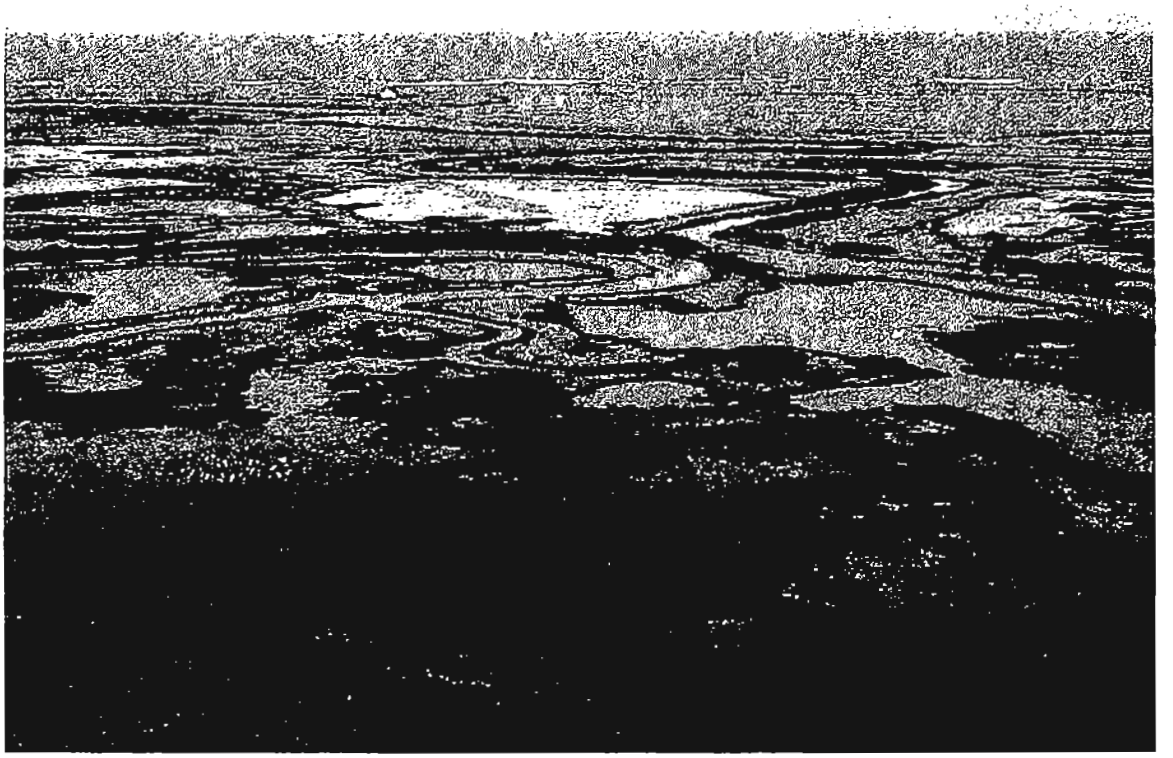
NATURAL RESOURCES of the EEL RIVER DELTA

State of California

DEPARTMENT OF FISH AND GAME

November, 1974



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State of California

DEPARTMENT OF FISH AND GAME

NATURAL RESOURCES

OF

THE EEL RIVER DELTA

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COASTAL WETLANDS SERIES #9

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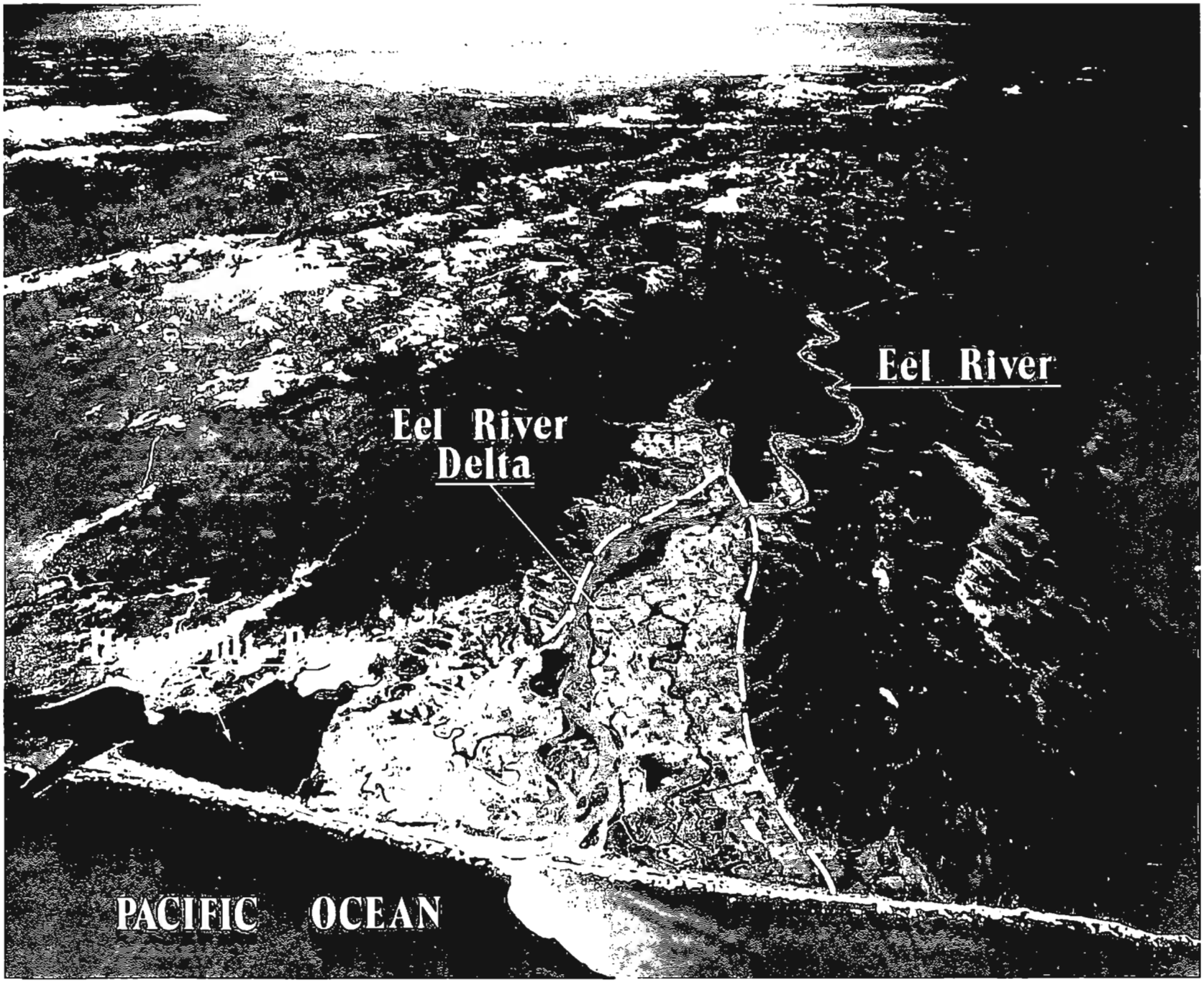
Eel River
Eel River
Delta
PACIFIC OCEAN

ACKNOWLEDGEMENTS

This report was prepared by personnel of the Department's Region I field office in Eureka and staff members of the Wildlife Management Branch in Sacramento. The Environmental Services, Anadromous Fisheries, Inland Fisheries and Marine Resources branches, as well as the Marine Resources Region and Planning Unit, contributed essential data and editorial assistance. Dave Rogers, Inland Fisheries Region I; Ron Warner, Marine Resources Region and Larry Puckett, Contract Services Section, Environmental Services, were particularly helpful. Ruth Hurd, Coastal Wetlands Project, typed the manuscript and Kenneth Gonzales, of the Department's Engineering Section, delineated the plates.

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TABLE OF CONTENTS

INTRODUCTION

The purpose of this report is to document the natural resources of the Eel River Delta, Humboldt County; to outline and evaluate the problems and conflicts of use that affect those resources; and, to recommend measures that will protect and enhance the Delta and its environs.

The Eel River Delta is an important segment of the coastal wetlands of California. Over two-thirds of the State's original bays, estuaries, lagoons and coastal marshes has already been lost to development and reclamation. Because of the importance of coastal wetland ecosystems to fish and wildlife, the Department has initiated a high priority, statewide inventory of the remaining wetland areas. This publication is an integral part of that program and one of a "Coastal Wetland Series" that includes reports on Upper Newport Bay, Orange County; Goleta Slough, Santa Barbara County; Bolinas Lagoon, Marin County; Elkhorn Slough, Monterey County; San Diego Bay, San Diego County; Humboldt Bay, Humboldt County; Los Penasquitos Lagoon, San Diego County; and Morro Bay, San Luis Obispo County.

This publication is intended as a guide for citizens, local, state and federal planners and administrators and all others interested in the use and development of coastal lands and waters. The Department, charged with the responsibility for the preservation, maintenance and wise use of fish and wildlife resources for the benefit of all people, presents this report towards the fulfillment of that obligation.

SUMMARY

The flood plain of the Eel River extending from the mouth of the river upstream to its confluence with the Van Duzen River is called the Eel River Delta. The delta covers approximately 33,000 acres. The Eel River system drains about 3,600 square miles, including parts of Humboldt, Mendocino, Glenn and Lake counties.

The dominant physical features of the area are the wide river course which meanders through pasturelands and the typical river delta of sloughs, marshes and other tidal wetlands. The climate is characterized by cool Mediterranean-like temperatures with very wet winters, and summers with low precipitation but common low, coastal fog.

Historically the rich soils of the delta attracted settlers and much of the original wetlands was converted to agricultural use by levee and dike construction. At one time, row crops, particularly potatoes, were a major product and agricultural produce was shipped by boat from Port Kenyon. Potato blight, increased siltation that brought shipping by boat to an end, together with the completion of the Northwestern Pacific Railroad and the Redwood Highway, brought a change in agricultural practices in the delta. Gradually row crops were replaced by pasture lands and livestock.

Tidal influence extends inland through the delta to the mouth of the Van Duzen River. The tides coupled with a steady inflow of freshwater give the lower delta its estuarine character. The substrate of the channels in the lower delta consist of silt and clay but are rich in humus from flood deposited alluvium.

Agriculture is the dominant land use in the Eel River Delta. Most of the land is used as beef and dairy livestock pasture. Row crops occupy only small acreages. Lumber mills and gravel operations constitute the only other significant industries in the delta area. About 600 acres of delta lands are used for commercial purposes and approximately 2,000 acres for residences, mostly centered in and around the communities of Fortuna, Ferndale, Fernbridge, Loleta and Port Kenyon. The remainder of the delta can best be described as wildlands and includes the river channel, riparian woodlands, tidelands and beaches. These areas, especially in the lower delta are used extensively for recreation. Water used within the delta for domestic, municipal, industrial and agricultural uses is obtained from wells or small tributaries.

Most of the Eel River Delta is in private ownership. Publically owned delta lands include two small county parks, one at Centerville and one at Crab Park. The Department of Fish and Game manages 170 acres on the sand spit north of the river's mouth, as a wildlife area. The lands under tidal influence and all navigable delta waters are state-owned.

The fish and wildlife values of the delta are high because of the variety and interspersion of habitat types. An inventory of habitats in the delta area includes well drained pasture, poorly drained pasture, cultivated fields, freshwater marsh, salt marsh, tidal mudflats, uplands, riparian woodland, sand dunes, sand and gravel bars, shallow water bays, sloughs and deepwater channels.

