wetlands were impacted by various activities. In the South Bay about 2,000 acres of seasonal wetlands had been degraded, 1,300 acres were converted to other habitat types, and 700 acres were filled. Additionally, only 45 percent (5,100 acres) of the 1975 seasonal wetland acreage for the South Bay would be left intact, if all proposed developments were

approved. Most of this remaining acreage is currently in public ownership.

The cumulative-impact analysis conducted for North San Francisco Bay found that 1,000 acres of wetlands were lost during the study period. Seasonal wetlands are being lost at a slower rate in the North Bay, because it is less densely populated, and current development pressures are not as great as in the South Bay. However, as South Bay development space becomes scarce, further losses of North Bay wetlands will become likely.

Table 7. SOUTH SAN FRANCISCO BAY ZONE HABITAT CHANGES 1956-1985

Habitat Type	1956	Year 1985	Net Change
=====			
	Acreage		
Deepwater Habitats:			
Open water	94,855	93,220	-1,635
Lakes, reservoirs & ponds	1,217	2,262	+1,045
Wetlands:			
Intertidal mudflat	30,992	30,379	-613
Tidal salt marsh	9,884	8,600	-1,284
Seasonal wetlands**	19,242	8,902	-10,340
Farmed wetlands	1,013	1,317	+304
Riparian wetlands	66	171	+105
Salt ponds	26,764	27,497	+733
Uplands:			
Urban	56,695	100,225	+43,530
Upland agriculture	37,153	4,706	-32,447
Upland range	1,517	2,122	+605

* Source: U.S. Fish and Wildlife Service (1988).

** Seasonal wetlands include diked, historic tidelands and seasonally inundated wetlands outside the historic bay margin.



GOLDENEYE

Introduced Species--A Possible Threat

Two introduced species have recently become established in the Bay Zone. The Asian clam, *Potamocorbula amurensis*, was introduced into San Francisco Bay in 1987, presumably, when a ship from an Asian point of origin discharged its ballast water into the Bay (L. Schemel pers. comm.). Because of the Asian clam's ability to tolerate a wide range of salinity levels and other environmental variables, the introduction and wide-spread establishment of the clam may pose a threat to the existing benthic community. Accordingly, this small clam may "out-compete" other invertebrates that currently serve as prey items in the diet of waterfowl and other waterbirds. Conversely, the expansion of the Asian clam population into some areas that have traditionally had low numbers of invertebrates may have a positive effect by providing an alternate food source for waterfowl. White *et al.* (1989) documented the use of the Asian clam as a food item by scaup and surf scoters. However, the nutritional benefit derived by waterfowl from the consumption of the clam is unknown at this time.

Nonnative red foxes have also become established in the San Francisco Bay Area during the past decade. The nonnative red fox is not a natural component of the salt marsh or upland communities in the area. The rapid population expansion of the nonnative red fox may be related to its ability to adapt to urbanization. Moreover, the nonnative red fox is an efficient and opportunistic predator that poses a severe threat to native, ground-nesting, endangered species, waterfowl, and shorebirds.

Contaminants

Contaminants also pose a potentially serious threat to waterfowl wintering in, and migrating through, San Francisco Bay (Ohlendorf and Fleming 1988). Surf scoters and greater scaups collected from the South Bay in Spring 1982 contained concentrations of selenium, mercury, and cadmium which were elevated in comparison to other sites (Ohlendorf *et al.* 1986; Ohlendorf and Fleming 1988). Selenium and mercury concentrations in these collected species were greater than levels associated with adverse effects in other waterfowl.

Mercury concentrations in livers of the collected scoters and scaups were higher than levels in mallards which were fed diets containing 0.5 ppm (dry weight) mercury (as methylmercury) for three generations (Heinz 1979). In the mallard study, Heinz found behavioral differences in nesting females and mallard ducklings, as well as fewer ducklings produced than in controls.

Of particular concern is the element selenium which has been associated with severe reproductive impairment and adult mortality of dabbling ducks and other waterbirds in the nearby San Joaquin Valley (Ohlendorf and Fleming 1988). In addition to the scoters and scaups collected from the South Bay in 1982, other studies by Ohlendorf *et al.* (1989) and the California Department of Fish and Game (White *et al.* 1989) revealed high levels of selenium in scoters collected from other parts of the Bay from 1985 to 1988. The highest selenium levels were found in birds collected from San Pablo and Suisun Bays and from extreme southern San Francisco Bay.

Effluent discharged from sewage treatment plants has been identified as a potential source of dissolved selenium in the South Bay (Cutter 1989). In the North Bay, effluent from oil refineries may be the major sources of selenium, particularly at periods of low river discharge (Cutter 1989). High levels of selenium and other contaminants have also been found in the invertebrate prey of diving ducks (Luoma *et al.* 1985 and White *et al.* 1989). It is not yet known what impact these selenium and other contaminant concentrations may be having on diving ducks or other species in San Francisco Bay. However, because of elevated selenium levels, the California Department of Health Services has issued a health advisory regarding human consumption of scaup and surf scoter from the Bay.

Oil spills also pose a threat to waterfowl and other tidal wetland-associated wildlife and plants. Seven oil refineries currently

operate in the Bay and support a fleet of ocean-going oil tankers. A large oil spill from a refinery or tanker occurring during the height of the migratory waterfowl season may devastate the bird populations. Moreover, because San Francisco Bay is a major, world-shipping center, the threat of a spill also exists from other commercial and military transport vessels.

Reduction in Freshwater Inflow

The amount and timing of freshwater inflow into San Francisco Bay has been drastically reduced and altered since the late 1800's/early 1900's. This issue has been a subject of the California State Water Resources Control Board's (SWRCB) Bay-Delta Water Quality Hearings. Upstream agricultural, municipal, and industrial uses have taken about 60 percent of the historic inflow to the Bay and Delta. About 90 percent of the current inflow comes through the Delta. The South Bay has been particularly affected, because much of its circulation and mixing is inflow-dependent. The historical high seasonal variation of inflow has been greatly altered. Former, low, summer/fall inflows are now higher, but historically high winter/spring inflows have been substantially reduced. Reductions in inflow are believed by many biologists and other scientists to be of a net detriment to fish and wildlife populations of San Francisco Bay. Significant relationships between some measured aquatic species and Bay inflows have been demonstrated. A direct relationship between waterfowl and other wildlife and Bay inflows has yet to be demonstrated. Linkages, however, through food chain relationships and these species are likely. While some estuarine-type species have undoubtedly declined due to reduced outflow, some marine-type species have benefited.

Higher (relative) inflow is beneficial as it can dilute, transform, or flush contaminants from the Bay, particularly the South Bay. Higher inflow is also beneficial from a productivity standpoint as more of the desirable food chain organisms are made available. Nutrients which are essential for growth of the planktonic food web are principally supplied by inflow to the Bay (Davis 1982). Presumably, the emergent and submerged aquatic vegetation and the food organisms that benefit from higher inflow also benefit waterfowl and other waterbirds. However, a better understanding is required of the quantitative and qualitative importance of physical processes in the Bay (freshwater inflow, water circulation and mixing, patterns of temperature and salinity variations) relative to the distribution and abundance of major food sources for fish and aquatic birds (Nichols and Pamatmat 1988).

In testimony before the SWRCB's Phase 1 Bay-Delta Hearings (1987), the California Department of Fish and Game stated that the standard (e.g., inflow, salinity, etc.) established to protect aquatic life should also protect wildlife resources. A standard for bay inflow has not yet been established, and it is unknown if or when one will be.

Sewage Effluent Discharge

Sewage effluent inflows, particularly in the South Bay, have overwhelmed natural water regimes, resulting in undesirable changes in the wetland ecosystem. The southern portion of San Francisco Bay receives 10 percent of the mean, annual, river runoff but 76 percent of the Bay's total wastewater inflow (Conomos 1979). This massive discharge, primarily into the Coyote Creek-Guadalupe Slough area, has caused the conversion of over 300 acres of tidal salt marsh, dominated by cordgrass and pickleweed, to brackish marsh, dominated by alkali bulrush. It may also have contributed to habitat degradation on an adjoining 300 acres of salt marsh. The numbers of endangered California clapper rails have been greatly reduced in these tidal marshes. Effluent discharges are projected to increase another 20 to 25 percent by the year 1995, continuing the loss of the South Bay's dwindling salt marshes.

CONSEQUENCES

If current trends in wetland losses and degradation continue, concomitant reductions in San Francisco Bay migratory waterfowl, shorebird, and other waterbird populations are highly probable. If losses of seasonal wetlands in the South Bay continue as predicted, seasonal wetland habitat in this part of the Bay will be reduced to less than half of the acreage present in the mid-1970's. Without additional protection, it is possible that the only seasonal wetland habitat remaining will be that currently in public ownership or private parcels which are dedicated to conservation purposes. Shorebirds that rely on seasonal wetlands in winter for high-tide foraging will be impacted most severely by reduction in acreage of this habitat type. As the Bay Area grows, a similar future for seasonal wetlands in the North Bay also may be realized.

Unless water quality problems, particularly in the South Bay, are resolved and new tidal salt marsh created, the endangered California clapper rail faces possible extirpation in some south San Francisco Bay marshes. If wetland losses and degradation of water quality continue, waterfowl and other wetland-dependent wildlife in the Bay may be subjected to contaminant-related problems and increases in disease outbreaks.

HABITAT PROTECTION STRATEGY

GENERAL GOALS

To meet the overall objectives of the North American Waterfowl Management Plan, waterfowl populations and their habitats will have to be protected, restored, and enhanced. Some species of waterfowl will require population increases of 40 to 50 percent to overcome the current deficit in their numbers. Wetland habitats throughout North America, including San Francisco Bay, will need to be preserved to provide sufficient breeding and nonbreeding habitat for waterfowl. Additionally, efforts must be made to improve the habitats utilized by rare and endangered species, thereby allowing the delisting of currently listed threatened and endangered species and making further listing of the numerous proposed and candidate species which utilize these wetland habitats unnecessary.

OBJECTIVES

San Francisco Bay is the largest estuary in California. Despite the dramatic changes in the acreage and configuration of the various wetland types that comprise the Bay ecosystem, this estuary remains the most important coastal wetland for waterfowl and other migratory and resident fish and wildlife in California. The observed trends of wetland-habitat losses and degradation of wetlands through contaminants and reduced Delta freshwater inflows must be reversed.

To accomplish these goals, the following objectives have been developed for the San Francisco Bay Area. Table 8 and Appendix E present the priority areas outside of existing National Wildlife Refuges and State Wildlife Areas where these objectives should be focused.

- (1) Protect and preserve all of the existing 366,000 acres of wetlands and deepwater habitats within the San Francisco Bay Zone. To support existing, wintering, waterfowl populations in the San Francisco Bay study area, this minimum acreage of wetlands must be maintained. No net loss of wetland acreage or value should occur.
- (2) Increase acreage of wetlands with the highest value to waterfowl, endangered species, shorebirds, and other wetland resources. To improve wetland habitat for wintering waterfowl and other wetland resources in the San Francisco Bay Area, new, high quality wetlands must be established in both the North and South Bays. Priority wetland habitat types to be increased include seasonal wetlands and tidal salt marshes.
- (3) Enhance the habitat value and the diversity of existing wetlands. Enhancement of existing wetland habitat is needed to improve the overall habitat quality of Bay Area wetlands. This objective includes the need to modify existing wetlands to enhance productivity and species diversity. Also needed is the improvement of water and habitat quality

and the reduction or elimination of contaminants within San Francisco Bay, adjacent wetlands, and tributary streams.

(4) Expand the research effort in the San Francisco Bay Area. Expanded research by the U.S. Fish and Wildlife Service, other agencies, and organizations is needed to improve the understanding of waterfowl and other wildlife habitat use, diet, interactions with other resources, influences of contaminants, and other factors. The overall ecological data base for the Bay Area needs to be expanded, kept up-to-date, and used in monitoring and evaluating waterfowl and other wildlife populations and habitat. This information should be available for use by Service biologists and managers as well as by the Environmental Protection Agency and State of California resources and regulatory agencies.

GENERAL FISH AND WILDLIFE SERVICE WETLANDS CONSERVATION STRATEGIES

The Service publication, Time for Wetlands: A U.S. Fish and Wildlife Service Initiative, (1989) is the source for the following list of wetlands conservation strategies, many of which the Service currently employs or is implementing. Appendix D provides the entire publication which includes detailed information relative to each of the strategies indicated here.

Private Stewardship. Provide technical and financial assistance to private landowners in protection, restoration, management, and enhancement of wetland resources.