The wide variety of habitats, especially the estuarine types, like the tidal flats, salt marsh and waterways, but including the low

pasturelands and riparian woodlands, makes the Eel River Delta very attractive to many sorts of wildlife. Over 200 species of birds and 40 species of mammals are listed from the delta. Some of the birds are residents, but most are migrants. The delta and adjacent Humboldt Bay wetlands are a vital link in the coastal flyway for migratory waterfowl, shorebirds, wading and other water-associated birds. Delta riparian habitat and pasturelands attract many types of land birds like the songbirds and upland gamebirds, as well as raptors such as hawks and owls. In the winter the poorly drained pastures are major feeding grounds for herons and egrets.

Black-tailed deer are the largest of the land mammels found in the delta. Water-associated animals like the beaver, mink and otter also are found along with other furbearers such as gray fox, ring-tailed cat, raccoon, skunks, weasel; and coyote and bobcats. Smaller animals, rabbits, squirrels, gophers and mice are prevalent throughout the pasture lands. Marine mammals, principally harbor seals and sea lions are often seen in the estuary.

The sloughs and tributaries of the delta provide spawning, nursery and feeding areas for a variety of fish including resident freshwater species, ocean and brackish water species and anadromous fish. The latter, including the coastal cutthroat trout, the steelhead and the king and silver salmon are the most highly prized by delta fishermen. Not much is known about the invertebrate life of the area, but Dungeness and yellow shore crabs inhabit the lower delta, and bay shrimp and soft shell clams also occur.

There exists in the delta a wealth of actual and potential recreational opportunities, most of which are associated directly or indirectly with fish and wildlife. Waterfowl hunting is the most significant appropriative wildlife use. Hunting opportunities for the public are largely confined to waterways traversable by boat or to the few levees where trespass is permitted. The combined estimate of waterfowl hunting use in the delta is about 4,000 hunter days. This is a conservative estimate based on the 1968-69 season when approximately 2,000 hunter days were expended on private gun clubs and an equal number of hunter use days on areas of the delta other than private hunting clubs. Another 400 days were used in pursuit of other game species such as snipe, upland game birds and deer.

Fur trapping during the winter months has augmented the income of a few individuals when other work is not available. Trapping also has provided opportunities for young students to gain an outdoor experience and a modest income.

There are 136 miles of waterways within the delta and they offer wide variety of fish to the sportfisherman. Favored species are coastal cutthroat trout, steelhead, salmon, shad, redtail perch and the Dungeness crab. The sport fishery for all delta species is declining at present. Siltation and sedimentation, pollution and contamination, and increased demands on the resources by both sports and commercial fishermen are several of the reasons accounting for the present decline.

Boating is another popular activity in the delta and generally is associated with hunting and fishing. Several boat launching ramps are provided by the county in the lower delta.

Non-appropriative use of the delta natural resources is even greater than appropriative use. A total of 8,000 user days is given as a conservative estimate of this type of resource use. Nature study, bird-watching, photography and family outings all contribute to the non-appropriative use of the delta's open space and natural resources.

Its proximity to the California State University, Humboldt, and the College of the Redwoods makes the delta particularly valuable for the study of natural history, ecology, fish and wildlife, and related subjects. High school and elementary schools also utilize the delta for field trips and classroom work. Scientific use of the area is also made by government agencies, independent research foundations and private industry.

As is the case with most of California's remaining coastal wetlands, sedimentation, pollution and urban and industrial developments pose the most serious threats to the wetlands of the Eel River Delta. Sedimentation is the most significant factor currently affecting water quality in the Eel River system and delta. Logging practices, road construction, land subdivision activities and livestock over-grazing have contributed large amounts of silt into the river system. The lack of proper watershed management is largely responsible for this problem.

Unfortunately little is known about current siltation rates, but the results of erosion in the watershed and siltation in the lower delta are dramatically demonstrated by the history of the area; for at one time the lower Eel was navigable as far as Port Kenyon by shallow draft commercial vessels.

Siltation adversely affects anadromous fish by compacting spawning gravel, filling pools, raising temperatures, depleting oxygen and smothering food organisms. Turbidity is a factor also and influences angling success. The ultimate solution to sedimentation problems lies in better land use controls and a broad program of watershed management.

Due to the relatively large watershed and normal pattern of heavy winter precipitation, the Eel River and its delta is periodically subject to severe flooding. Major flooding has occurred in 16 of the last 120 years. Hence, flood control has always been a consideration of the public and concerned government agencies alike. Dams on the upper Eel River and channelization of the river through the delta have been the means most commonly proposed to prevent delta floods. Structural flood control methods would be detrimental to the natural resources of the delta in two ways: physical destruction of habitat and unfavorable long-term land-use changes.

An effective alternative to flood control structures is a flood plain management program. Flood plain management involves non-structural methods of reducing flood damage such as zoning lands to uses compatible with periodic inundation, building regulations, and differential flood insurance rates favoring agricultural and other compatible uses.

Pollution is not a major problem in the Eel River at the present time. Wastes from the wood products industry, livestock operations and domestic sources are responsible for what little problem there is at present, but these sources should continue to be carefully monitored. Any increase in development or human use of the delta area requiring

large waste discharges could cause changes in the water quality of delta waters that would be harmful to its natural resources.

The Eel River Delta is not expected to undergo any major expansion of urban and industrial land use in the immediate future. However, should the river be channelized or other flood measures undertaken that would accelerate developmental expansion, the fish and wildlife resources would be seriously threatened. The Department therefore proposes, on a contingency basis, that certain wetlands (Plate 7) be acquired and placed in public ownership. Priority of acquisition would consider lands under tidal influence and poorly drained pasturelands.

The Eel River Delta has tremendous recreational potential, but current limited access prevents fulfillment of that potential. Boat access is provided at several places in the lower delta. Additional access should be provided upstream from Cannibal and Cock Robin islands. Additional recreation, particularly hunting, could be provided by public acquisition of wetlands. A program encouraging private landowners to allow public hunting would also prove helpful.

Stream channeling, non-functioning road culverts, water control and diversion practices, together with sedimentation and silting, have reduced the capacity of the delta system of tributaries to support the highly prized anadromous fish, such as the coastal cutthroat trout, steelhead and salmon. Since all streams tributary are important nursery areas for anadromous fish, these streams should be returned to a productive state. After upstream problems, such as watershed erosion, are solved, active rehabilitation programs to remove blockages, improve

culverts, and modify water controls to include fish passage should be implemented.

In addition to stream rehabilitation, there also is a need to discourage the unauthorized reclamation of delta wetland and riparian habitats. Riparian habitat is one of the most seriously threatened types of wildlife habitat in California and should be protected wherever and whenever possible.

In the delta, reclamation of state-owned lands under tidal influence is no longer the ongoing practice that it once was; however, any unauthorized reclamation of sloughs, salt marsh and tidelands should be discouraged by all means possible.

The Eel River Delta is an important link in the chain of bays, estuaries, lagoons and river deltas found along the California coastline. Two-thirds of these coastal wetlands and natural resources have succumbed to the demand for development and "economic progress." The Eel River Delta is a classic example of what is now popularly called "open space" and possesses many "natural amentities." The task before the people of Humboldt County and the State of California is to resolve economic progress with natural amenities. Out of that resolve will come the decision whether to destroy or degrade, or to preserve, maintain and wisely use, the natural resources of the delta.

RECOMMENDATIONS

The Eel River Delta is an important segment of the coastal wetlands of California. It is rich in biological and scenic resources and provides many opportunities for outdoor recreation. In conjunction with adjacent Humboldt Bay, the delta is one of the most heavily used wetlands in the State, in terms of days used by migratory water-associated birds. The delta also contains much riparian habitat vital to many other forms of wildlife as well as many tributary streams and sloughs important to many fish species.

In order to preserve the natural resources and aesthetic quality of the Eel River Delta and to realize the full biological and recreational potential of the area, the Department of Fish and Game recommends that:

1. A comprehensive plan, including provisions for the preservation, maintenance and wise use of the area's natural resources, be prepared for the Eel River Delta. Experience in other coastal wetlands has shown that without the guidelines of a comprehensive plan, developments often are made with little consideration for maintaining natural resources. Because of overlapping jurisdictions over the delta resources, the development of a master plan will require a cooperative effort of representatives of citizens' interests, as well as from local, state and federal agencies (like the Humboldt Bay Harbor District, Humboldt County and the California Coastal Zone Conservation Commission, etc.).

   The comprehensive plan should recognize the recreational, educational and scientific use of the delta resources, in addition to agricultural use, as the highest and best uses of the area's total assets.

2. Appropriate city and county jurisdictions zone the delta to provide for protection and preservation of its agricultural and open space character. The present land use patterns within the delta are generally compatible with wildlife and recreational use. If proper zoning ordinances are enacted and enforced, and an open space policy spelled out, the delta area will continue to provide a multitude of benefits to those who use its natural resources.

3. No unauthorized filling or dredging of tidal mudflats or salt marshes be permitted in the Eel River Delta. These estuarine habitat types are extremely important to a variety of fish and wildlife. Destruction of similar California coastal wetlands has greatly reduced the acreage of these vital habitats. In the delta, existing wetlands under tidal influence are relatively undisturbed and very productive; and, hence should remain unaltered.

4. Public acquisition and management of delta wetlands be considered on a priority basis (Plate 7), should these lands be threatened by land uses detrimental to fish and wildlife. The Eel River Delta is not expected to undergo any major expansion of urban or industrial land use in the immediate future. However, should this projection change, public acquisition and management of the delta wetlands is the surest way to perpetuate the resources and increase their biological productivity and recreational potential.

5. A flood plain management program be developed and adopted for the Eel River Delta. Such a program, involving non-structural

measures, land use zoning and building regulations, should be part of the delta master plan. Flood plain management would be more beneficial to the maintenance of the natural resources than would structural flood control measures like river channelization and levee construction. Structural projects would seriously reduce the delta's capability to support fish and wildlife.

Should a structural flood control project be authorized in the future, full compensation for fish and wildlife losses must be provided by the project sponsor as a condition of approval for any such project.

6. Federal, state, county and local authorities prepare a joint plan for watershed protection and management to reduce the inflow of sediments into the delta. Erosion and resulting sedimentation, accelerated by logging practices, road construction, land subdivision activities and overgrazing, pose a continued threat to the biological resources of the delta. And, sedimentation is the most significant factor currently affecting the water quality of the Eel River.

Because of the large area that the Eel River watershed encompasses (Plate 2), and because of the resulting overlap in jurisdictions, legislative action may be required to initiate the development of a watershed protection plan. Agency cooperation should be coordinated by the State Water Resources Control Board.

7. Streams tributary to the delta and capable of supporting anadromous fish be returned to a productive state, wherever possible, by means of stream rehabilitation. Historically, tributaries to

the delta were important nursery and spawning areas for anadromous fish, and particularly the coastal cutthroat trout. Hence, reasonable efforts should be made to improve the contribution of the delta streams to the productivity of the anadromous fishery in the Eel River system.

8. Unauthorized reclamation of State-owned delta tidelands be prohibited. In the past delta wetlands have been isolated, degraded or destroyed by unauthorized diking and levee construction. This illegal practice has removed vital fish and wildlife habitats, such as mudflats, salt marsh and riparian vegetation, from the delta estuarine ecosystem.

9. Riparian habitat and vegetation be protected and preserved on all public and private lands in the Eel River Delta. It is amply documented in the delta and through the State that riparian habitat is not only one of the most valuable to wildlife, but also is one of the most productive and threatened habitats required by many varieties of wildlife. This habitat type should be protected by every means possible. It will take the understanding and cooperation of all land owners to ensure that the remainder of this critical living space for wildlife is not destroyed.

10. Federal, state, county and local agencies continue to control contamination and pollution of the delta and its tributaries. Due to the cooperative efforts of concerned interests, pollution is not a major problem at present. However, demands upon, and use of, delta waters may increase and change in the future; and high water quality is essential to the maintenance of the natural

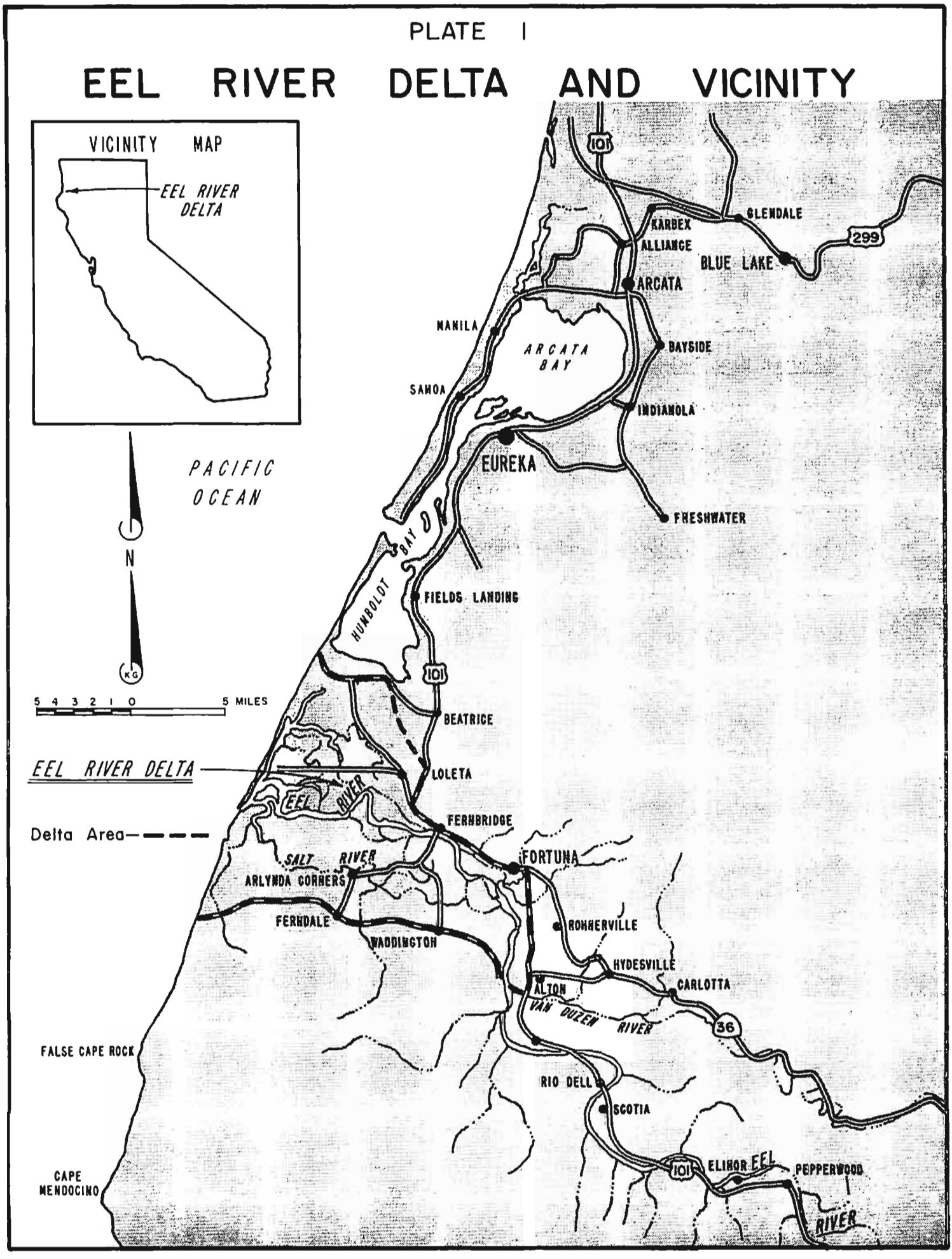
resources and aesthetic values of the delta. Consequently, there should be strict adherence to water quality criteria set forth in the State Water Resources Control Board policy for bays and estuaries.

11. Public access be provided to the Eel River at several locations between Cannibal Island and the mouth of the Van Duzen River. Greater access at strategic sites would greatly enhance public fishing and other recreational opportunities.

Future uses of the Eel River Delta should be guided by criteria which require that any use depend entirely upon the inherent natural resources and environmental attributes of the area.

PLATE I

EEL RIVER DELTA AND VICINITY



THE EEL RIVER DELTA AREA

Description of Area

The Eel River enters the Pacific Ocean some 200 miles (321.8 kilometers)[1/] north of San Francisco Bay in Humboldt County, California (Plate 1). The Eel River Delta is herein described as the flood plain of the Eel River from the ocean upstream to the mouth of the Van Duzen River. This flood plain is bounded on the north and south by foothills of the Coast Range and covers approximately 33,000 acres (13,365 hectares).

In general aspect, the Eel River Delta is a lightly populated river valley facing the sea. The principal population centers are located in the relatively small communities of Fortuna, Fernbridge, Ferndale, Loleta and Port Kenyon. The total resident population is approximately 6,400.

Primary land use is agriculture, particularly pasture for livestock, although some row crops are grown. Much of the agricultural land along the lower reaches of the river was originally marsh land which has been reclaimed by levees and dikes.

The dominant physical feature of the valley is the wide river channel which meanders through the green pasture land, eventually forming a typical river delta with associated small tributaries, sloughs and estuaries near its mouth. For most of its length the river and many of its tributaries are lined with riparian cover of willow, alder and cottonwood.

1/ In compliance with the Department's intention to facilitate a transition from the English to the metric system of measurements, all measurements herein are stated in English terms with metric terms in parentheses.

The delta lands are separated from the ocean beach by low sand dunes which extend from Table Bluff on the north to Centerville Beach on the south. These dunes are broken only by the mouth of the Eel River.

History

Long before European explorers discovered the Humboldt Coast the American Indian was making his home in the Eel River Valley. Earliest written accounts by settlers indicate that numerous small bands of Indians lived in the delta area. They generally depended upon the abundant natural resources for food, subsisting largely on eels, salmon, roots, berries, waterfowl and occasionally deer and elk.

Originally the lowlands near the mouth of the river were heavily overgrown with low brush as were many of the surrounding hillsides. The delta was transected by a maze of sloughs and tidal channels, and marshland extended well back from the river.

The lower river was much deeper than it is now, as evidenced by the early use of the area as a port for ocean shipping. The first ship known to have crossed the bar was the "F. M. Ryerson" in 1850. The depth of the bar at that time was such that small shallow draft sailing ships could pass some distance upstream.

The rich soil of the delta attracted settlers and the area was soon under cultivation. Levees and dikes were constructed to reclaim the tidelands, and small communities developed at various locations around the valley.

By the late 1800's the delta was a major producer of potatoes. Port Kenyon, on Salt River, became a shipping point for the area's agricultural products. During the early 1900's, potato blight and falling prices made the growing and shipping of potatoes uneconomical. At the same time, changes occurred in the river channel which ended the area's brief history as a port for seagoing vessels. Increased siltation brought on by logging and other upstream land use changes made the river too shallow to allow boat passage.

The completion of the Northwestern Pacific Railroad and the Redwood Highway a few years later provided new avenues of transportation. These developments, along with the change from row crops to pasture, ended the need for ocean shipping.

Basically, the valley has seen little change during the intervening years. The area is probably much the same today as it was 50 years ago, with only minor differences resulting from further man-made alterations and river floods.

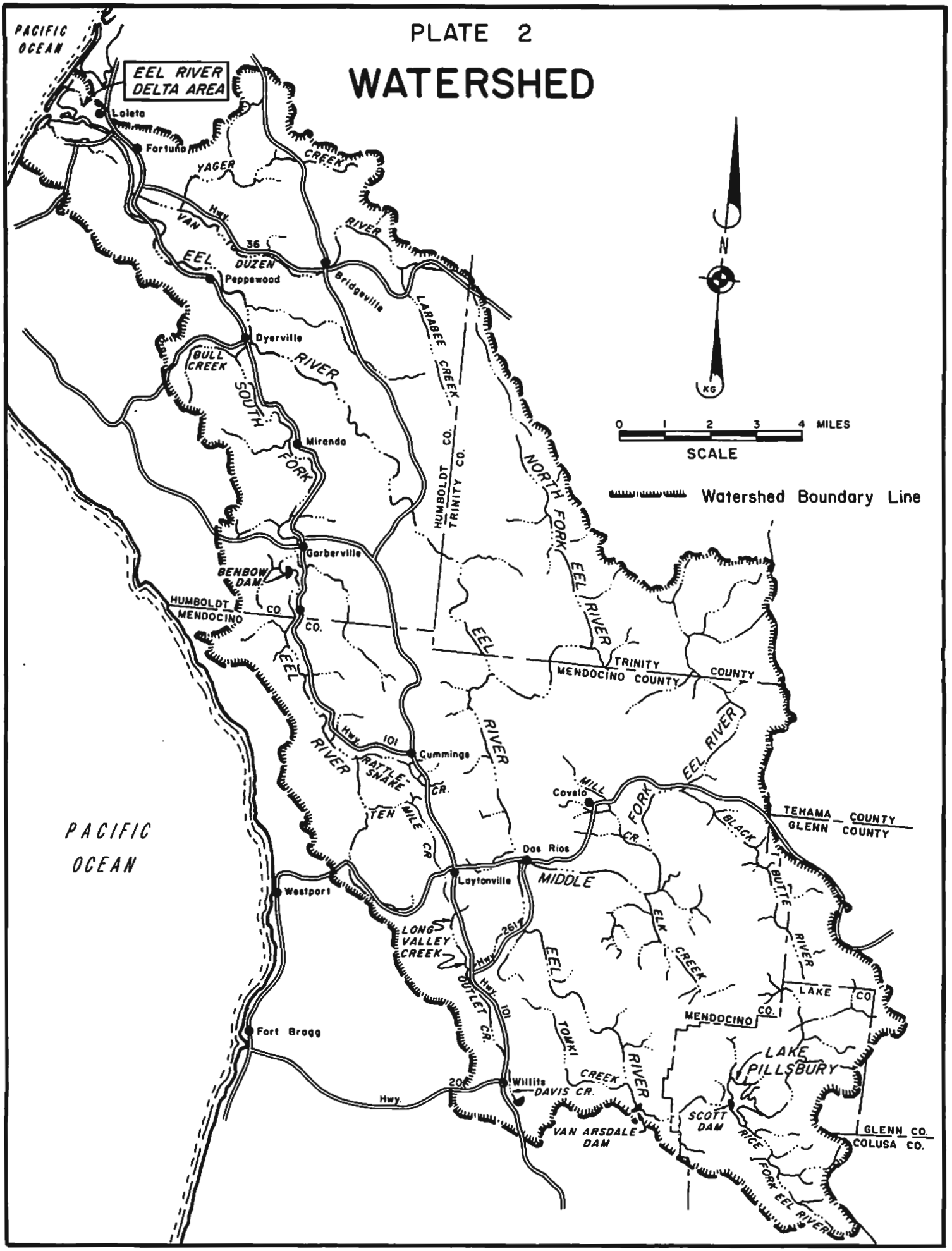
Climate

Seasonal weather characteristics are typically cool Mediterranean with dry summers and very wet winters. Low coastal fog is common during the summer.