Partnerships. Encourage other agencies, through their programs and authorities, to protect, restore, manage, and enhance wetland resources.

Awareness. Increase knowledge, develop a public conservation ethic, and foster citizen participation in wetland conservation.

Public Lands. Maximize protection, restoration, management, and enhancement of wetland resources on public lands.

Protection. Promote long-term and permanent protection of wetland resources using easements, leases, and acquisition.

Trends. Provide national leadership in monitoring the status and trends of wetland habitats, migratory birds, and other associated species.

Compliance. Support full compliance with all legal and regulatory requirements that provide protection to wetlands and wetland associated species on public and private lands.

Research. Provide national leadership in research on wetland habitats and their fish and wildlife functions and values.

Contaminants. Assess the effects of environmental contaminants on wetland habitats and promote corrective actions.

Global. Promote global awareness of wetlands values and effect wetland protection and management with international cooperators.

SPECIFIC SAN FRANCISCO BAY STRATEGIES

A number of strategies are available to preserve, expand, and enhance wetlands in and around San Francisco Bay. Protection of existing wetlands first involves strict adherence to laws and regulations designed to protect wetlands. The National Audubon Society *et al.* (1989) noted deficiencies in the existing regulatory process and provided comprehensive recommendations to preserve seasonal wetlands through Federal, State, and local regulations. The recommendations include: strengthen the existing regulatory process, enforce existing regulations, develop fully protective mitigation policies, increase seasonal wetlands through acquisition and management, and increase seasonal wetland awareness through educational programs.

In the San Francisco Bay Area, tidal-wetland habitat types, particularly tidal salt marshes, are well protected by the policies and regulations of the Bay Conservation and Development Commission and the U.S. Army Corps of Engineers. Seasonal, farmed, and riparian wetlands, however, often do not fall within the regulatory boundaries of the Bay Conservation and Development Commission, or, because of existing land use practices or other reasons, they do not meet the Corps' criteria for defining wetlands. As a result, over the last 10 years an average of about 270 acres of seasonal, riparian, and farmed wetlands per year have been filled for development or severely degraded in the heavily urbanized South Bay. In the case of these wetland types, some other form of protection is clearly needed.

Acquisition

Habitat protection objectives may be accomplished most effectively by the acquisition of lands or purchase of conservation easements on currently unprotected San Francisco Bay wetlands. The Fish and Wildlife Service's role in wetland acquisition could be pursued under the authority of the Fish and Wildlife Act of 1956 (16 U.S.C. 742a - 742j) as amended, the Endangered Species Act of 1973 (16 U.S.C. 1531 - 1543) as amended, or the Emergency Wetlands Resources Act of 1986 (P.L. 99-645). These authorities provide for the acquisition of land or the establishment of protective easements under the provisions of the Land and Water Conservation Fund Act (16 U.S.C. 4601 - 9). Funds for wetland acquisition or easement could also be sought under the authority of the Migratory Bird Conservation Act of 1929 (16 U.S.C. 715 - 715s) as amended, which utilizes Federal duck stamp proceeds as the funding source.

The California Department of Fish and Game and the Wildlife Conservation Board depend on several sources of funding for wetland acquisitions.

The State's most important current source of funding is derived from Proposition 70, a ballot measure passed in 1988, that allocates \$15,000,000 for wetland acquisition in San Francisco Bay. Other State funding sources include California Duck Stamp Funds, the Endangered Species Tax Check-off Fund, the Environmental License Plate Fund, the Wildlife Restoration Fund, and Proposition 99--the Tobacco Tax and Health Protection Act of 1988. The Federal Aid in Wildlife Restoration Act of 1937 (Pittman-Robertson) and Section 6 of the Federal Endangered Species Act provide Federal funds to the State for land-acquisition programs.

Other agencies may acquire lands or easements having secondary objectives which result in the protection of wetland habitat. These may be local, regional, or State parks, public utilities, etc. Wetlands may also be protected by local wildlife or conservation groups. Organizations such as The Nature Conservancy, The National Audubon Society, Ducks Unlimited, California Coastal Conservancy, and others may become involved with the purchase of lands through National, State, or local efforts.

Cooperative Agreements

Another form of habitat protection and management may occur with the initiation of Cooperative Management Agreements. This method of protection would facilitate the preservation and management of wetlands on areas such as military bases, lands and reservoirs of public utility companies, or lands owned by other Federal, State, or local agencies. An example of cooperation between the Service and the Military has been demonstrated through the joint development of wildlife management plans for military lands (e.g., Moffett Field, Skaggs Island in the Bay Area) as specified by the Sikes Act. In addition, the Navy is proposing to incorporate some of the tidal wetlands within the Mare Island Naval Shipyard into the San Pablo Bay National Wildlife Refuge. Under this proposal the Navy would retain ownership of the lands and the Service would manage the area for wildlife. Cooperative agreements may also be established on private lands.

Wetland Habitat Enhancement and Expansion

Priority wetland habitat types to be increased are: (1) seasonal freshwater/brackish wetlands, emphasizing the creation of marsh habitat for early and late migrants through water management and creation of more high-tide foraging/roosting areas; (2) tidal salt marshes, including the possible use of uncontaminated dredge material to raise subsided land to the appropriate elevations for tidal salt marsh development; and (3) deepwater habitat, emphasizing the creation of open-water areas similar to that found on Lower Tubbs Island in the North Bay.

Key strategies in the objective of providing wetland enhancement for the benefit of waterfowl and other Bay Area fish and wildlife resources include efforts to: (1) reduce the levels of contaminants currently within the Bay and to eliminate, or reduce to acceptable levels, any future contaminant loading in this ecosystem; (2) maintain or increase

freshwater inflows through the Delta and Bay tributaries; (3) reduce altered inflows such as sewage effluent into the Bay, while continuing support research on the use of contaminant-free effluent in wetland habitat creation, enhancement, and maintenance; and (4) improve overall wetland diversity and value through controlled alteration of selected wetlands (e.g., returning an abandoned salt pond to tidal action).

Coordination, Cooperation, and Education

With the given complexity of the San Francisco Bay environment, one cannot stress enough the continuing need for coordination, cooperation, and education. Currently there are numerous, on-going efforts around the Bay Area which directly or indirectly affect wetlands and associated resources of the Bay. U.S. Fish and Wildlife Service and California Department of Fish and Game interactions with these individuals and entities will be critical to the success of a waterfowl-habitat, protection effort. Educational programs aimed at the future users of this ecosystem, our children, should also be an important strategy.

Research and Information

Resource information on the Bay Area's wetland habitats, surrounding influences, fish and wildlife populations, contaminants, and other factors must be expanded and made available to decision makers. The Service's National Wetland Inventory is an essential piece of resource information that fish and wildlife biologists, resource planners and analysts, and managers need in an up-to-date and tangible manner. However, such information represents only one part of the complex ecosystem that makes up San Francisco Bay, and other information including wildlife-use factors, soils, vegetation, and hydrologic components must be added to the data base available to Service resource managers.

Research investigations are needed in many areas of the Bay's ecosystem. Research needs related to waterfowl populations and habitat protection include: (1) abundance, distribution, habitat use, and movements of waterfowl in San Francisco Bay wetlands (1st phase of this study is currently being conducted by Patuxent and Northern Prairie Wildlife Research Centers); (2) contaminant analyses and impacts on San Francisco Bay waterfowl (studies underway by Patuxent Wildlife Research Center); (3) the role of salt ponds in San Francisco Bay wintering, waterfowl populations (Salt ponds have created a new habitat type in the Bay for waterfowl and other migratory birds. Additional data, however, are required to better determine the role the Bay and salt ponds play for wintering waterfowl); (4) waterfowl energetics, diet, and food-chain characteristics and quality; (5) habitat restoration and wetland-enhancement techniques and applications; and (6) habitat diversity and interrelationships between waterfowl and other Bay Area wetland-dependent fish and wildlife. Coordination with the Service's Research and Development Centers and Units, the Environmental Protection Agency, and various California State agencies will be important in the near future to help build and expand a data base for use by these and other agencies. Such an effort should enable the Service to have the proper tools and information in decision making as it endeavors to solve the

problems and begins to track the future of waterfowl habitats and other fish and wildlife resources which can flourish in the Bay's wetlands.

PRIORITIES

Various aspects of all the objectives and strategies presented in this report must be achieved to assure that waterfowl populations and wetland habitats of the Bay Area are viable and robust resources. It is clear that waterfowl which utilize the Bay Area's wetland resources require a diversity of habitat types. Furthermore, it is necessary that these habitats be protected from disturbance, contamination, or destruction and that new research be required to better understand the needs of waterfowl and shorebirds and their interactions with Bay Area resources.

Land acquisition and easement programs by the U.S. Fish and Wildlife Service and the California Department of Fish and Game are most likely to result in the protection of some existing wetlands. It is noted, however, that most tidal wetland habitat types are fairly well protected by existing regulatory processes and may not be the prime focus for acquisition by the Service or Department of Fish and Game. Table 8 and Figures 7 and 8 display and describe important wetland habitats to be protected, enhanced, and expanded in the San Francisco Bay study area. These sites and their current habitat types are further described in Appendix E (under separate cover). These and other important wetland habitats in the San Francisco Bay Zone may be preserved and enhanced by the Service, Department of Fish and Game, private conservation groups, through cooperative efforts, or by other means. The Fish and Wildlife Service currently owns or otherwise controls 18,219 acres within an approved 23,000-acre refuge boundary at San Francisco Bay NWR. A proposal to expand the approved refuge boundary was approved by the U.S. House and the Senate and signed by the President in October 1988. This effort provides for a 20,000-acre expansion of the currently approved refuge boundary at San Francisco Bay NWR. In the North Bay, the Service controls 11,634 acres at the San Pablo Bay NWR. An addition of the 1,493-acre Cullinan Ranch is currently proposed by the Service. Both of these efforts will help to protect existing habitat of key importance to waterfowl and other fish and wildlife resources. The Department of Fish and Game is currently planning to direct most of its acquisition program to the North Bay. This is because North Bay land is generally more available, costs less, and the Department has more resources available to manage acquired lands in this area.

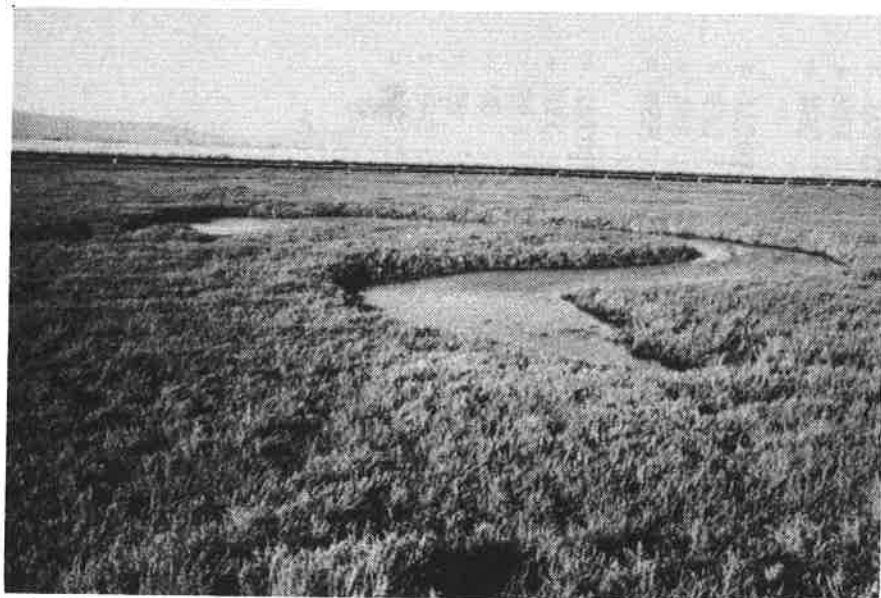
The great majority of wetlands within the San Francisco Bay area receive, or can be modified to receive, tidal salt water from the Bay. However, should the restoration, enhancement, or maintenance of a proposed, wetland acquisition require a fresh water source, then the Service will actively pursue acquisition of the water rights along with the property.

Resource planners and managers should give utmost care in providing an adequate balance between uplands and wetlands in the design of wildlife

areas. These transitional upland areas, in association with wetlands, provide increased habitat diversity, refugia for endangered species and waterbirds during extreme high tides, and nesting cover for waterfowl.

Areas outside of the designated Bay Zone are not earmarked for acquisition at this time. However, wetlands within these upslope portions of the study area are important, and local agencies and organizations are encouraged to protect, enhance, and restore wildlife habitats with value to waterfowl and other species.