Weather profiles for the Eel River Delta are generally similar to those of the Eureka area. Data gathered at Eureka indicate a mean annual precipitation of 38 inches (71 centimeters) with a high of 64.53 inches (163.91 centimeters) (1904), and a low of 21.14 inches (53.70 centimeters) (1929). Precipitation occurs almost entirely

PLATE 2

WATERSHED



as rain and 35 to 40 percent of the annual total comes during December and January. The mean annual temperature is 52 degrees Fahrenheit (11 degrees Centigrade) with a mean annual range from 33 degrees to 84 degrees Fahrenheit (0.6 degrees to 29 degrees Centigrade). Temperatures below freezing are rare.

Winds are predominantly from the north and northwest. Gale winds from 55 to 75 miles per hour (88 to 121 kilometers per hour) may be recorded during winter storms.

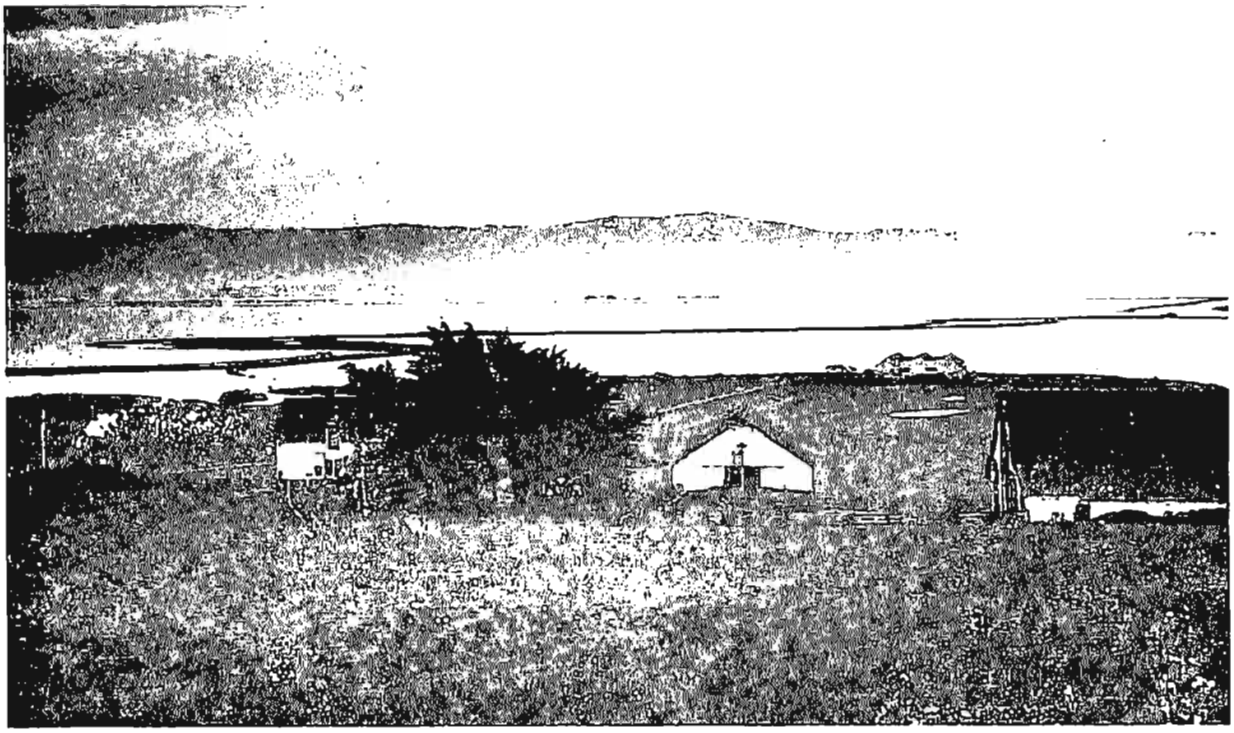
Drainage

The Eel River drains approximately 3,600 square miles (9,324 square kilometers) of watershed in northern California, including portions of Humboldt, Mendocino, Trinity, Glenn and Lake counties (Plate 2). The principal tributaries are the South, Middle and North forks of the Eel River, and the Van Duzen River.

The entire drainage lies with the Coast Range. The basin is approximately 140 miles (225 kilometers) long and 40 miles (64 kilometers) wide and ranges in elevation from sea level to over 5,000 feet (1,525 meters).

About 70% of the basin is covered by moderate to heavy stands of conifer forests. At lower elevations the tree cover is predominantly redwood. Above the redwood belt mixed forests of pine, fir and hardwoods are common. Open grassland interspersed with hardwood stands and brush fields make up most of the remaining vegetative cover.

Approximately 90% of the mean annual runoff of the Eel River Basin, which is about 6.3 million acre-feet (0.8 million hectare-meters),



MAJOR FLOODS IN THE EEL RIVER DELTA HAVE OCCURRED IN 16 OF THE PAST 120 YEARS. FLOOD WATERS THAT LAY DOWN RICH RIVER SOILS AND SEDIMENTS HAVE CONTRIBUTED TO THE DELTA'S PRODUCTIVITY IN AGRICULTURE AND WILDLIFE. DEPT. FISH AND GAME PHOTOS - WINTER 1973

occurs between the months of October and May. Due to the rugged nature of the terrain, excess precipitation drains very quickly, resulting in river levels that vary rapidly. The downstream movement of water is accelerated by the removal of vegetation on steep hillsides, by logging or overgrazing by livestock. The result is annual flooding of delta lands. Major floods have occurred in 16 of the past 120 years.

The normal river channel has a capacity of about 150,000 cubic feet per second (4,200 cubic meters per second). The largest recorded flood, which occurred in 1964, produced peak flows at Fernbridge of about 840,000 cubic feet per second (23,520 cubic meters per second). Floods in excess of 600,000 cubic feet per second (16,800 cubic meters per second) can be expected once in 40 years.

Periods of flooding do not necessarily correspond to heaviest rainfall periods in the delta since flood waters may come from as far as 140 miles (225 kilometers) upstream. Floods are generally rated on a recurrence interval which predicts their frequency. An indication of the regularity of at least mild flooding in this valley is that the chance of a 25.5 foot (7.8 meter) flood as measured at Fernbridge is roughly 50 percent for any given year.

Tides

Tidal influence extends some distance upstream in the main river and its tributaries. Intrusion of salt water gives the lower river its estuarine character. The tidal characteristics coincide with those of Humboldt Bay which is located about five miles to the north. Mean high tide is 6.30 feet (1.92 meters) above mean lower low water (MLLW).

Mean sea level is 3.39 feet (1.03 meters) above MLLW. The highest and lowest tides which have been recorded are 10.0 feet (3.05 meters) above MLLW and 3.0 feet (.91 meters) below MLLW. During normal flows tidal influence generally extends upriver to Fernbridge where the zero point on the flood gauge is 4.1 feet (1.25 meters) above mean sea level.

The salinity intrusion from tidal waters reaches approximately 7 miles (11.3 kilometers) upstream from the mouth. The degree of salinity increases as the river nears the sea. Seasonal and daily variations depend on tide stages and the volume of freshwater moving downstream.

Geology and Soils

The Eel Delta is an alluvial river valley which lies within the Coast Range. Geologically this range is composed of Mesozoic and Cenozoic sediment. The valley's most common soils are Ferndale silty clay loams, Bayside silty clay loams and river wash. The uplands are primarily Hookton silt loams and Rohnerville silt loams.

It is believed that during the middle to upper Pleistocene period the Van Duzen, Eel, Elk and Mad Rivers all flowed into a single large bay (Ogle, B.A., 1953). The Hookton Formation sedimentary deposit was formed, which extended beyond the present ocean shoreline and was more than 400 feet (122 meters) deep. Table Bluff was subsequently formed through warpage and the Eel drainage was separated from Humboldt Bay.

Geological evidence indicates that 15,000 years ago sea level was about 400 feet (122 meters) below its present level. As the sea level rose, the delta decreased in size and alluvial deposits created the flat valley which constitutes the present delta.

The present form of the lower river is constantly being altered by floods and wave action which sweep across the ocean beach and almost annually change the location of the river mouth.

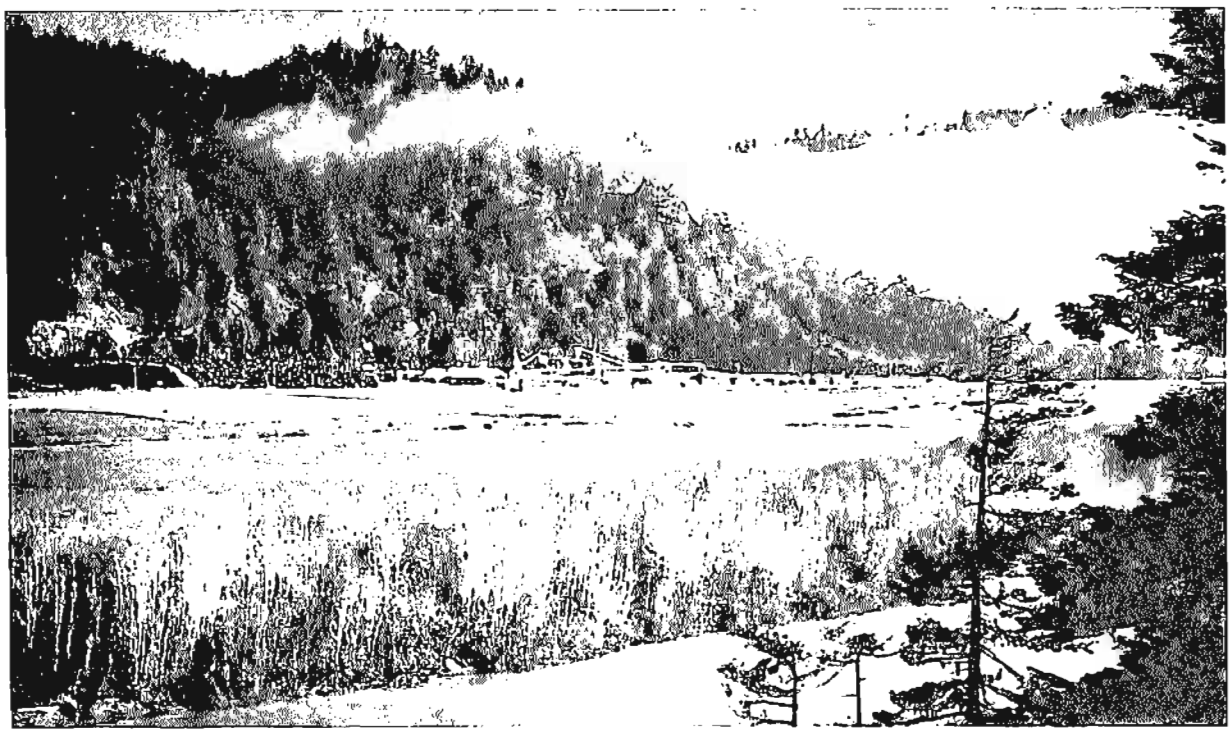
The river sediments near the mouth are composed primarily of sand and sandy silt. The river channel upstream gradually changes to a gravel bottom with sandy silt deposits in the back waters and the high water zones. The estuaries and sloughs are primarily silt and clay bottoms lined by soils rich in plant humus. The process of alluvium deposition is constantly in progress and during every major flood additional soil material is deposited over the delta.

Land and Water Uses

Agriculture is the most important industry of the Eel River Delta. Most of the land is used as pasture for beef and dairy livestock. Some hay is grown although not extensively. Occasionally row crops such as potatoes and corn are grown in small acreages.

Lumber mills in the Fortuna area and gravel operations on the river bar are the only other major industries. Many residents of the area do not depend upon the delta for their livelihood and commute to other areas to work.

Approximately 2,000 acres (810 hectares) are used for residential purposes and about 600 acres (243 hectares) are used for business or commercial purposes. The commercial and residential uses are centered around the communities of Fortuna, Ferndale, Fernbridge, Loleta and Port Kenyon.



AGRICULTURE IS THE MOST IMPORTANT INDUSTRY IN THE EEL RIVER DELTA. MOST OF THE LAND IS USED AS PASTURE FOR BEEF AND DAIRY LIVESTOCK. LUMBER AND GRAVEL OPERATIONS ARE THE ONLY OTHER MAJOR INDUSTRIES.
DEPT. FISH AND GAME PHOTOS - 1974

The remainder of the area can best be described as wildlands and includes the river channel, riparian woodlands, tidelands and ocean beaches. These latter, and especially the lower delta and estuarine areas, are used extensively for recreation, particularly fishing, hunting, boating, sight-seeing and related activities.

Table 1

Land Use Classification

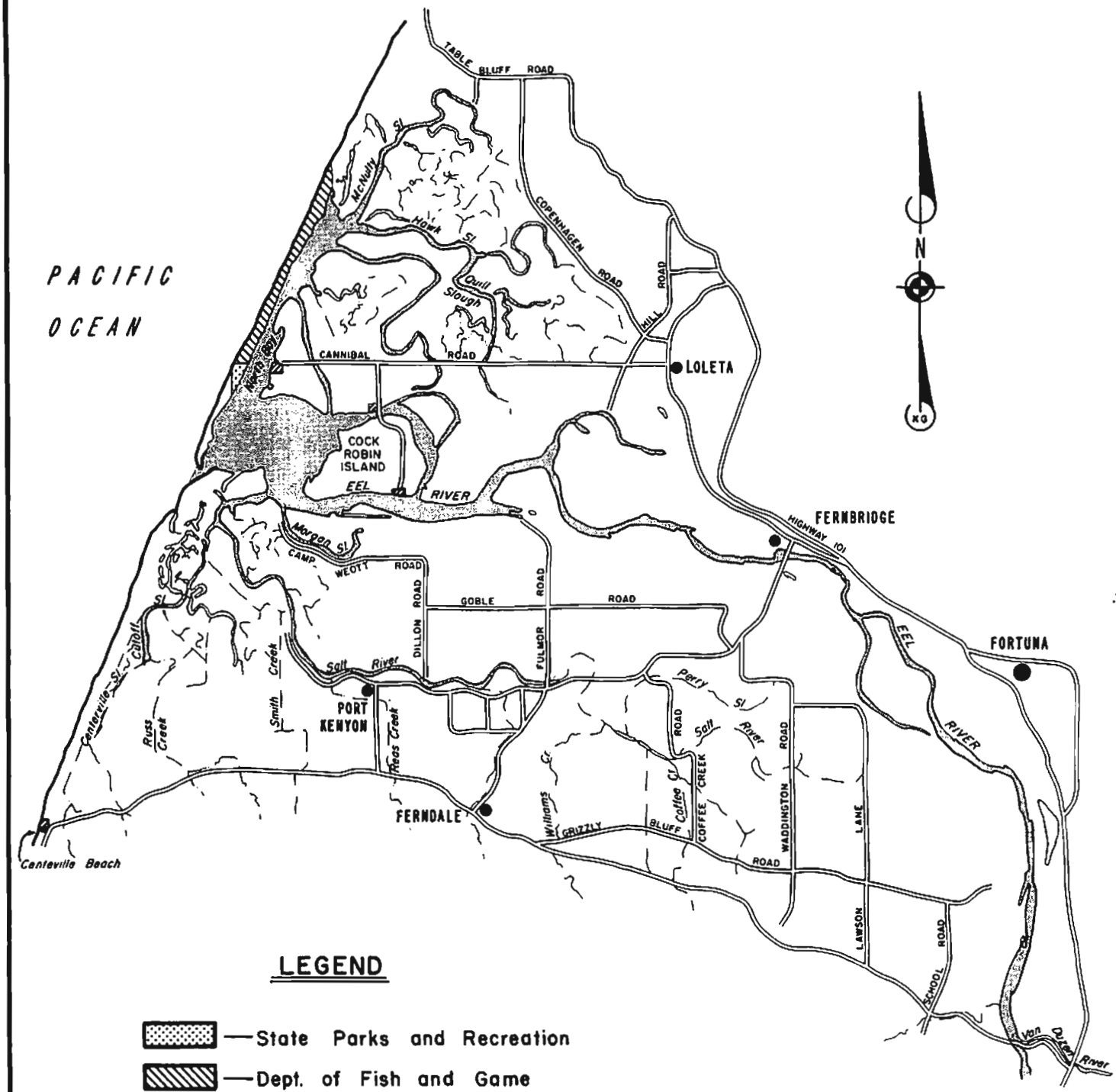
Classification	Approximate Acreage (Hectares)
Agriculture	21,700 (8,788)
Residential	2,000 (810)
Commercial	600 (243)
Wildlands	8,700 (3,523)
Total	33,000(13,364)

Present consumptive use of Eel River water for domestic, municipal and industrial purposes is estimated by the U. S. Public Health Service to be from 8,500 to 13,000 acre-feet (1,050 to 1,606 hectare-meters) annually. Most of this use occurs upstream from the delta. Direct diversion of river water for municipal use does not take place below the town of Scotia.

About 25,000 acre-feet (8,088 hectare-meters) of water are used for irrigation upstream areas, and approximately 200,000 acre-feet (24,705 hectare-meters) are diverted by Van Arsdale Dam from the upper Eel River into the Russian River drainage for power generation. Within the delta area, water for domestic, municipal, industrial and agricultural uses is obtained from ground water or from small tributaries.

PLATE 3

LAND OWNERSHIP—DELTA AREA



LEGEND

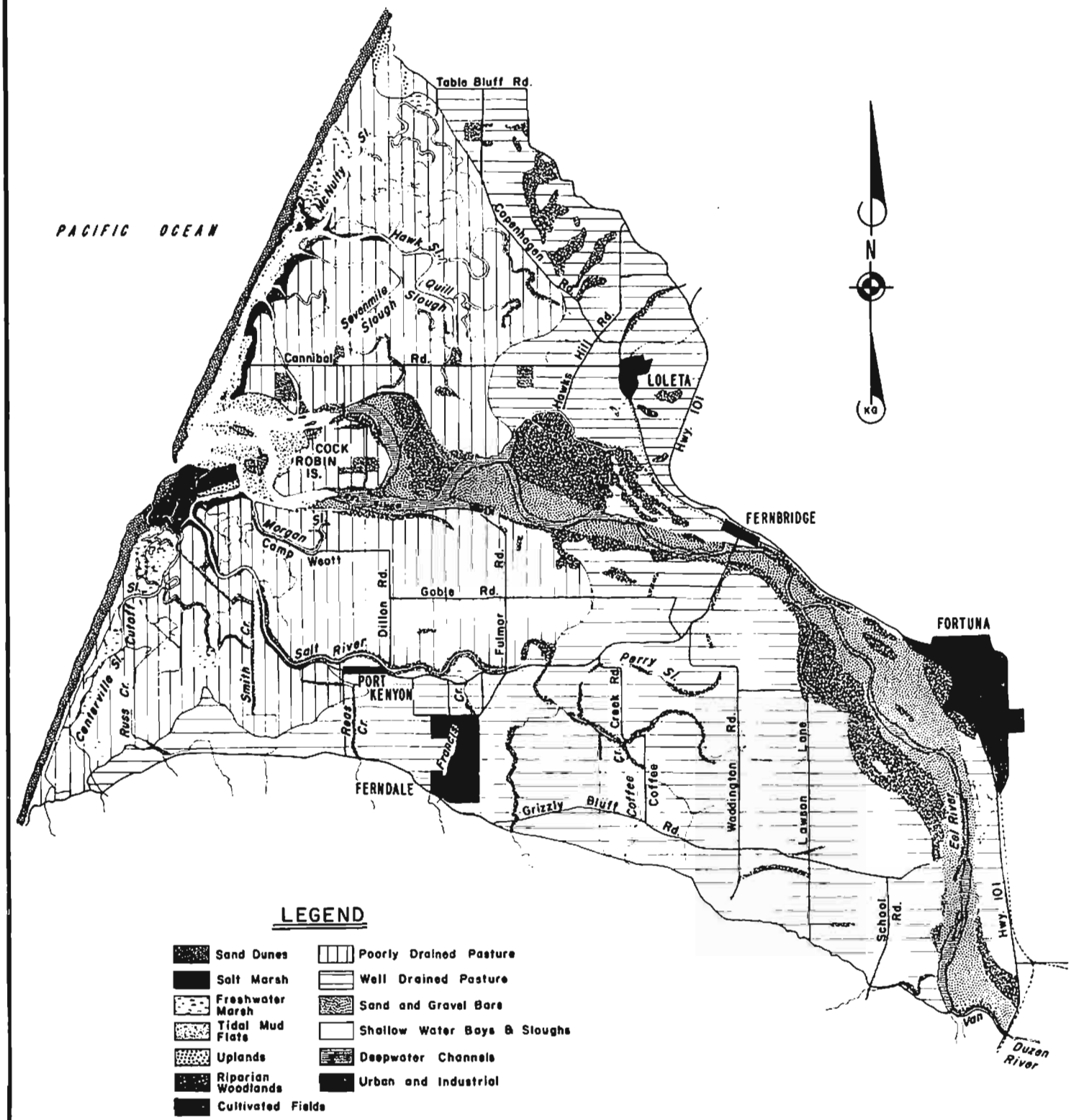
- —State Parks and Recreation
- —Dept. of Fish and Game
- —State Lands and Navigable Waters
- —County Parks and Easements
- —Private

Land Ownership

Most of the delta lands is in private ownership; only a few areas are publically owned (Plate 3). The Department of Fish and Game manages 170 acres (69 hectares) as a wildlife area on the north sandspit. Humboldt County maintains two small parks, one at Centerville Beach and one at Crab Park, located at the western end of Cannibal Road. The largest public land ownership embraces the land under tidal influence to the mean high tide line, which is under the jurisdiction of the California State Lands Division. All navigable streams, sloughs and other water courses in the delta are also designated by statute as state-owned.