These upslope-drainage ways and wetlands are important parts of the total bay ecosystem. It is essential that, as in the Bay Zone, these areas be protected, remain contaminant free, and be monitored as part of the San Francisco Bay environment which affords essential habitat for migratory waterfowl, fish, and other wildlife resources.



BAY AREA WETLAND

TABLE 8. IMPORTANT WETLANDS TO BE PROTECTED, ENHANCED, AND EXPANDED IN THE SAN FRANCISCO BAY AREA
(PARTIAL LIST)

SOUTH BAY

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
1	FOSTER CITY WETLANDS	RP	58	TOTAL = 28 ITM = 3 TSM = 25	Protect and restore wetlands
2	REDWOOD SHORES	RP	149	TOTAL = 139 LPR = 12 SWL = 122 TSM = 5	Protect and restore wetlands
3	BAIR ISLAND	RP/PA	1,989	TOTAL = 1,937 ITM = 137 LPR = 51 OW = 98 SP = 633 SWL = 692 TSM = 326	Protect wetlands; convert salt ponds to tidal wetlands

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
4	REDWOOD CITY/ RAVENSWOOD WETLANDS	RP/PA	2,686	TOTAL = 2,482	Protect and enhance saltponds and seasonal wetlands; tidal restoration
4A	Redwood	RP/PA	1,438	SUBTOTAL = 1,409 ITM = 1 OW = 6 SP = 1,342 SWL = 50 TSM = 10	(see above)
4B	Menlo	PA	803	SUBTOTAL = 690 ITM = 2 OW = 1 SP = 657 SWL = 5 TSM = 25	(see above)
4C	Ravenswood Point North	RP/PA	53	SUBTOTAL = 43 ITM = 1 SWL = 38 TSM = 4	(see above)
4D	Ravenswood Point	PA	392	SUBTOTAL = 340 ITM = 11 SP = 233 SWL = 78 TSM = 18	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
5	MOFFETT FIELD SALTPONDS & WETLANDS	MV	1,607	TOTAL = 1,550 ITM = 35 LPR = 172 SP = 1,282 SWL = 34 TSM = 27	Protect and enhance saltponds and seasonal wetlands; tidal restoration
6	ALVISO SALT PONDS	MV/MP	3,560	TOTAL = 3,559	Manage ponds for wildlife; tidal restoration
6A	West	MV	822	SUBTOTAL = 822 ITM = 1 OW = 1 SP = 814 TSM = 6	(see above)
6B	North	MV/MP	1,571	SUBTOTAL = 1,570 OW = 1 SP = 1,364 SWL = 165 TSM = 40	(see above)
6C	South	MV/MP	281	SUBTOTAL = 281 SP = 280 SWL = 1	(see above)
6D	East	MP	886	SUBTOTAL = 886 SP = 864 TSM = 22	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
7	SAMMIS TRACT	MP	53	TOTAL = 40 SWL = 38 TSM = 2	Protect and enhance seasonal wetlands
8	NEW CHICAGO MARSH	MP	200	TOTAL = 175 SWL = 175	Protect and enhance seasonal wetlands
9	FREMONT/NEWARK WETLANDS & AGRICULTURAL LANDS	MP/NI/NE/MV	2,238	TOTAL = 1,461	Protect and enhance seasonal wetlands; modify uplands
9A	Nimitz	MP	1,025	SUBTOTAL = 706 ITM = 11 SP = 444 SWL = 205 TSM = 46	(see above)
9B	Albrae	MP	626	SUBTOTAL = 311 SWL = 310 TSM = 1	(see above)
9C	Four Corners	NE/NI/MP/MV	587	SUBTOTAL = 444 FWL = 315 LPR = 7 SWL = 107 TSM = 15	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
10	FREMONT/NEWARK SALT PONDS	MV/NE	2,985	TOTAL = 2,849	Manage ponds for wildlife; tidal restoration
	10A East	NV/NE	2,829	SUBTOTAL = 2,712 LPR = 11 SP = 2,659 SWL = 17 TSM = 25	(see above)
	10B West	NE	156	SUBTOTAL = 137 LPR = 9 OW = 7 SP = 98 TSM = 23	(see above)
11	HICKORY/MAYHEWS	NE	252	TOTAL = 112 LPR = 15 SWL = 85 TSM = 12	Protect and enhance wetlands
12	COYOTE TRACTS	NE	269	TOTAL = 200	Protect and enhance seasonal wetlands
	12A East	NE	158	SUBTOTAL = 96 SWL = 96	(see above)
	12B West	NE	111	SUBTOTAL = 104 FWL = 4 SWL = 100	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
13	PATTERSON RANCH	NE	422	TOTAL = 138 FWL = 93 LPR = 4 SWL = 34 TSM = 7	Restore agricultural land to wetlands
14	PATTERSON SLOUGH	NE	91	TOTAL = 78 ITM = 2 SP = 4 SWL = 63 TSM = 9	Protect and enhance wetlands
15	UNION CITY AREA	NE/RP	3,609	TOTAL = 3,300 FWL = 90 ITM = 31 LPR = 7 RWL = 17 SP = 2,456 SWL = 431 TSM = 268	Protect and enhance seasonal wetlands; modify agricultural land to wetlands

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
16	HAYWARD WETLANDS	NE/RP/SL	3,895	TOTAL = 3,844	Protect and enhance seasonal wetlands; tidal restoration; modify salt ponds and agricultural lands
	16A South	RP/NE	3,779	SUBTOTAL = 3728 FWL = 255 ITM = 39 LPR = 27 SP = 2,441 SWL = 741 TSM = 225	(see above)
	16B North	RP/SL	116	SUBTOTAL = 116 SWL = 116	(see above)
17	MARATHON	SL	121	TOTAL = 96 LPR = 1 SWL = 95	Protect and enhance seasonal wetlands; modify uplands
18	ROBERTS LANDING	SL	525	TOTAL = 410 ITM = 42 LPR = 1 SWL = 353 TSM = 14	Protect and enhance seasonal and tidal wetlands; modify uplands

TABLE 8. CONTINUED.

NORTH BAY

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
20	EMERYVILLE CRESCENT	OW	369	TOTAL = 355 ITM = 278 TSM = 77	Protect and enhance wetlands
21	HOFFMAN MARSH	RI	99	TOTAL = 54 ITM = 3 TSM = 51	Protect, enhance, and restore wetlands
22	WILDCAT/SAN PABLO CREEKS	SQ/RI	707	TOTAL = 620	Protect, enhance, and restore wetlands
	22A Wildcat Marsh	SQ	548	SUBTOTAL = 494 ITM = 104 LPR = 28 SP = 2 SWL = 47 TSM = 313	(see above)
	22B San Pablo Creek	SQ/RI	159	SUBTOTAL = 126 ITM = 3 LPR = 2 TSM = 121	(see above)
23	RICHMOND/PT. PINOLE	RI	136	TOTAL = 42 ITM = 2 LPR = 1 SWL = 25 TSM = 14	Protect and enhance seasonal and tidal wetlands; modify uplands

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
24	WHITE SLOUGH	MI/CW	428	TOTAL = 399 ITM = 159 TSM = 240	Protect and enhance wetlands
25	CULLINAN RANCH	MI/CW	1,611	TOTAL = 1,543 FWL = 1,498	Protect and enhance farmed wetlands; tidal restoration; modify uplands
26	NAPA RIVER AREA	MI/CW/SP	24,919	TOTAL = 24,712	Protect and enhance farmed and seasonal wetlands; manage salt ponds for wildlife; tidal restoration; modify uplands
26A	Islands & Sloughs-West	MI/CW/SP	22,786	SUBTOTAL = 22,739 FWL = 647 ITM = 63 LPR = 126 OW = 302 SP = 7,722 SWL = 829 TSM = 13,050	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
26B	Salt Ponds-East	CW	1,683	SUBTOTAL = 1,529 ITM = 44 LPR = 34 OW = 11 SP = 1,060 SWL = 372 TSM = 8	(see above)
26C	Fagan Slough	CW	341	SUBTOTAL = 335 OW = 13 SP = 175 TSM = 147	(see above)
26D	Bull Island	CW	109	SUBTOTAL = 109 OW = 4 TSM = 105	(see above)
27	STANLEY RANCH	NA/CW	1330	TOTAL = 1048 FWL = 416 LPR = 10 OW = 38 SWL = 574 TSM = 10	Protect and enhance seasonal and farmed wetlands; modify uplands

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
28	SONOMA CREEK AREA	SP/PP	10,074	TOTAL = 9,405	Protect and enhance farmed wetlands; modify uplands
28A	Sonoma Valley	SP	8,333	SUBTOTAL = 7,665 FWL = 6,320 LPR = 71 OW = 119 RWL = 1 SWL = 465 TSM = 689	(see above)
28B	Lower Tubbs Island	SP/PP	1,741	SUBTOTAL = 1,740 FWL = 1,705 LPR = 10 SWL = 20 TSM = 5	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
29	PETALUMA RIVER AREA	SP/PR/PP	8,735	TOTAL = 8,194	Protect and enhance seasonal and farmed wetlands, tidal restoration; modify uplands
29A	Sears Point	PP/SP	1,889	SUBTOTAL = 1,872 FWL = 1,813 SWL = 6 TSM = 53	(see above)
29B	Hog Island	PR/SP	2,711	SUBTOTAL = 2,622 FWL = 2,554 LPR = 1 OW = 16 SWL = 33 TSM = 18	(see above)
29C	Lakeville South	PR	107	SUBTOTAL = 98 OW = 8 SWL = 39 TSM = 51	(see above)
29D	Lakeville North	PR	1,291	SUBTOTAL = 1,228 FWL = 631 ITM = 9 LPR = 66 OW = 1 SWL = 108 TSM = 413	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
29E	Nells Island	PR	1,415	SUBTOTAL = 1,075 FWL = 93 ITM = 10 LPR = 10 OW = 14 RWL = 1 SWL = 234 TSM = 713	(see above)
29F	Burdell	PR	804	SUBTOTAL = 802 FWL = 183 SWL = 582 TSM = 37	(see above)
29G	Basalt Creek	PR	518	SUBTOTAL = 497 FWL = 169 LPR = 3 SWL = 314 TSM = 11	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
30	NOVATO CREEK	NO/PP	3,736	TOTAL = 3,671	Protect and enhance farmed wetlands; modify uplands
30A	Central	NO/PP	1,054	SUBTOTAL = 1,043 FWL = 910 SWL = 120 TSM = 13	(see above)
30B	North	NO	918	SUBTOTAL = 882 FWL = 364 LPR = 11 SWL = 478 TSM = 29	(see above)
30C	South	NO/PP	1,764	SUBTOTAL = 1,746 FWL = 1,441 LPR = 35 SWL = 269 TSM = 1	(see above)

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
31	GALLINAS CREEK	NO/PP	1,176	TOTAL = 1,082	Protect and enhance seasonal and farmed wetlands; modify uplands
31A	Long Point	NO/PP	807	SUBTOTAL = 717 FWL = 669 LPR = 1 SWL = 46 TSM = 1	(see above)
31B	Central	NO	191	SUBTOTAL = 190 SWL = 183 TSM = 7	(see above)
31C	South Fork	NO	75	SUBTOTAL = 72 SWL = 71 TSM = 1	(see above)
31D	Gallinas Beach	NO/PP	103	TOTAL = 103 ITM = 4 OW = 1 TSM = 98	(see above)
32	MCNEALS QUARRY	SQ	66	TOTAL = 47 ITM = 1 SWL = 45 TSM = 1	Protect seasonal wetlands

TABLE 8. CONTINUED.

MAP #	SITE NAME	QUAD(S)*	TOTAL ACRES	WETLAND HABITAT TYPES/ACREAGE**	DESCRIPTION OF NEED
33	CANALWAYS	SQ	95	TOTAL = 91 LPR = 11 SWL = 80	Protect seasonal wetlands
34	TRIANGLE MARSH	SQ	16	TOTAL = 16 ITM = 2 TSM = 14	Protect and enhance wetlands
35	RICHARDSON BAY	SR	15	TOTAL = 12	Protect and enhance wetlands
	35A Goodwin Marsh	SR	6	SUBTOTAL = 4 TSM = 4	(see above)
	35B Silva Island Marsh	SR	9	SUBTOTAL = 8 TSM = 8	(see above)

TABLE 8. CONTINUED.