PLATE 4

EEL RIVER DELTA HABITAT



LEGEND

- Sand Dunes
- Salt Marsh
- Freshwater Marsh
- Tidal Mud Flats
- Uplands
- Riparian Woodlands
- Cultivated Fields
- Poorly Drained Pasture
- Well Drained Pasture
- Sand and Gravel Bars
- Shallow Water Bays & Sloughs
- Deepwater Channels
- Urban and Industrial

NATURAL RESOURCES

Habitat and Vegetation

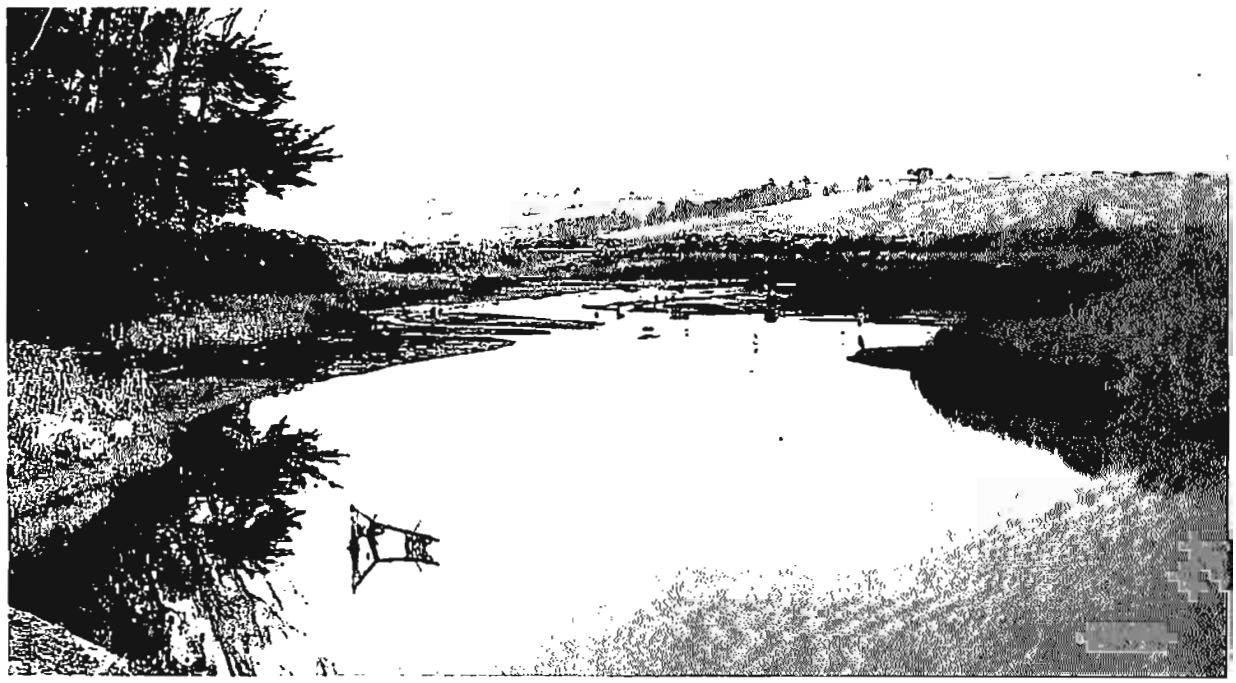
The Eel River Delta area encompasses approximately 33,000 acres (13,365 hectares). Of that total, 2,600 acres (1,053 hectares) are intensively developed for residential, industrial or commercial purposes, hence their value for fish and wildlife has been greatly reduced. The remaining land and waters are all important fish and wildlife habitats. The fish and wildlife values of the delta are high because of the variety and interspersion of these habitats, and because of seasonal flooding which coincides with the arrival of migrating and wintering water-associated birds. The various habitat types (Plate 4) are classified into 12 categories:

Table 2

Habitat Inventory

Type	Acres	(Hectares)
Well Drained Pasture	10,300	(4,171)
Poorly Drained Pasture	10,800	(4,374)
Cultivated Fields	700	(283)
Freshwater Marsh	350	(142)
Salt Marsh	700	(283)
Uplands	800	(324)
Riparian Woodland	2,500	(1,012)
Sand Dunes	700	(283)
Sand and Gravel Bars	500	(202)
Tidal Mudflats	500	(202)
Shallow Water Bays and Sloughs	1,600	(648)
Deepwater Channels	700	(283)

POORLY DRAINED PASTURELAND IN THE LOWER DELTA MAKES GOOD HABITAT FOR MANY SPECIES OF WATERFOWL, SHOREBIRDS, WADING BIRDS AND RAPTORS.



TIDAL SLOUGHS AND STREAMS ARE IMPORTANT SPAWNING AND NURSERY AREAS FOR ANADROMOUS FISH. THE DELTA SYSTEM OF TRIBUTARIES SHOULD BE RETURNED TO A PRODUCTIVE STATE BY MEANS OF STREAM REHABILITATION.
DEPT. FISH AND GAME PHOTOS - SEPTEMBER 1974

Well Drained Pasture

Well drained pastures are usually located on the higher ground. Standing or flowing water on these areas is uncommon. Typical plant species are clover, dandelion, spike bentgrass and trefoil.1/

Poorly Drained Pasture

Vegetative cover on these areas is similar to that found on the well drained pasture with the exception of the more frequent occurrence of rush, saltgrass, and other more water tolerant species. Poorly drained pasture is usually found on lower ground and during the rainy season much of it may be covered by water.

Cultivated Fields

Row crops are grown in small areas at scattered locations within the delta. The principal crop is potatoes; but corn, squash, artichokes and other produce are grown occasionally.

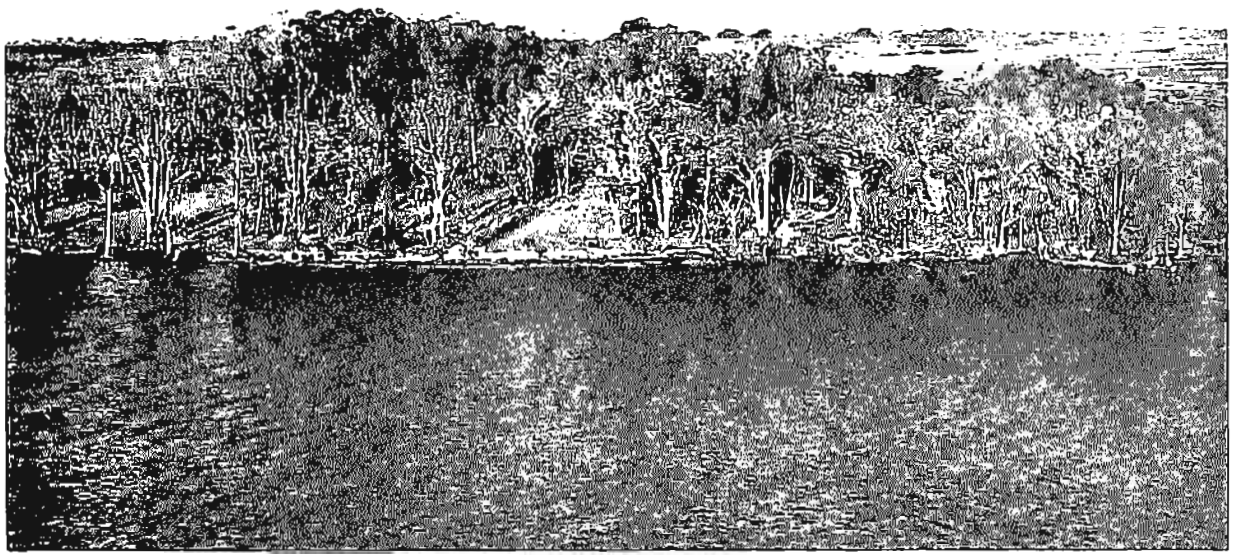
Freshwater Marsh

The size of freshwater marsh varies seasonally depending on water levels within the delta. The average, however, is about 350 acres (142 hectares). Bulrush, sago pondweed, spikerush and widgeon grass are common plants of this habitat type. Small freshwater marshes, including old borrow pits, are scattered throughout the delta; however, these fresh marshes are more extensive in the lower valley.

Salt Marsh

Much of the agricultural lands in the lower delta is reclaimed salt marsh. Only about 700 acres (283 hectares) of salt marsh are left. The largest

1/ A check list of Eel River Delta plants and their scientific names is appended (Appendix A).



RIPARIAN HABITAT SERVES AS ESCAPE COVER FOR SOME WILDLIFE, AND ROOSTING AND NESTING COVER FOR OTHERS. DEPT. FISH AND GAME PHOTOS - 1974

area of salt marsh is located south of the river mouth between Salt River and the ocean, and is about 300 acres (122 hectares) in size. In other areas salt marsh occurs as edge cover between the tidal sloughs and levees throughout the lower delta. Plant life is typified by such salt tolerant species as cordgrass, pickleweed, alkali bulrush, marsh rosemary and saltgrass.

Uplands

Although upland habitats actually include the pasture lands, in this context, uplands are defined as areas of higher ground which support low growing shrubs such as willow, blackberry and coyote brush. Within the Eel River Delta this habitat type occurs primarily along levees and on some of the more stabilized sand dunes. Although none of the upland areas is extensive in size, they are well distributed throughout much of the lower delta.

Riparian Woodland

Alder, oak, willow and cottonwood are the dominant plant species which characterize this type of habitat. An understory of dense blackberry and other low growing shrubs often is found in association with riparian cover. Although much of this habitat occurs as a narrow strip along the river and some of its tributaries, it also may be found in stands covering many acres (hectares) at several locations.

Sand Dunes

The dunes extend along the ocean beach from Table Bluff to Centerville Beach, a distance of about 10 miles (16 kilometers). Their appearance is somewhat variable depending on their location, elevation and degree

of stability. The low dunes, particularly along the spit north of the river's mouth, support less plant growth and are subject to change from wind and wave action. Higher, more stable dunes are characterized by a greater density and variety of plant cover. Typical dune plants include European dunegrass, bush lupine, beach strawberry, sand verbera, dune tansey and beach morning glory.

Sand and Gravel Bars

The bars include some areas of the river channel above the zone of significant tidal influence. Because of scouring action of winter river flows there is virtually no plant cover. Bare river rock, fine sand and silt are the dominant soil types. The pattern of sand and gravel bars changes with every alteration in the river course, but the total area generally remains fairly constant at about 500 acres (202 hectares).

Tidal Mudflats

The sizes of the mudflats fluctuate with the variation in water levels of the river, bays and sloughs due to tidal action and, to some extent, by variations in the volume of water flowing downstream. During high tide the mudflats are covered by water. As the water recedes the mudflats again become exposed. Plant life is generally confined to algal forms, especially green algae such as *Enteromorpha* and *Ulva*, and the soft mud usually supports many small invertebrate organisms.

Shallow Water Bays and Sloughs

Much of the Eel River Delta is interlaced with bays and sloughs. Most are tidal in nature but some have been separated from salt water

by flood gates. Those not open to tidewater are often formed seasonally and contain water only during the rainy period.

Deep Water Channels

Some 700 acres (284 hectares) are classed as deep water channels. The Eel River and some parts of the estuary are so classified. The channels are distinguished from shallow water bays and sloughs by the relatively higher water flows which tend to scour out the channel formations.

Wildlife

In conjunction with Humboldt Bay, the Eel River Delta is one of the most important coastal wetlands on the north coast in terms of wildlife use. The delta supports a wide variety of wildlife including over 200 species of birds (Appendix B) and over 40 species of mammals (Appendix C). Some are residents that spend their entire lives within the area while most are migrants or occasional visitors.

Birds

In order to determine the numbers of wildlife using the Eel River Delta, aerial census counts were conducted monthly over a three-year period beginning in October of 1967 (Appendix D). Local bird populations undergo dramatic seasonal fluctuations. The highest number and greatest variety occur from September through April when the winter migrants are present. Their numbers are constantly changing as large numbers of birds come and go. During summer months populations are much lower.

For discussion purposes, birds are grouped into three broad categories according to their habits and habitat associations. These categories are raptors, land birds and water-associated birds.

Raptors

The raptors, or birds of prey, are probably the most misunderstood of the birds. Over the years they have been persecuted by man with the mistaken idea that they were detrimental to other wildlife. In actual fact they feed largely on insects and small rodents and play an important role in the natural ecosystem. Today they are protected by state and federal laws. In spite of this protection some populations of some species continue to be reduced by illegal shooting, pesticides and especially by loss of habitat.

Raptors include the eagles, hawks, falcons, ospreys, kites, owls and vultures. The most common in the delta area are the red-tailed hawk, rough-legged hawk, coopers hawk, sharp-shinned hawk, American kestral (sparrow hawk), marsh hawk, great horned owl, short-eared owl, barn owl, screech owl and turkey vulture. Less commonly seen are the osprey, red-shouldered hawk, goshawk, merlin (pigeon hawk), long-eared owl, saw-whet owl and burrowing owl. Golden eagles, bald eagles, white-tailed kites, and the extremely rare peregrine falcon also are observed occasionally.

Agricultural lands, marshes, open water and scattered wood lots provide the necessary habitat to support raptor populations. Many of the hawks feed on small rodents and insects in the fields and pastures. Others tend to stay in heavier cover along the river. At night the predatory efforts of hawks in the fields and pastures are replaced by those of the nocturnal owls. The river and its estuaries are the primary source of food for the osprey which preys on fish. The riparian habitat along

with the other woodlands in and adjacent to the delta is essential to raptors for roosting and nesting cover.

Since many birds of prey are difficult to observe from the air no attempt was made to determine numbers during aerial census counts. Consequently no population estimates are available.

Land Birds

These birds are associated with the agricultural lands, uplands, residential areas and riparian woodlands. As a group they comprise the largest number of individual species. Each species has its own habitat requirements determining what areas of the delta it uses. Some can be found in many habitats while others require specialized types.

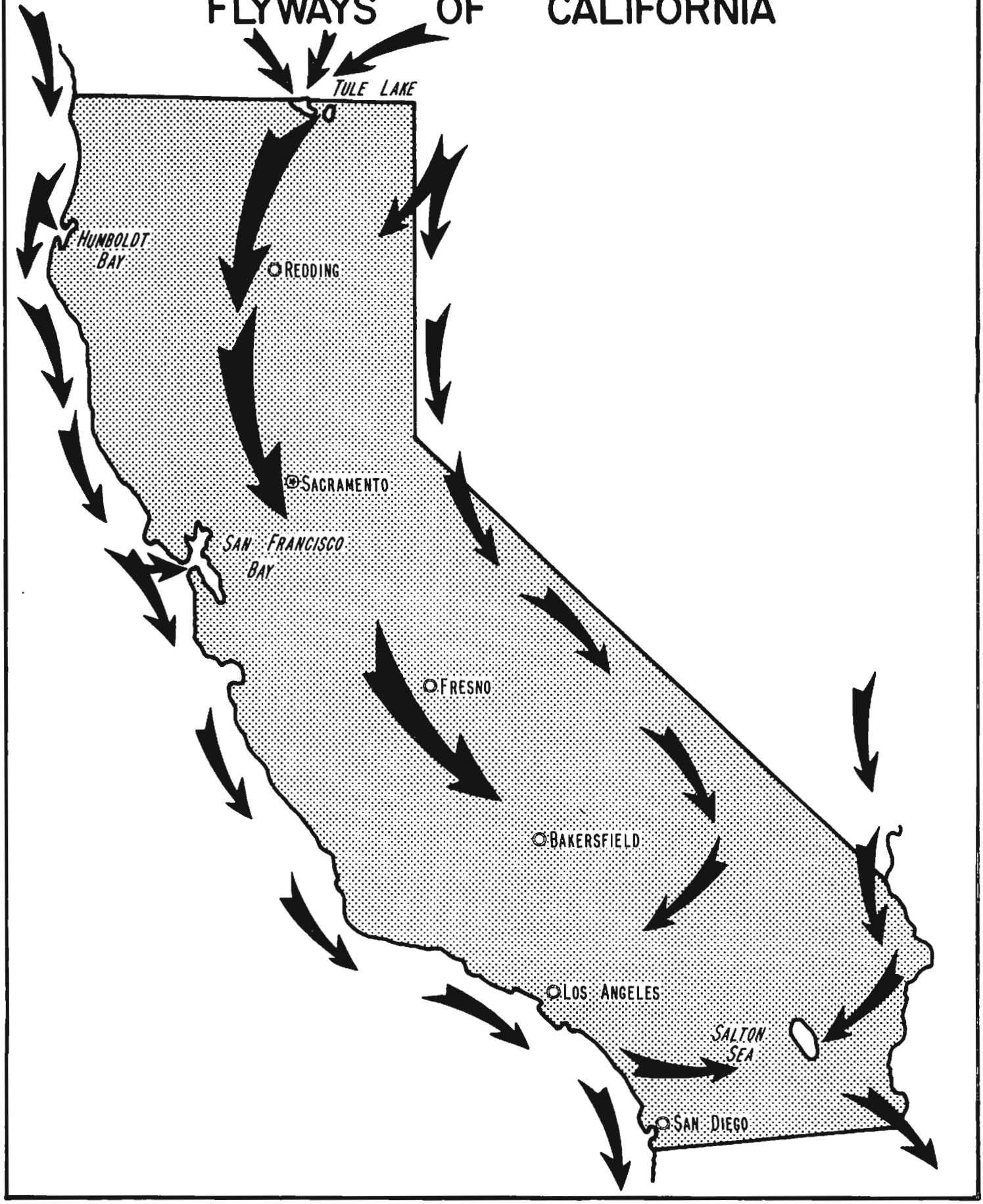
The predominant forms in terms of numbers and varieties are the songbirds. Represented in this category are the sparrows, thrushes, flycatchers, wrens, larks, warblers, finches and juncos.

Upland game birds including valley quail, mourning doves, and band-tailed pigeons are sought by sportsmen during the fall hunting seasons. Periodically ring-necked pheasants raised in game farms have been released within the area but only a few have survived in the wild.

Crows, ravens, jays, woodpeckers, flickers, swallows, hummingbirds and many other land birds also utilize the delta area. Some are local residents but many are migratory and only visit the area at certain times of the year.

PLATE 5

MAJOR WATERFOWL FLYWAYS OF CALIFORNIA



Water-associated Birds

Members of this group include nine orders of birds with over 100 species represented locally. Although exhibiting much diversity in size, form and habits, all share one basic similarity—a dependence on aquatic or marine environment.

Through evolutionary processes these birds have developed very specialized physical characteristics which enable them to utilize food and other life requirements provided by water related habitat. Specialization has led to complete dependence on sometimes very specific habitat types and a high degree of susceptibility to environmental changes. Consequently man's alteration of wetlands has greatly reduced populations of many water-associated bird species. For this reason the Eel River Delta, along with the other remaining coastal wetlands of California, is of particular importance to water related species; and, preservation of sufficient habitat to sustain viable populations is essential to their survival.

Waterfowl

All species of waterfowl, which include the ducks, geese and swans, are migratory. Although a few nest locally the vast majority come from nesting areas as far north as Alaska to spend the winter in more moderate climates. In their travels they follow traditional migration routes known as flyways. California is the major wintering ground for waterfowl of the Pacific flyway.

Within California most waterfowl follow three basic flight paths (Plate 5), one of which passes along the coast and includes Humboldt Bay and the

Eel River Delta. This coastal route is second only to the central valley in numbers of birds using it.

In the Pacific Flyway both the winter grounds in California and the breeding grounds in Canada and Alaska have suffered much from man's alterations of habitat. Of the original estimated 5 million acres (2 million hectares) of wetlands in California only about 500 (200) thousand remain. The maintenance of waterfowl populations will thus largely depend on a willingness and ability to preserve the remaining habitat.

There are 22 species of ducks commonly found in the Eel River Delta. Depending on certain characteristics of form and habits they are classified into three general types referred to as puddle, diving and fish ducks.

The puddle ducks are so named because of their preference for shallow water ponds and marshes. Most of their food is derived from aquatic plants or agricultural crops, although some animal organisms are taken. Food habits of waterfowl using the delta area are probably closely comparable to those reported in the adjacent Humboldt Bay wetlands (Yocum and Keller, 1961). The more important local food plants are cultivated barley, spikerush, alkali bulrush, sago pondweed, smartweed, sedge, clover, water buttercup and mare's-tail. Mallards, pintail, wigeon, gadwall, green-winged teal and shovelers are typical puddle ducks.

The common diving ducks of the Eel River area are canvasbacks, redheads, scaup, ring-necked ducks, buffleheads, golden-eyes, ruddys and scoters. They differ from the puddle ducks by their preference for deeper water and by their habit of diving underwater in search of food.

As a group the divers tend to consume more animal food than plant food. Mollusks, crustaceans and insects comprise the major items taken. Some species such as the canvasback and ruddy utilize plant foods to a greater extent. Pondweeds, ditch grass, alkali bulrush and spike-rush are the principal plants consumed.

The American, red-breasted and hooded mergansers are known as fish ducks. Unlike other ducks they have a narrow, finely toothed bill for capturing small fish which they pursue under water. The hooded merganser is rather uncommon but the other two species are seen regularly throughout the year along the river.

Geese, with the exception of black brant, do not occur in large numbers along the north coast but occasionally small groups of Canada geese, snow geese and white-fronted geese can be seen in the delta area.

The black brant is found in large numbers around Humboldt Bay during the late winter and spring months but they seldom use the Eel Delta. Brant feed almost exclusively on eelgrass which is abundant in the bay but completely absent from the delta. The delta is important to brant during periods of low eel grass production. Records indicate a high use of pasture lands by brant coincident with periods of eel grass failure in Humboldt Bay.

Several hundred whistling swans winter in the delta valley each year. They are most abundant during the months of December, January and February. Usually they concentrate in flooded pastures south of the river between Ferndale and Centerville Beach. These large white birds nest in remote areas of Canada and Alaska.

Although most waterfowl using the area are migratory several species of ducks do nest here. The most common nesters are mallards, cinnamon teal and mergansers. The mergansers nest along the river and its tributary sloughs. The mallards and cinnamon teal prefer marshy areas and ditches located in or near the pasture lands. Although no specific information is available regarding numbers it is estimated that between one and two thousand birds are produced here each year, based on the acreage of suitable nesting habitat available and the number of adult birds present during the breeding season.

During the summer months waterfowl numbers are low and relatively stable. With the arrival of winter migrants the population increases dramatically. In terms of both numbers and species composition it is a dynamic, ever-changing population, with birds constantly arriving and departing. Many stop for only short periods of rest on their long migration trips. Others utilize the area for longer periods, flying back and forth between the delta, Humboldt Bay and other nearby areas of suitable habitat.

Because of the dynamic nature of the local waterfowl population, annual use in the area cannot be determined. However, the total use can be derived in terms of days of bird use. A bird use day represents one bird present for one day. Ten birds present for a five day period is therefore expressed as 50 bird days of use, or 50 bird use days.

The average monthly population of waterfowl in the Eel River Delta from 1967 to 1970, as determined by aerial census counts, was 3,704 birds. The total annual average for the three year period can therefore be computed to be about 1,351,960 waterfowl use days. About 90% of this use

occurs between September and April when winter migrants are present (Appendix D).