* U.S. GEOLOGICAL SURVEY
7.5' QUAD SHEET NAMES

CW = Cuttings Wharf
 MI = Mare Island
 MP = Milpitas
 MV = Mountain View
 NA = Napa
 NE = Newark
 NI = Niles
 NO = Novato
 OW = Oakland-West
 PA = Palo Alto
 PP = Petaluma Point
 PR = Petaluma River
 RI = Richmond
 RP = Redwood Point
 SL = San Leandro
 SP = Sears Point
 SQ = San Quentin
 SR = San Rafael

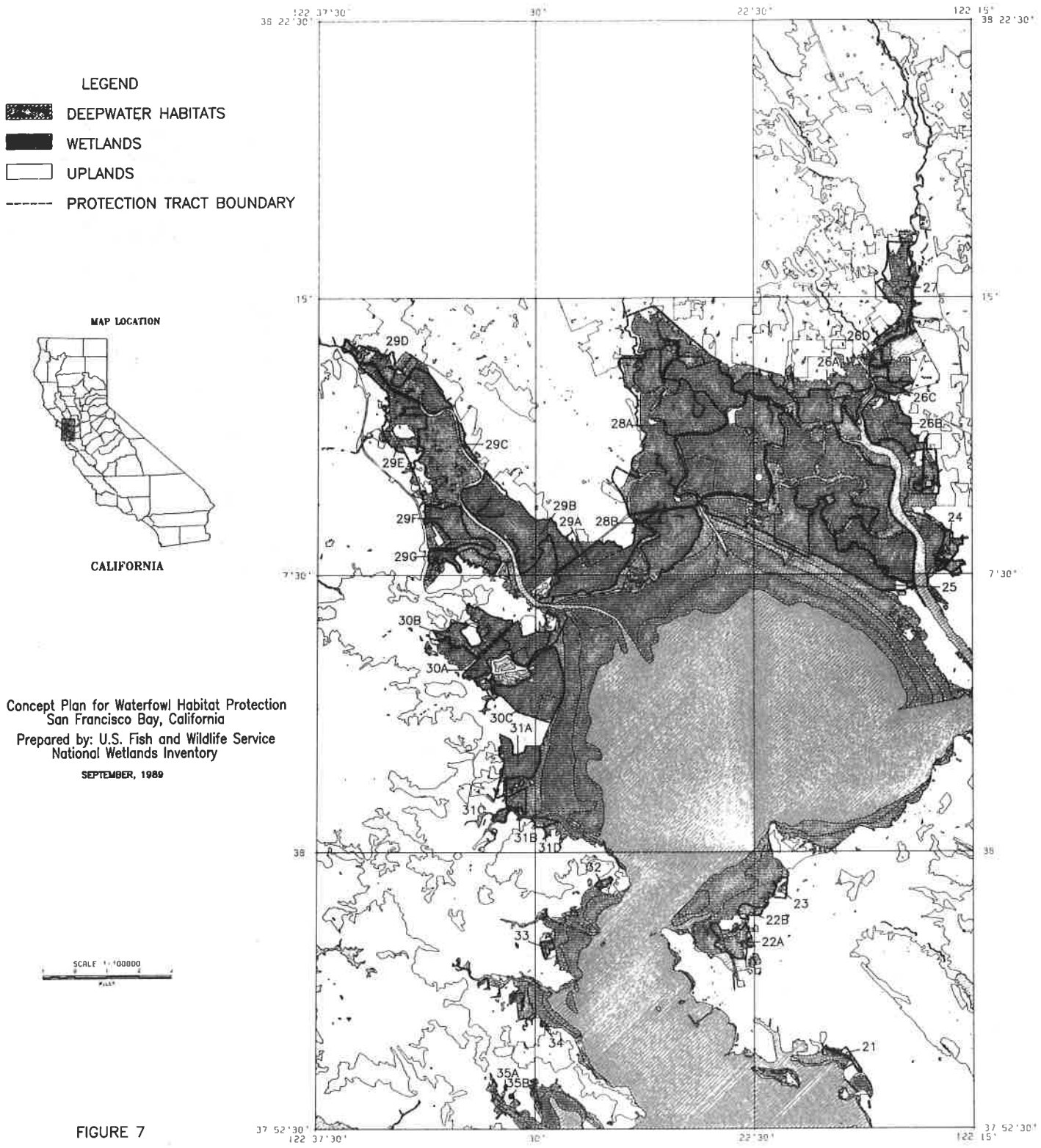
** WETLAND HABITAT TYPES

FWL = Farmed Wetlands
 ITM = Intertidal Mudflats
 LPR = Lakes, Ponds, Reservoirs
 OW = Open Water
 RWL = Riparian Wetlands
 SP = Salt Ponds
 SWL = Seasonal Wetlands
 TSM = Tidal Salt Marsh

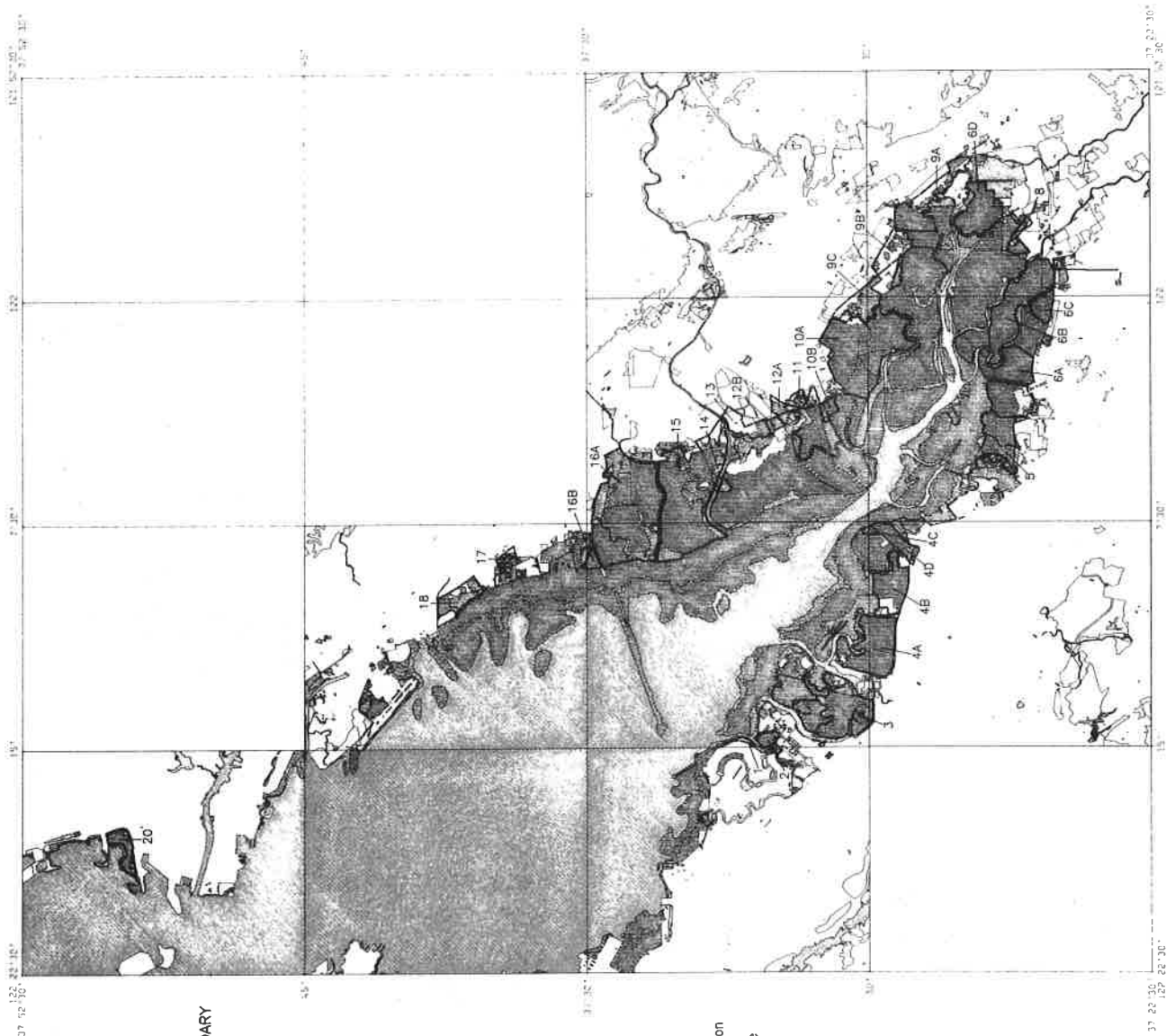
TABLE 8 SUMMARY





Total Acres	
North Bay	53,512
South Bay	24,709
Bay Zone	78,221
Total Wetland Acres	
North Bay	51,291
South Bay	22,398
Bay Zone	73,689

WATERFOWL HABITAT PROTECTION SITES SAN FRANCISCO BAY – NORTH



WATERFOWL HABITAT PROTECTION SITES SAN FRANCISCO BAY - SOUTH



- LEGEND**
-  DEEPWATER HABITATS
 -  WETLANDS
 -  UPLANDS
 -  PROTECTION TRACT BOUNDARY



Concept Plan for Waterfowl Habitat Protection
San Francisco Bay, California
Prepared by: U.S. Fish and Wildlife Service
National Wetlands Inventory
SEPTEMBER, 1989



FIGURE 8

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APPENDIX A

ENDANGERED, THREATENED, AND RARE SPECIES IN THE SAN FRANCISCO BAY STUDY AREA

ALEUTIAN CANADA GOOSE (Branta canadensis leucopareia)-- (endangered - Federal and State)

Within the study area, the Aleutian Canada goose is known to winter (November-February) only on San Pablo Reservoir (Contra Costa County), Calaveras Reservoir (Alameda and Santa Clara Counties), and adjoining uplands which are used extensively for grazing. Other reservoirs in the general area may be used by these geese.

AMERICAN PEREGRINE FALCON (Falco peregrinus anatum)-- (endangered - Federal and State)

Tidal, seasonal, fresh-to-brackish water, and riparian wetlands of San Francisco Bay are important habitats year-around for the American peregrine falcon, especially in nonbreeding seasons. This bird nests on protected ledges of high cliffs--mainly in woodland, forest, and coastal habitats. Peregrine falcons also nest on the Oakland Bay Bridge. The U.S. Fish and Wildlife Service has identified critical habitat for breeding peregrine falcons in Sonoma and Napa Counties outside the San Francisco Bay study area.

CALIFORNIA BROWN PELICAN (Pelecanus occidentalis californicus)-- (endangered - Federal and State)

Breakwaters, pilings, levees, and jetties within San Francisco Bay, as well as offshore rocks and islands, provide important roosting sites for migrating brown pelicans. Open-bay waters offer feeding and loafing habitat.

CALIFORNIA CLAPPER RAIL (Rallus longirostris obsoletus)-- (endangered - Federal and State)

The California clapper rail is found within eight of the nine San Francisco Bay counties. The estimated population of 500 to 700 rails is largely centered in South San Francisco Bay tidal marshes (Unpublished U.S. Fish and Wildlife Service and California Department of Fish and Game data, 1989). Smaller and more widely scattered populations occur in the tidal marshes bordering San Pablo and Suisun Bays.

CALIFORNIA LEAST TERN (Sterna antillarum browni)-- (endangered - Federal and State)

In the last decade California least terns have nested in a few San Francisco Bay locations including the Oakland Airport/Harbor Bay Isle, Bair Island, Baumberg Tract salt ponds, and the Alameda Naval Air Station, where a sanctuary has been established. They stage their migration at various locations adjoining salt ponds in South San Francisco Bay.

CALIFORNIA BLACK RAIL (Laterallus jamaicensis coturniculus)--
(threatened - State)

In the San Francisco Bay Area, black rails historically have been found in tidal salt marshes of both the North and South Bays, including Petaluma marsh, the Napa River Marshes, San Pablo Bay, Southampton Bay, and the extreme South Bay in San Mateo and Alameda Counties. Recent surveys of San Francisco Bay wetlands confirm that the black rail is less widely distributed than previously believed. Its distribution is very "patchy," since the bird is found only in tidal marshes that still have a higher elevational zone.

SALT MARSH HARVEST MOUSE (Reithrodontomys raviventris)-- (endangered - Federal and State)

The salt marsh harvest mouse is restricted to scattered, discontinuous, tidal, and nontidal wetlands around San Francisco Bay. The northern subspecies (Reithrodontomys raviventris halicoetes) occurs north of Point San Pedro (Marin County) and Point Pinole (Contra Costa County) in wetlands bordering San Pablo Bay, the Petaluma and Napa Rivers, and Suisun Bay, east to Collinsville and Antioch. The southern subspecies (Reithrodontomys raviventris raviventris) occurs from Point Pinole and Point San Pedro, south to Alviso.

SAN FRANCISCO GARTER SNAKE (Thamnophis sirtalis)-- (endangered - Federal and State)

The San Francisco garter snake is found in San Mateo County. Small populations occur at Ano Nuevo State Reserve, Pescadero Marsh Natural Preserve, San Francisco State Fish and Game Refuge (including both lower and upper Crystal Springs Reservoirs), Sharp Park golf course (Laguna Salada), Mori Point, Cascade Ranch, and Millbrae (San Francisco International Airport). This snake uses sunny, standing, freshwater habitats--chiefly ponds, lakes, marshes, sloughs, and slow moving streams, and adjacent uplands.

WINTER-RUN CHINOOK SALMON (Oncorhynchus tshawytscha)-- (threatened - Federal and endangered - State)

Young winter-run chinook salmon pass through the Bay during migration out of the Sacramento River system. Adults return from the ocean after three years and migrate through the open-bay waters prior to spawning in the Sacramento River system. The California Department of Fish and Game estimates the 1989 return of winter-run chinook salmon is at an all-time low of 500 fish.

BAY CHECKERSPOT BUTTERFLY (Euphydras editha bayensis)-- (threatened - Federal)

The Bay checkerspot butterfly occurs at San Bruno Mountain, Edgewood Park, Redwood City, Jasper Ridge in San Mateo County, and at Morgan Hill in Santa Clara County. Its habitat includes isolated islands of native grassland on shallow, serpentine soils that support abundant growth of the butterfly's larval food plants--annual plantain and owl's clover.

SAN BRUNO ELFIN BUTTERFLY (Callophrys mossi bayensis)-- (endangered - Federal)

The San Bruno elfin butterfly is found in fewer than 20 colonies in the fogbelt of steep, north-facing slopes on San Bruno and Montara Mountains and Milagra Ridge in San Mateo County. This butterfly occurs near rocky outcrops that contain prolific growth of the larval and adult food plant Sedum, a low-growing succulent.

MISSION BLUE BUTTERFLY (Plebejus icarioides missionensis)-- (endangered - Federal)

The mission blue butterfly's habitat is dominated by coastal chaparral and coastal grasslands. The species occurs in Twin Peaks, City of San Francisco, and Fort Baker, Marin County. It is also found at Milagra Ridge, Skyline College (Guadalupe Canyon Parkway), and San Bruno and Montara Mountains--all in San Mateo County.

CALIFORNIA FRESHWATER SHRIMP (Syncaris pacifica)-- (endangered - Federal and State)

The California freshwater shrimp is endemic to gentle-gradient, low-elevation, freshwater streams of Marin, Napa, and Sonoma Counties. The species, a true freshwater shrimp, inhabits quiet portions of tree-lined streams with underwater vegetation and exposed tree roots. Once common in the three counties, this species now occurs only within restricted portions of 12 streams. Decline of the California freshwater shrimp is attributed to degradation and loss of riparian habitat.

SAN MATEO THORN MINT (Acanthomintha obovata subsp. duttoni)-- (endangered - Federal and State)

The San Mateo thornmint occurs only in one known location, at Edgewood County Park in San Mateo County. It is an annual herb, found in grassy, serpentine, hillside habitat. Historically, it was found at scattered locations within an approximately 5-mile range in San Mateo County from Crystal Springs Reservoir in the north, to Woodside in the south.

LARGE-FLOWERED FIDDLENECK (Amsinckia grandiflora)-- (endangered - Federal and State)

The large-flowered fiddleneck occurs only in one known location, Corral Hollow, in the hills east of Livermore and very near the Alameda-San Joaquin County line. It is an annual grassland forb growing on light-colored, clay soils with low densities of competing grasses.

PRESIDIO MANZANITA (Arctostaphylos pungens var. ravenii)-- (endangered - Federal and State)

Presidio manzanita historically was found in scattered sites on serpentine soils within the San Francisco Peninsula from Fort Point in the north to Mount Davidson, in the south. The one known, remaining site occurs on the Presidio of San Francisco within the Golden Gate National Recreation Area.

PALMATE-BRACTED BIRD'S BEAK (Cordylanthus palmatus)-- (endangered - Federal and State)

This plant occurs near Livermore, in Alameda County. Its habitat includes alkali sinks and seasonal wetlands.

MASON'S QUILLWORT (Lilaeopsis masonii)-- (rare - State)

Mason's quillwort is a wetland plant that tends to form a sod at the bayward edges of tidal, brackish marshes. It also has been found growing in soil deposited in cracks of partially buried logs. The only known location of this rare plant in the San Francisco Bay study area is the Napa River.

APPENDIX B FEDERAL CANDIDATE SPECIES IN THE SAN FRANCISCO BAY STUDY AREA

<u>Species</u>	<u>Status</u> <u>Bay Zone*</u>	<u>Habitat Type</u>	<u>Location**</u>
<u>Birds</u>			
California black rail (<u>Laterallus jamaicensis coturniculus</u>)	1	Wetland	N,S
Western snowy plover (<u>Charadrius alexandrinus nivosus</u>)	2	Wetland	N,S
Salt marsh yellowthroat (<u>Geothlypis trichas sinuosa</u>)	2	Wetland	N,S
Suisun song sparrow (<u>Melospiza melodia maxillaris</u>)	2	Wetland	N
San Pablo song sparrow (<u>Melospiza melodia samuelis</u>)	2	Wetland	N
Alameda song sparrow (<u>Melospiza melodia pusillula</u>)	2	Wetland	S
Long-billed curlew (<u>Numenius americanus</u>)	2	Wetland	N,S
Tri-colored blackbird (<u>Agelaius tricolor</u>)	2	Wetland	N,S
<u>Mammals</u>			
Suisun shrew (<u>Sorex ornatus sinuosus</u>)	2	Wetland	N
Salt marsh wandering shrew (<u>Sorex vagrans halicoetes</u>)	2	Wetland	N,S
<u>Fish</u>			
Delta smelt (<u>Hypomesus transpacificus</u>)	1	Wetland	N
Sacramento splittail (<u>Pogonichthys macrolepidotus</u>)	2	Wetland	N
<u>Invertebrates</u>			
San Francisco forktail damselfly (<u>Ischnura gemina</u>)	2	Wetland	N,S
Ricksecker's water scavenger beetle (<u>Hydrochara rickseckeri</u>)	2	Wetland	N,S
Callippe silverspot butterfly (<u>Speyeria callippe callippe</u>)	2	Upland	S
Leech's skyline diving beetle (<u>Hydroporus leechi</u>)	2	Wetland	S

APPENDIX B FEDERAL CANDIDATE SPECIES IN THE SAN FRANCISCO BAY STUDY AREA (Cont.)

<u>Species</u>	<u>Status</u> <u>Bay Zone*</u>	<u>Habitat</u> <u>Type</u>	<u>Location</u>
<u>Alameda manzanita</u> (<u>Arctostaphylos pallida</u>)	2	Upland	N
<u>Tamalpais manzanita</u> (<u>Arctostaphylos pungens</u> subsp. <u>montana</u>)	2	Upland	N
<u>Suisun aster</u> (<u>Aster chilensis</u> var. <u>lentus</u>)	2	Wetland	N
<u>valley spearscale</u> (<u>Atriplex patula</u> subsp. <u>spicata</u>)	2	Wetland	N
<u>Tiburon mariposa</u> (<u>Calochortus tiburonensis</u>)	1	Upland	N
<u>Tiburon paintbrush</u> (<u>Castilleja neglecta</u>)	1	Upland	N
<u>Sonoma spineflower</u> (<u>Chorizanthe valida</u>)	2	Upland	N
<u>north coast bird's-beak</u> (<u>Cordylanthus maritimus</u> subsp. <u>palustris</u>)	2	Wetland	N, S
<u>procumbent bird's-beak</u> (<u>Cordylanthus nidularius</u>)	2	Upland	N
<u>Baker's larkspur</u> (<u>Delphinium bakeri</u>)	2	Upland	N
<u>San Francisco wallflower</u> (<u>Erysimum franciscanum</u>)	2	Upland	N, S
<u>diamond-petaled poppy</u> (<u>Eschscholzia rhombipetala</u>)	2	Upland	N, S
<u>adobe lily</u> (<u>Fritillaria pluriflora</u>)	2	Upland	N
<u>Diablo rock-rose</u> (<u>Helianthella castanea</u>)	2	Upland	N, S
<u>Tiburon tarweed</u> (<u>Hemizonia multicaulis</u> subsp. <u>vernalis</u>)	2	Upland	N
<u>Brewer's dwarf-flax</u> (<u>Hesperolinon breweri</u>)	2	Upland	N
<u>Marin dwarf-flax</u> (<u>Hesperolinon congestum</u>)	1	Upland	N, S
<u>Santa Cruz tarweed</u> (<u>Holocarpha macradenia</u>)	1	Upland	N, S
<u>Contra Costa goldfields</u> (<u>Lasthenia conjugens</u>)	2	Wetland	N, S
<u>delta tule-pea</u> (<u>Lathyrus jepsonii</u> subsp. <u>jepsonii</u>)	2	Wetland	N, S
<u>legenere</u> (<u>Legenere limosa</u>)	2	Wetland	N, S
<u>Mason's lilaeopsis</u> (<u>Lilaeopsis masonii</u>)	2	Wetland	N
<u>San Francisco owl's-clover</u> (<u>Orthocarpus floribundus</u>)	2	Upland	N, S
<u>white-rayed pentachaeta</u> (<u>Pentachaeta bellidiflora</u>)	2	Upland	N, S
<u>Mt. Diablo phacelia</u> (<u>Phacelia phacelioides</u>)	2	Upland	N, S

APPENDIX B FEDERAL CANDIDATE SPECIES IN THE SAN FRANCISCO BAY STUDY AREA (Cont.)

<u>Species</u>	<u>Status</u> <u>Bay Zone*</u>	<u>Habitat Type</u>	<u>Location**</u>
<u>Plants</u>			
glabrous allocarya (<u>Plagiobothrys glaber</u>)	2	Wetland	N,S
Calistoga allocarya (<u>Plagiobothrys strictus</u>)	2	Wetland	N
Napa bluegrass (<u>Poa napensis</u>)	2	Upland	N
Marin knotweed (<u>Polygonum marinense</u>)	2	Wetland	N
rock sanicle (<u>Sanicula saxatilis</u>)	2	Upland	N,S
Marin checkermallow (<u>Sidalcea hickmanii</u> subsp. <u>viridus</u>)	2	Wetland	N,S
Tamalpais streptanthus (<u>Streptanthus batrachopus</u>)	2	Upland	N
Morrison's jewelflower (<u>Streptanthus morrisonii</u>)	2	Upland	N
Tiburon jewelflower (<u>Streptanthus niger</u>)	1	Upland	N
showy Indian clover (<u>Trifolium amoenum</u>)	2+	Wetland	N,S
San Bruno manzanita (<u>Arctostaphylos imbricata</u>)	1	Upland	S
Montara manzanita (<u>Arctostaphylos montaraensis</u>)	2	Upland	S
Alameda manzanita (<u>Arctostaphylos pallida</u>)	2	Upland	S
Laurel Hill manzanita (<u>Arctostaphylos uva-ursi</u> var. <u>franciscana</u>)	1++	Upland	S
Leo Brewer's manzanita (<u>Arctostaphylos uva-ursi</u> var. <u>leobreweri</u>)	1++	Upland	S
Pacific manzanita (<u>Arctostaphylos uva-ursi</u> var. <u>saxicola</u>)	1	Upland	S
miniature manzanita (<u>Arctostaphylos uva-ursi</u> var. <u>suborbiculata</u>)	2	Upland	S
Coyote California-lilac (<u>Ceanothus ferrisiae</u>)	2	Upland	S
Mt. Hamilton thistle (<u>Cirsium fontinale</u> var. <u>campylon</u>)	2	Upland	S
fountain thistle (<u>Cirsium fontinale</u> var. <u>fontinale</u>)	2	Upland	S
no common name (<u>Clarkia concinna</u> subsp. <u>automixia</u>)	2R	Upland	S
Presidio clarkia (<u>Clarkia franciscana</u>)	1	Upland	S
Mt. Hamilton coreopsis (<u>Coreopsis hamiltonii</u>)	2	Upland	S

APPENDIX B FEDERAL CANDIDATE SPECIES IN THE SAN FRANCISCO BAY STUDY AREA (Cont.)

	Status Bay Zone*	Habitat Type	Location**
Santa Clara Valley dudleya (<u>Dudleya setchellii</u>)	1R	Upland	S
Contra Costa buckwheat (<u>Eriogonum truncatum</u>)	2	Upland	S
San Mateo woolly-sunflower (<u>Eriophyllum latilobum</u>)	1	Upland	S
San Francisco gumplant (<u>Grindelia maritima</u>)	2	Wetland	S
San Francisco lessingia (<u>Lessingia germanorum</u> var. <u>germanorum</u>)	1	Upland	S
slender pentachaeta (<u>Pentachaeta exilis</u> subsp. <u>aeolica</u>)	2	Upland	S
San Francisco popcornflower (<u>Plagiobothrys diffusus</u>)	2+	Upland	S
Hickman's cinquefoil (<u>Potentilla hickmanii</u> var. <u>hickmanii</u>)	2	Upland	S
Mission Delores campion (<u>Silene verecunda</u> subsp. <u>verecunda</u>)	2	Upland	S
Metcalf Canyon jewelflower (<u>Streptanthus albidus</u> subsp. <u>albidus</u>)	2	Upland	S
Mt. Hamilton jewelflower (<u>Streptanthus callistus</u>)	2	Upland	S

- * Status:(1) Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
 (2) Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
 (1R) Recommended for Category 1 status.
 (2R) Recommended for Category 2 status.
 (+) Possibly extinct.
 (++) Extinct in the wild.

** Location Within Study Area: N = North Bay
 S = South Bay

APPENDIX C

STATE SPECIES-OF-SPECIAL-CONCERN
WITHIN THE SAN FRANCISCO BAY ZONE *

<u>Species</u>	<u>Priority**</u>	<u>Habitat Type</u>	<u>Study Area***</u>
<u>Mammals</u>			
Salt marsh wandering shrew (<u>Sorex vagrans halicoetes</u>)	1	Wetland	N
Suisun shrew (<u>Sorex ornatus sinuosus</u>)	1	Wetland	N,S
<u>Birds</u>			
Common loon (<u>Gavia immer</u>)	1	Wetland	N,S
American white pelican (<u>Pelicanus erythrorhynchos</u>)	1	Wetland	N,S
Barrow's goldeneye (<u>Bucephala islandica</u>)	1	Wetland	N,S
Northern harrier (<u>Circus cyaneus</u>)	2	Wet/Upl	N,S
Osprey (<u>Pandion haliaetus</u>)	2	Wetland	N,S
Western snowy plover (<u>Charadrius alexandrinus nivosus</u>)	2	Wetland	N,S
Burrowing owl (<u>Athene cunicularia</u>)	2	Upland	N,S
California gull (<u>Larus californicus</u>)	3	Wet/Upl	N,S

* Source: Remsen (1982) and Williams (1986)

** Priority: 1 - Species faces immediate extirpation if current trends continue
2 - Species declining in large portion of range
3 - Very small populations vulnerable to extirpation

*** Study Area: N - North Bay
S - South Bay

APPENDIX D

TIME FOR WETLANDS:
A U.S. FISH AND WILDLIFE SERVICE INITIATIVE

JUNE 1989

FISH AND WILDLIFE SERVICE WETLANDS INITIATIVE

Prepared by

**FISH AND WILDLIFE SERVICE
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PROBLEM

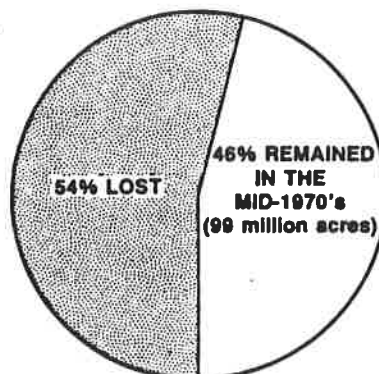
More than half of the wetlands in the contiguous United States have been lost, most in the past 30 years. The loss continues at more than 400,000 acres per year.

As wetlands are lost, their value to the nation's environmental and social health becomes more apparent. Wetlands provide economical flood storage, sediment control, and water treatment and supply. Wetlands provide economic returns in the foods and fiber they nourish. Education, research, history, recreation, and open space are valued products of wetlands. Wetlands are essential to fish and wildlife populations.

For more than 10 years, scientists and conservation leaders have emphasized the importance of wetlands and the critical magnitude of their loss. In November 1988, the Conservation Foundation facilitated a prestigious National Wetland Policy Forum that published a recommendation, now widely accepted and even endorsed by the President, for no overall net loss in the Nation's remaining wetlands base.

The U.S. Fish and Wildlife Service has long recognized the importance of wetlands to fish and wildlife resources. In response to the national attention on wetlands, the Service established a Team to review the status of its wetlands programs. The Team was directed to develop a framework for an expanded Service response to the problem of wetland loss and the opportunities to join other Federal, state, and private efforts to reverse the trend.

215 MILLION ORIGINAL ACRES



BACKGROUND

The Fish and Wildlife Service (Service) has a long, consistent history of wetlands protection and enhancement. Since its establishment in 1871 and its transition into the Bureau of Biological Survey in 1905, the Service has progressed in its responsibilities for the wetland resources of the Nation.

It became the steward for parcels of wetlands in the National Wildlife Refuge System and for sport fishery resource management. International treaties protecting migratory birds, primarily those dependent upon wetlands across the continent, became its core authority.

The Service gained responsibilities for federal leadership in fishery and wildlife research and education. Its counsel on federal water projects and permits was mandated.

Endangered species concerns of the Nation, many associated with wetlands, were legislated for Service action. Service law enforcement reached broadly but wetlands and migratory bird species remained its nucleus. The Service assumed leadership in learning about the effects of contaminants, including acid precipitation, on fish and wildlife resources. Its National Wetlands Inventory established a substantial base of knowledge on wetland abundance and distribution. Progress in wetlands conservation has been made under the 1985 Food Security Act. More recently, the Emergency Wetlands Resources Act, National Recreational Fisheries Policy, and North American Waterfowl Management Plan emphasized continued Service wetland conservation leadership.

Although the Service's responsibilities for and work on wetlands increased during the past 85 years, continental wetlands loss continues. The Service must reevaluate its budget and management priorities to do even more to enhance its wetlands conservation effectiveness.

The Administration recognizes the national importance of wetlands and the devastating economic and social implications of continued wetland loss. Congress is attuned to growing national concerns for wetlands conservation. A national groundswell for action is documented in the recent publications, "Blueprint for the Environment,"

produced by 18 national conservation organizations, and "Protecting America's Wetlands: An Action Agenda," by the National Wetlands Policy Forum and The Conservation Foundation. The timing could not be better for the Service to further promote wetlands protection and enhancement for fish and wildlife values, garnered by public support of integrated wetlands initiatives.

As the organization charged with the leadership for conserving fish and wildlife values of wetland resources, the Service recognizes the multiple benefits of wetlands to the environmental, social, and economic well-being of the Nation.

This document, beginning with a policy statement and supported by a set of definitive strategies and actions, describes the renewed commitment of the Service for conservation of the wetlands of North America. Some actions will require new funding; many others can be accomplished by internal adjustments. The Service invites Federal, state, university, and private cooperators to continue to form effective coalitions with the Service to address the common, national wetlands conservation challenge that is before us.

Budgets and operational plans will be developed by the Service regions to implement the programs outlined in this initiative.

POLICY STATEMENT

The Service's mission is "to provide the Federal leadership to conserve, protect, and enhance fish and wildlife and their habitat, for the continuing benefit of the people."

Wetlands maintain the quality of life through material contributions to our national economy, food supply, water supply and quality, flood control, and fish, wildlife, and plant resources, and thus to the health, safety, recreation, and economic well-being of all citizens. Wetlands are the most biologically productive and diverse habitats in North America. They are also the most threatened. Consequently, the Service emphasizes the protection and wise use of wetlands.¹

The Service's policy is to promote no net loss of the Nation's remaining wetlands base, and to accomplish a net gain in the quality and quantity of wetlands through restoration, development, and enhancement.

¹Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

FRAMEWORK

The Service has programs in wetland-related activities such as land acquisition, wetlands inventory, endangered species, Farm Bill implementation, restoration, and habitat management on refuges and private lands, fisheries management, fish and wildlife technical assistance, review of Federal development activities, cooperative program with agricultural interests, and implementation of the North American Waterfowl Management Plan. These efforts clearly need to be expanded. The Service must also encourage fuller participation from other Federal agencies, the states, and private cooperators in addressing the national wetlands conservation concern. More leadership and individual action is required by all if the challenge of wetlands conservation is to be met.

The framework for the Service's wetlands initiative is 10 strategies that are the basic concepts for an effective, comprehensive Service wetlands program. Within each strategy is first, a set of new and expanded efforts required for effective wetlands conservation. Second, a listing of priority ongoing wetland efforts is provided to guide the Service wetlands activities through the 1990's. The Service wetlands initiative builds upon existing successes, capabilities, and ideas. It provides for the Service and its cooperators to concentrate on wetlands resources primarily through existing authorities.

CONSERVATION STRATEGIES

The Service implements its wetlands conservation policy through national and international strategies that include:

- PRIVATE STEWARDSHIP** *Provide technical and financial assistance to private landowners in protection, restoration, management, and enhancement of wetland resources.*
- PARTNERSHIPS** *Encourage other agencies, through their programs and authorities, to protect, restore, manage, and enhance wetland resources.*
- AWARENESS** *Increase knowledge, develop a public conservation ethic, and foster citizen participation in wetland conservation.*
- PUBLIC LANDS** *Maximize protection, restoration, management, and enhancement of wetland resources on public lands.*
- PROTECTION** *Promote long-term and permanent protection of wetland resources using easements, leases, and acquisition.*
- TRENDS** *Provide national leadership in monitoring the status and trends of wetland habitats, migratory birds, and other associated species.*
- COMPLIANCE** *Support full compliance with all legal and regulatory requirements that provide protection to wetlands and wetland associated species on public and private lands.*
- RESEARCH** *Provide national leadership in research on wetland habitats and their fish and wildlife functions and values.*
- CONTAMINANTS** *Assess the effects of environmental contaminants on wetland habitats and promote corrective actions.*
- GLOBAL** *Promote global awareness of wetlands values and wetland protection and management with international cooperators.*

Specific Service actions to implement these strategies are listed on the following pages. Budget and organizational requirements needed will be developed upon final acceptance of this framework.

PRIVATE STEWARDSHIP STRATEGY

Provide technical and financial assistance to private landowners in protection, restoration, management, and enhancement of wetland resources.

The Nation's private sector owns the majority of wetlands in all states but Alaska, totaling 65 million acres. It is clear that the majority of wetlands conservation opportunities exist on private lands. The Service, recognizing an historically close alliance with rural landowners, should concentrate its efforts on programs that will implement this strategy by the following actions.

NEW AND EXPANDED EFFORTS

- Expand existing programs that provide information, technical assistance, and financial incentives to private landowners in conserving wetland resources and improving land use practices on adjacent uplands, thus benefitting wetland wildlife, especially migratory species.
- Develop joint ventures with private landowners as provided for under U.S. Department of Agriculture programs, endangered species authorities, North American Waterfowl Management Plan, etc., to reduce the impact of agricultural practices on existing wetlands and to enhance habitats for waterfowl and other wetland species (e.g., converting farmed wetlands to moist-soil management areas, restoring drained wetlands, reforesting cleared bottomland hardwood areas, reducing wetland siltation, and creating deltas).
- Develop cost-effective demonstration projects in key areas to show landowners how wetlands, wetland values, and land stewardship can be incorporated into a profitable farming or ranching operation.
- Work with private landowners near existing Waterfowl Production Areas and National Wildlife Refuges to develop and

restore temporary and seasonal wetlands. Improving the complex will increase habitat quality and quantity for waterfowl and other wetland species.

- Organize cooperative wetlands protection, restoration, management, and enhancement initiatives with public and private groups that have private- land programs (e.g., conservation organizations habitat programs; adding \$10/acre for select Water Bank areas by which the Service obtains additional fish and wildlife benefits from the landowners).
- Work with private land developers and municipalities to identify high priority wetland areas before their planning reaches the Federal regulatory process.

ONGOING PRIORITY EFFORTS

- To Service field staff, aggressively communicate what the Service roles are under the Food Security Act, and how outreach and cooperative efforts with Farmers Home Administration, Soil Conservation Service, Agriculture Stabilization and Conservation Service, and other components of the U.S. Department of Agriculture will continue to support Service wetland conservation efforts.
- Encourage and participate in regional and state-wide water management planning efforts, with emphasis on watershed management of wetland resources.
- Assist with planning private water development projects to resolve wetland impact concerns and develop non-adversarial approaches to discourage drainage of private wetlands.
- Promote legislation providing Federal, state, and local tax incentives in agricultural, industrial, and commercial enterprises for wetland protection and enhancement for fish and wildlife purposes.

PARTNERSHIPS STRATEGY

Encourage other agencies, through their programs and authorities, to protect, restore, manage, and enhance wetland resources.

The Service is one of many public agencies with responsibilities for wetland conservation. To maximize economy and efficiency in the Federal wetland management and protection effort, the Service will implement this strategy by the following actions:

NEW AND EXPANDED EFFORTS

- Increase field level wetlands management technical assistance to Federal agencies and Tribes.
- Develop programs with state agencies to promote cooperative wetlands conservation efforts, especially using the Federal Aid Programs, Emergency Wetlands Resources Act, Clean Water Act, Endangered Species Act, North American Waterfowl Management Plan, Recreational Fisheries Policy, Food Security Act, and to aid states in assuming primary wetland regulatory responsibility.
- Intensify cooperative wetlands education programs.
- Develop private funding sources for cost-sharing wetlands protection.

ONGOING PRIORITY EFFORTS

- Establish personal contacts among high level Service and Department of the Interior officials and their counterparts in other Federal agencies to improve wetlands protection and management efforts.
- Develop agreements with appropriate Federal agencies to eliminate subsidies for wetland conversion and provide incentives for wetland conservation from any federally sponsored funding.

- Establish an Interagency Wetlands Resources Task Force to coordinate Federal wetland protection and management activities.
- Participate with other Federal agencies in planning for a National Agricultural Wetlands Reserve Program and to establish a National Wetlands Trust Fund for sustained financing of wetland conservation actions.
- Develop, in cooperation with U.S. Department of Agriculture, a strategy for long-term maintenance of Conservation Reserve Program acreages that provide protection for wetland resources and associated values and to expand the Water Bank Program to its fully authorized level.
- Serve on committees to develop national technical guidance and designs for wetland restoration and development.
- Provide guidance and technical assistance in mapping existing and restorable wetlands and in tracking the status of wetlands on areas managed by other agencies.
- Assist the Federal Emergency Management Agency in ensuring that areas are not brought into the Federal flood insurance program until the localities to be benefitted have taken adequate steps to protect any wetland located in those areas.
- Explore legislative and other means of establishing a grants program to enable the Federal government to cost-share with private landowners the expenses of restoring or improving their wetlands.
- Assist the Environmental Protection Agency in establishing and implementing procedures for verifying compliance with wetland mitigation measures.
- Assist the Environmental Protection Agency and state water pollution control agencies to demonstrate improved ways to prevent/reduce wetland degradation due to permitted activities such as pollutant discharges and mineral extraction.

AWARENESS STRATEGY

Increase knowledge, develop a public conservation ethic, and foster citizen participation in wetlands conservation.

To carry out its mandated mission to conserve, protect, and enhance fish and wildlife resources and their habitats for the continuing benefit of the American people, the Service recognizes the essential involvement of private landowners, who own the bulk of the Nation's wetlands, and the citizens who are concerned about wetland resources. The Service's ultimate purpose in serving the public then, is to apprise them of their wildlife trust and aid them in the conservation of that trust. Therefore, the Service will implement the following actions:

NEW AND EXPANDED EFFORTS

- Seek innovative ways to inform rural landowners of the economic benefits of wetland conservation for fish and wildlife, including wetland restoration and the justification for various state and federal wetland regulations.
- Develop mass media outreach to urban populations. Inform the public of the benefits they derive from wetlands and how they can assure the preservation and management of wetlands for all fish and wildlife resource values.
- Develop nation-wide public information programs for primary and secondary school use on the value of wetlands to waterfowl and fish, other wetland dependent species, and other wetland values.
- Widen the support base by promoting use of public wetlands by all users and develop programs designed specifically for non-consumptive users of public lands (e.g., Wetlands Conservation Stamp, U.S. postage stamp, increased marketing of the Federal Duck Stamp, wetlands user fee, wetlands income tax incentives).

- Develop a national program with other agencies and private groups to recognize private citizens, corporations, and businesses for wetlands preservation or restoration efforts.

ONGOING PRIORITY EFFORTS

- Increase outreach to local conservation groups, sportsmen's clubs, private individuals, to encourage their awareness of and participation in various Service programs such as the North American Waterfowl Management Plan and its joint ventures, endangered species recovery plans, enforcement of fish and wildlife laws, and agricultural programs that benefit wildlife.
- Continue updating popular Service publications and audio-visual materials to better inform and educate the public of the loss of U.S. wetlands, the effects on high priority fish and wildlife species, and what can be done to restore these diverse habitats.
- Determine attitudes of private wetland owners on values of wetlands and fish and wildlife, and the importance of wetlands conservation.
- Improve the quality/quantity and availability of information about wetlands management to wetland managers.
- Co-produce information packages with private conservation organizations to stimulate citizen participation in wetland conservation.
- Explore ways of encouraging state/local governments to provide additional incentives for private wetlands protection.
- Increase internal awareness, through in-Service briefings and cross-training, of the benefits of Service actions under various programs (e.g., the Food Security Act, with special emphasis on encouraging greater Service farm outreach on wetland economic values; North American Waterfowl Management Plan, with emphasis on encouraging greater involvement of all Service employees in the opportunities available for promoting fish and wildlife resources management through the Plan and its partners).

PUBLIC LANDS STRATEGY

Maximize protection, restoration, management, and enhancement of wetland resources on public lands.

The Service, as the lead National agency for conserving fish and wildlife values of wetlands, will implement this strategy by the following actions:

NEW AND EXPANDED EFFORTS

- Increase development, restoration, management, enhancement of wetland resources on Service lands.
- Assist other public land management agencies to improve protection, restoration, development and management of their wetland resources for fish and wildlife values. The Service can accomplish this through development of memoranda of understanding or cooperative agreements, wetlands inventories, evaluation of sites and operating procedures, and developing cooperative management plans to implement work on their lands.
- Increase participation of other public land management agencies in joint ventures, especially in priority areas under the North American Waterfowl Management Plan and other Service programs.
- Secure water rights, when appropriate, for all Service managed wetlands and encourage other Federal, state, and local land management agencies to do likewise.
- Create demonstration projects on select Service lands that promote the economic, biological, and social values of wetlands to the public and neighboring private landowners.

ONGOING PRIORITY EFFORTS

- **Promote the development of a policy and legislation, if appropriate, for no net loss of wetland acres and functions for all Federal, state, and local public lands.**
- **Continue ongoing cooperative efforts with the Department of Defense to enhance and manage wetlands on military lands and to identify excess properties with wetlands potential.**

PROTECTION STRATEGY

Promote long-term and permanent protection of wetland resources using easements, leases, and acquisition.

Permanent easement, long-term leases, and fee title acquisition are the preferred means of providing protection for key wetland resources. As the lead Federal agency in conserving wetland habitats for fish and wildlife functions, the Service should pursue this strategy by the following actions:

NEW AND EXPANDED EFFORTS

- Accelerate permanent protection of high priority wetlands, particularly those needed to protect or allow recovery of endangered or threatened species, areas identified under the North American Waterfowl Management Plan and the Emergency Wetlands Act, unique areas that provide maximum habitat values to the widest diversity of species and critical nursery areas for important recreational fisheries.
- Accelerate efforts to identify and acquire damaged wetlands with potential for restoration and enhancement, and complete the restoration and enhancement on those lands, particularly in the North American Waterfowl Management Plan joint venture areas and in areas needed to protect or allow recovery of endangered or threatened species, and in critical nursery areas for important recreational fisheries.

ONGOING PRIORITY EFFORTS

- Aggressively pursue wetland acquisition and protective measures through joint ventures with all interested and capable parties under the North American Waterfowl Management Plan, to help reach the Plan's goal of 2 million additional protected acres in the United States by the year 2000.

- Assist other Federal and state agencies to identify and acquire key existing and restorable wetlands that are in-holdings or are adjacent to their lands.
- Pursue legislative changes to the Refuge Revenue Sharing Act to correct deficiencies.
- Promote the operational use of other wetlands protection actions including easements, wetland mitigation banking, and wetland exchanges in cooperation with other public agencies.
- Identify additional funding sources for acquisition (Wetlands Conservation Stamp, fines from wetland violations, user fees, supplies, refuge revenues, etc.)

TRENDS STRATEGY

Provide national leadership in monitoring the status and trends of wetland habitats, migratory birds, and other associated species.

Fish and wildlife are indicators of the health of wetlands on a continental basis and at local sites. The Service is primarily interested in wetland fish and wildlife functions while recognizing the other important values of wetlands. As the recognized authority in the status and trends of wetlands wildlife, especially migratory birds and endangered species and their wetlands habitats, the Service must maintain international leadership if it is to be an effective advocate for wetlands resources. The Service will implement this strategy by the following actions:

NEW AND EXPANDED EFFORTS

- Update the Service's "Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1950's to 1970's," to provide current trend information on loss of wetland functions and on the causes and acreages of wetland alterations, particularly in key regions of the United States as identified under the North American Waterfowl Management Plan.
- Improve waterfowl breeding ground surveys to both increase coverage outside normally surveyed areas and better assess wetlands and associated habitats in surveyed areas, and to restructure winter waterfowl surveys to better delineate waterfowl use of high priority habitat categories.
- Digitize all National Wetlands Inventory maps for easy conversion to acreage totals, beginning with wetlands within the high priority habitat categories identified in the North American Waterfowl Management Plan.
- Conduct accelerated population assessment programs for key species such as black ducks and pintails to determine waterfowl

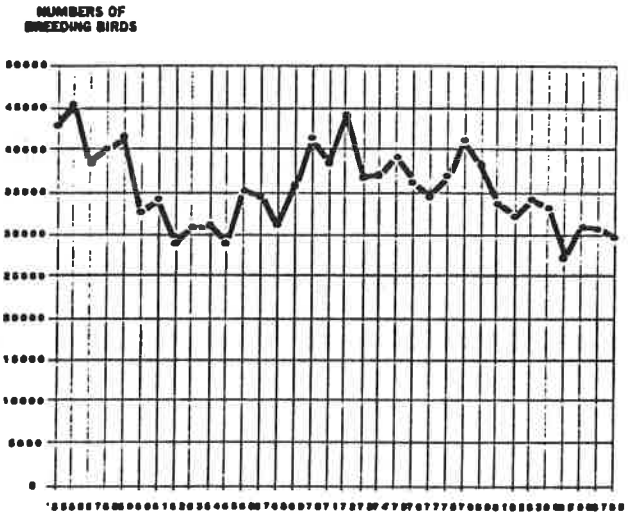
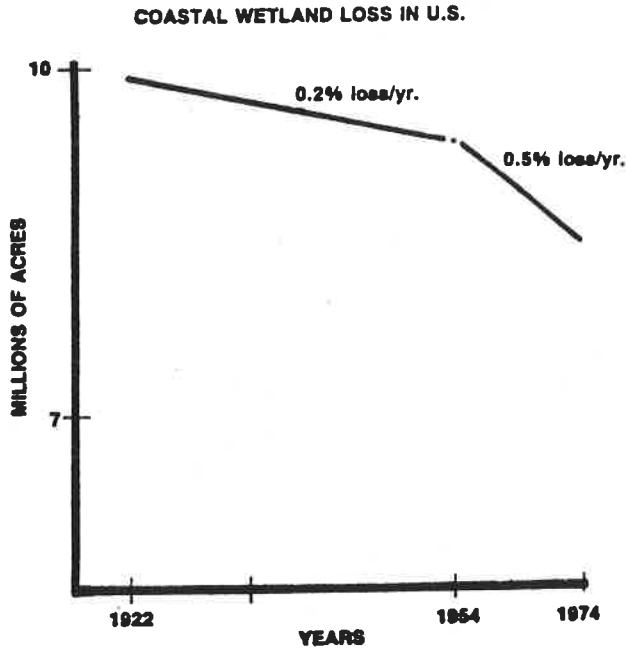
migration patterns as they relate to utilization of high priority habitat categories.

- Provide wetlands resources databases that would be available to all private/state/Federal cooperators. The information and spatial data system should, at a minimum, include -- National Wetlands Inventory maps, U.S. Department of Agriculture Swampbuster and Conservation Reserve areas, joint venture areas, North American Waterfowl Management Plan priority waterfowl areas of concern, migratory bird population data, Priority Wetland Conservation Plan areas, and protected wetlands in private, state, and Federal ownership.
- Quantify the relationship between increasing and decreasing trends in waterfowl and wetland nongame species, and the availability of wetland habitats.

ONGOING PRIORITY EFFORTS

- Continue the mapping of wetlands under the National Wetlands Inventory, emphasizing areas identified in the North American Waterfowl Management Plan and monitor the status of wetlands in these areas.
- Utilize data gathered from the Breeding Bird Survey, Colonial Waterbird Survey, Christmas Bird Count, Breeding Bird Census, state breeding bird atlases, and International Shorebird Survey to quantify non-game species use of wetland habitats.
- Encourage state agencies to maintain an active monitoring program of state wetland areas and establish a nationwide system for compiling and tracking state wetland habitat trends.
- Evaluate existing migratory bird population monitoring techniques and operations as the means of reflecting wetland health continentally. Define deficiencies relative to the needs of the North American Waterfowl Management Plan and design programs to correct the deficiencies.
- Maintain the list of wetlands related endangered species correlated to types of essential wetlands habitat.

- Use wetland dependent fishery monitoring methods as an additional method of reflecting wetland well-being.
- Accelerate dissemination information about availability and utility of wetland mapping products.
- Identify future sites for designation as wetlands of International Importance under the "Convention on Wetlands of International Importance," especially as Waterfowl Habitat (Ramsar Convention).



COMPLIANCE STRATEGY

Support full compliance with all legal and regulatory requirements that provide protection to wetlands and wetland associated species on public and private lands.

The Service has been empowered by Congress to protect wetland-dependent wildlife species, including migratory birds and Federally-listed threatened and endangered species. The Service will direct its effort to:

NEW AND EXPANDED EFFORTS

- Continue to enforce regulations affecting migratory birds and all provisions of the Migratory Bird Treaty Act that affect wetland bird species.
- Ensure compliance with all regulations affecting contaminants on Service administered wetlands.
- Monitor success of wetland mitigation for fish and wildlife.

ONGOING PRIORITY EFFORTS

- Eliminate further loss of wetlands and degradation of their quality and function and promote restoration and enhancement by serving as a wetlands advocate in Section 404 reviews and in review of Federal water projects.
- Strive for full implementation of the wetland conservation provisions of the Food Security Act.
- Ensure protection of wetland resources provided by the Small Wetlands Acquisition Program, primarily wetland easement agreements.
- Strengthen the Section 404 provisions of the Clean Water Act and the role of the Service or support an independent Federal wetlands protection law.

- Encourage all government agencies to be accountable for compliance with and enforcement of wetland environmental laws and regulations.
- Provide recommendations on measures needed to effect successful mitigation in accordance with the Service's mitigation policy.
- Assist Federal (Corps of Engineers and Environmental Protection Agency) and state regulatory agencies in the development of regional general permits that implement a no net loss concept and related enforcement.
- Promote the multi-agency establishment of a public reporting system for non-compliance of any wetland protection regulation inclusive of a monetary reward system.

RESEARCH STRATEGY

Provide national leadership in research on wetlands habitats and their fish and wildlife functions and values.

To implement the wetlands conservation strategy, the Service will utilize the scientific expertise available in the 13 research centers including the Cooperative Fish and Wildlife Research Units. Emphasis will be to generate information and develop methodologies required to manage critical wetland habitats, and to determine factors required to enhance populations of priority species of fish and wildlife that depend on wetlands. Research expertise will assist in planning, conducting, and managing of wetland habitats and species. The Service will implement this strategy by the following actions:

NEW AND EXPANDED EFFORTS

- Develop and disseminate information that describes the state of knowledge related to wetland fish and wildlife habitats; their extent, functions, and values; their support of priority wetland species, such as waterfowl and endangered species; and the best techniques for restoration, management, and enhancement of wetlands for fish and wildlife.
- Develop evaluation techniques to monitor effectiveness of wetlands mitigation, restoration, and management efforts for waterfowl and other wetland species, and suggest alternatives for improvement. Techniques should include the assessment of other functional values of wetlands. Priority should go to the Prairie Pothole, Gulf and Atlantic Coasts, Lower Great Lakes, Lower Mississippi, and Central Valley of California.
- Conduct research on methods to identify and assess where and how existing wetland habitats are limiting fish and wildlife populations and determine dependencies of priority or declining

species on wetlands (i.e., pintail, black duck, canvasback, lake trout, anadromous fish).

- Establish baseline water quality data for the Service's most valuable waterfowl/wetland areas; evaluate changes in key limnological parameters as an early warning system of habitat degradation; define the function, dynamics, and hydrological relationships of wetlands and of water quality and quantity on a watershed basis, and the hydrologic requirements necessary to sustain wetland systems nationwide.
- Investigate and explain the effects of registered anthropogenic chemical, acid precipitation, and other contaminants on wetland-dependent species, and their ecosystems. Priority should be given to wetland dependent species, and to the interaction of disease and contaminants in wetlands. (i.e., avian cholera).
- Evaluate the effectiveness of the Service's land protection programs relative to long-term, biological considerations (i.e., projected impacts of global warming, needs for breeding migration and wintering habitats, rates of habitat and species); develop an ecological approach for implementing "no-net-loss" of wetlands so that protection (i.e., purchase, easements, etc.), of wetland sites can be based on wetland habitat quality and on the opportunities for fish and wildlife population.
- Expand research and develop management techniques to address disease and contaminant impacts on waterfowl, concentrating on avian cholera interactions with other environmental variables.
- Consolidate literature and conduct research on economic values of wetlands, especially to farmers, and alternative economic use and benefits of wetland resources. Provide recommendations on how to motivate business and industry to protect wetlands.

ONGOING PRIORITY PROJECTS

- Develop rapid, continent-wide population assessment techniques for migratory bird populations as indicators of wetland health.
- Describe the ecology of wetlands important to fish and wildlife, and ecological responses of fish and wildlife to habitat change.

- Determine data gaps and define research needs of the North American Waterfowl Management Plan, National Fisheries Policy, National Mitigation Policy, and other wetland related Service policies.
- Conduct field investigations into predator complex/prey relationships affected by damage to wetland ecosystems and by varying cover types and sizes of habitat blocks.
- Develop and adapt new remote sensing, video and biological assessment techniques to serve as wetland protection, survey, and management tools in preserving wetland resources.
- Determine effects of farm chemicals on wetlands in the prairies with emphasis on water quality and invertebrate populations.
- Evaluate moist soil management techniques on lands under Service control and make improvements to enhance fish and wildlife populations.
- Expand field research into habitat needs of wetland-dependent species, including waterfowl, fish, and endangered and threatened species.
- Demonstrate how habitat loss and degradation work to reduce species diversity and overall resilience of the ecosystem, as evidenced by declines in species complexity and quantity, and develop meaningful cumulative impact assessment models.
- Demonstrate the importance of the timing and availability of water supply to wetland quality and function by developing recommendations to accompany restoration and management techniques.
- Conduct field research to determine the degree to which atmospheric contaminants, such as acid rain, are impacting wetland ecosystems.

CONTAMINANTS STRATEGY

Assess the effects of environmental contaminants on wetland habitats and promote corrective actions.

The Service is pre-eminent among public agencies in the world in its investigations into the negative biological impacts of pesticides and industrial contaminants upon wildlife and their habitats. Because the rate at which man-made chemicals are released into the environment will not likely diminish for the balance of this century, the Service should implement this strategy by seeking to:

NEW AND EXPANDED EFFORTS

- Increase the scope and intensity of contaminant investigations on National Wildlife Refuge lands, and quickly recommend the surest and most cost-effective remedies available if contaminant levels of concern are found.
- Monitor wetland quality trends for possible interactions with contaminants and the effect on invertebrate populations.
- Develop information on the fate of contaminants as they relate to waterfowl, furbearers, non-game species, and important interjurisdictional fishes.
- Expand contaminant impact studies of effects of dredging and disposal operations on wetlands along the Texas and Louisiana Gulf Coast, Great Lakes, and other coastal areas.
- Assess methods to prevent additional contamination of National Wildlife Refuges from non-point source pollution.
- Encourage chemical companies to develop safer chemicals and non-chemical alternatives such as biological controls.

ONGOING PRIORITY EFFORTS

- Determine the effects of farm chemical applications (e.g., pesticides, fertilizers,) on wetlands, with emphasis on water quality, fish, and invertebrate populations.
- Continue reconnaissance and detailed investigations of irrigation drainwater in western states.
- Focus acquisitions and protective measures towards those tracts and habitats threatened by immediate contaminant pollution, or to those with the greatest potential for low-cost and short-term recovery.
- Work with the Environmental Protection Agency and other agencies to establish water quality standards for wetlands, especially as related to fish and wildlife requirements.
- Seek widespread cooperative action and productive consensus on the best means to avert future wetland contamination.
- Determine the condition of restored areas that have long-term agricultural/chemical treatment prior to their restoration.

GLOBAL STRATEGY

Promote global awareness of wetlands values and wetland protection and management with international cooperators.

Throughout its history, the Service (and its antecedent agencies in other Departments) has been keenly attuned to both the international nature of the species it sought to research and manage, and to the link to wetland habitat. To further recognize and expand the scope of protection for the scores of species whose habitats occur only seasonally in the continental U.S., the Service should implement this strategy by the following actions:

NEW AND EXPANDED EFFORTS

- Support agreements with Mexico, Canada, and the United States to determine practical means by which Mexico's wetlands may be conserved while balancing the needs of the native people.
- Provide protection of wetlands under the Great Lakes Water Quality Agreement, working with the Great Lakes Fishery Commission and the International Joint Commission.
- Promote greater international public awareness of the values of wetlands in developing nations in the Western Hemisphere by increased scientific wildlife training and expanded technology transfer to these nations to implement low-cost effective means to assess and safeguard remaining wetland habitats.
- Provide expertise upon request to all nations interested in assessing the quality/quantity of their wetland habitat resource.
- Work with international financial institutions, such as World Bank, to include conditions on development loans to conserve wetland resources and to create economic incentives to foreign business and industry.
- Work with institutions such as the Agency for International Development to include conditions on economic development assistance requiring the adoption of wetland conservation policies.

- Create a central clearinghouse for receiving, packaging, and delivering wetland values awareness messages to international cooperators.

ONGOING PRIORITY EFFORTS

- Use the North American Waterfowl Management Plan to work with Caribbean partners to protect key wetland sites.
- Coordinate with South America and the Soviet Union the protection/enhancement of wetlands important to shared migratory bird resources.
- Develop, better utilize, and strengthen international wetlands preservation agreements.
- Support the Ramsar Convention by identifying additional wetland habitats in the U.S. deserving international recognition and promote increased awareness of Service participation in the Convention.
- Seek to include wetland issues on the United Nations' agenda.
- Coordinate with other countries on the issue of illegal harvest of migratory birds.
- Participate in Earth Day 1990, emphasizing fish and wildlife values of wetlands.
- Propose large wetland areas for designation as "Biosphere Reserves" under the "Man and the Biosphere" program.

TRANSITIONS

The 1990's will be a decade of continued change, more rapid than ever. Society's social and economic expectations will heighten demands on natural systems, especially wetlands. Society's demands on the wetland resource will escalate the pressure on the Service to protect, restore, manage, and enhance wetlands for fish and wildlife and related values.

To meet its mandates, the Service must adopt the strategies in the proposed wetlands initiative. The Service must become more effective in its work with private wetland owners. It must promote public awareness of wetlands conservation. It must find more opportunities to integrate fish and wildlife objectives with those of the Nation's agricultural industry. The Service must act to maintain the quality and quantity of wetlands in the face of spiralling human impacts on land, air, and water. The Service must respond to the expanding number of outdoor enthusiasts who visit the Nation's wetlands.

The North American Waterfowl Management Plan will continue to expand as a means to accomplish many of the Service's responsibilities. The Service will also build on the past successes of Federal, state, and private efforts.

First, the Service will respond by reviewing the current distribution of funding and work priorities. It will shift emphasis from traditional activities that demonstrate moderate to little effect on meeting the "no net wetland loss/overall gain" in wetlands the Service controls and influences, to new activities that show more promise.

Secondly, the Service will seek resources for initiatives that cannot be implemented effectively with existing funding and personnel. The Service and its cooperators will support new legislation to aid wetland protection.

Finally, and as an historic foundation for its credibility, the Service's dedicated staff will continue to be committed to a level of professional resource management services expected by the American public.