Shorebirds

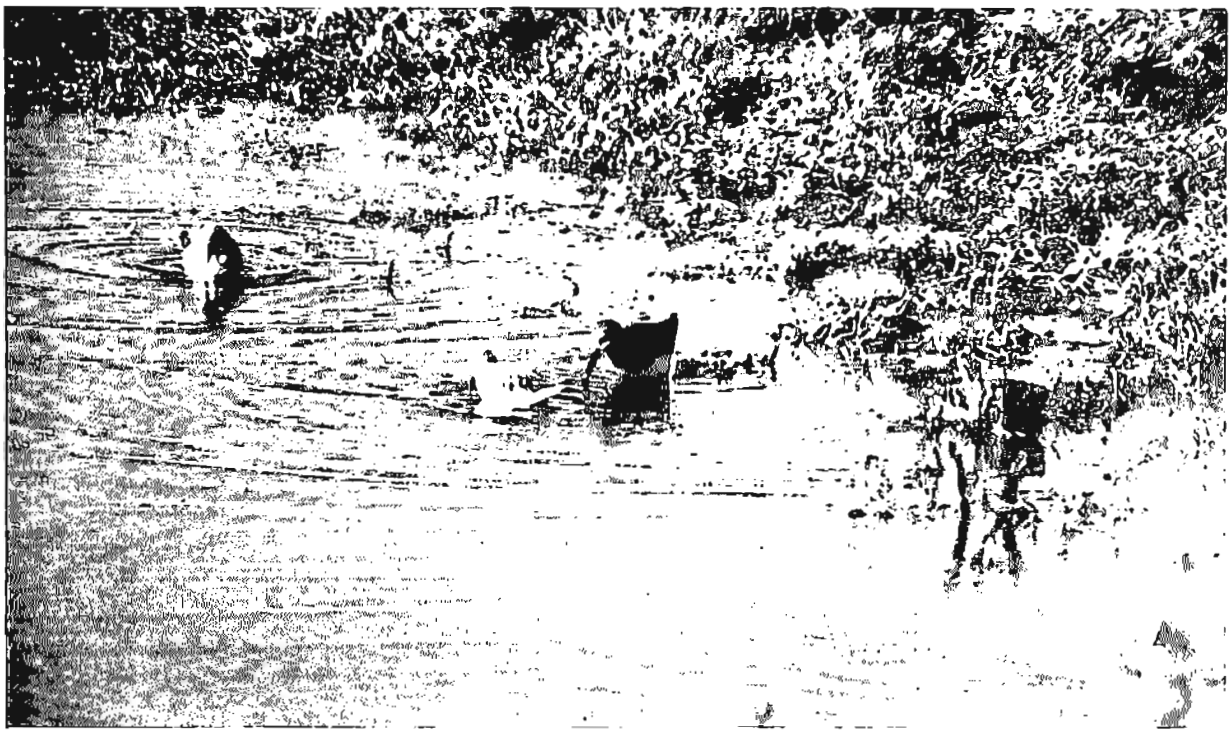
Like the waterfowl, shorebirds follow well established flyways between breeding and wintering grounds. Although they occur throughout the state the greatest number and variety of species are found along the coast. Coastal wetlands are therefore extremely important in maintaining flyway populations of shorebirds.

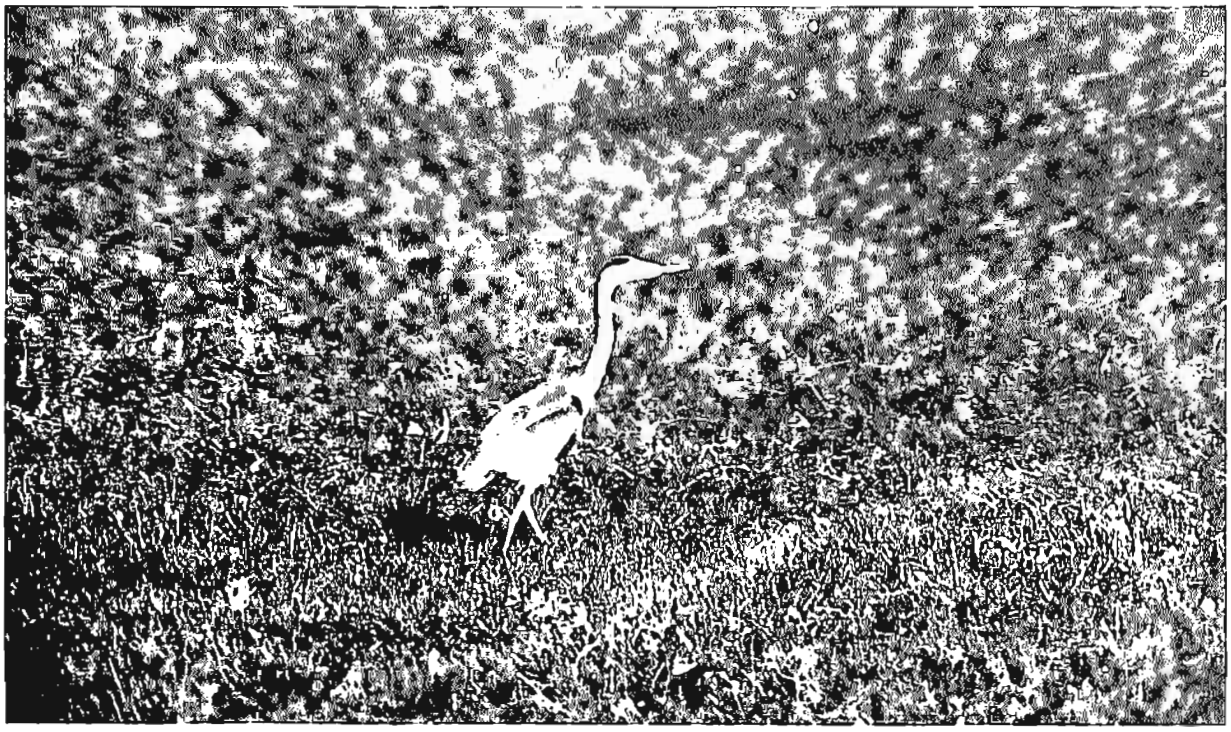
At least 31 shorebirds are known to occur within the study area. Some of the more common species include the dunlin, western sandpiper, least sandpiper, black bellied plover, killdeer, short-billed dowitcher, sanderling, willet, marbled godwit, black turnstone, northern phalarope and common snipe.

The shorebirds are highly specialized for feeding in certain kinds of habitat. The mudflats and sandy beaches are probably the most heavily used areas. Shorebirds also use shallow water marshes and flooded pastures. Some species utilize other agricultural lands, gravel bars, salt marshes and even open water.

Shorebirds feed primarily on small aquatic organisms and insects which are found in the mud, sand or soil of wetland areas. Depending on the bill structure and feeding methods used by each species, shorebirds pick or probe for food items in sand, mud or water.

A few species including the killdeer and spotted sandpiper nest locally in fields or along the river; however, most are winter migrants from





SHOREBIRDS AND WADING BIRDS ARE AMONG THOSE WATER-ASSOCIATED BIRDS THAT ARE ATTRACTED TO THE DELTA. DEPT. FISH AND GAME PHOTOS - SEPT. 1974

nesting areas much farther north. Peak populations occur during the winter months. The total annual shorebird days use averaged 1,023,825 over the three year census period (Appendix D). Because of the small size of many species it is difficult to count them all by air. It is therefore assumed that the total bird use days is actually much higher for shorebirds.

Wading Birds

The great egret, great blue heron, green heron, black-crowned night heron and American bittern are local wading birds. Cattle egrets and snowy egrets also occur in the delta but only rarely. Although wading birds are migratory to some extent, most that use the area also nest there. Wading birds nest in at least three locations in the Eel River Delta and several locations in adjacent Humboldt Bay.

Egrets and herons are colonial nesters that use the same nesting site or rookery year after year unless they are disturbed by man's activities or other causes. One of the delta rookeries is located in riparian woodland between the river and the town of Loleta. Another is located on a small island near the river's mouth, and the third is south of the river between Salt River and Cutoff Slough. The destruction of existing and potential nesting sites in other areas has greatly increased the importance of the delta rookeries.

The population of birds using the delta is fairly stable throughout the year averaging monthly about 108 for an annual total of 39,420 use days (Appendix D).

The food habits of most wading birds are similar. Small fish, crustaceans, amphibians and other aquatic organisms make up most of their diet.

The great blue heron and great egret also feed on small mammals and reptiles. Important feeding areas include the river, sloughs, ditches, mudflats, salt marshes, freshwater marshes and pasture lands.

Miscellaneous Marsh Birds

Several varieties of birds associated with marsh or aquatic habitat are included in this group. Between species there is great diversification in size, form and habits. Each kind has developed physical characteristics and food habits which enable it to utilize a particular niche in the environment. In this miscellaneous category are the coots, grebes, loons, rails and king fishers. All but the rails and kingfishers are easily censused from the air. The average annaul total of those censused amounted to some 274,845 bird days use.

Pelagic and Coastal Birds

Several species of gulls, terns and cormorants, as well as the brown pelican, utilize the Eel River Delta. Others, like the murre, guillemot, puffin and auklet, are seldom found within the delta itself but are fairly common inshore along the beach. Still others--petrels, fulmars, shearwaters, albatrosses and jaegers--are primarily pelagic and usually remain well offshore, although they may be seen occasionally flying through the delta.

Mammals

Generally mammals are less often seen than are the birds. They tend to be found in heavier cover, and many are active only at night. As a result their presence is known only by tracks and other signs. The greatest variety and number are found in or near the riparian woodlands

or uplands where escape cover is available, but one or another can be found in almost all delta habitat types.

The blacktail deer is the largest of the land mammals found in the delta. They are most often seen near the river or the foothills adjacent to the valley. The coyote and bobcat are found generally in the same areas.

The river and its tributary sloughs provide habitat for the water associated beaver, mink and river otter. Other furbearers such as the gray fox, ringtail cat, raccoon, striped skunk, spotted skunk and weasel are more terrestial in nature but are often found near the river.

Blacktail jackrabbits, brush rabbits, ground squirrels, gophers, mice and other small mammals occupy various habitat types throughout the delta. These smaller mammals are a vital part of the food chain which supports the higher forms of bird and animal life within the ecosystem.

A number of marine mammals also utilize the lower delta or the sea close inshore. Harbor seals and sea lions are often seen in the estuary and sometimes several miles upstream in the river. Porpoises and dolphins rarely enter the river but are common offshore.

Reptiles and Amphibians

Other wildlife species observed in the delta area include several varieties of frogs, toads, salamanders, lizards and snakes. The upper reaches of almost every tributary stream contain a population of the giant Pacific salamander.

None of these species are harvested for use by man except as curiosities or for research but they are of great value to him indirectly. All eat insects and, in the case of some snakes, small rodents. Along with other predators these reptiles and amphibians help to control populations of prey species within the ecosystem.

Fish

Within the Eel River Delta are 136 miles of rivers, streams, and sloughs.[1/] They offer habitat ranging from nearly pure fresh water in the headwaters of the several streams to sea water at the mouth of the Eel River. In between these two extremes are varying and changing degrees of brackishness, depending upon tide and runoff. These varying conditions yield a variety of aquatic fauna.

Some of the fish species found in the delta are resident and live and reproduce in the habitat they find suitable to their needs. Others may live out part of their lives in the delta and then migrate to another area to complete their life cycle. Still other species use the waters of the delta as a highway to other places or simply visit it incidental to their life in the ocean.

Resident Freshwater Species

Strictly speaking there are only two delta species which inhabit only fresh water. They are the western roach and the Humboldt sucker.[2/]

1/ Appendix E lists the names of waterways and streams in the delta and the miles of fresh and brackish water in each.

2/ A list of the common and scientific name of the species found in the delta are given in Appendix F.

Both are native to California but the western roach was introduced into the Eel River system from elsewhere in the state. Neither support a sport or commercial fishery, although in some areas suckers are taken for food.

Ocean and Brackish Water Species

The estuary and sloughs of the delta provide a spawning and nursery area as well as a place of residence for several ocean fish. Some, such as the starry flounder, Pacific staghorn sculpin, sanddab and topsmelt ascend into fresh water on occasion.

The redtail surfperch, more commonly found along the sandy beaches, maintain a substantial sport fishery in the estuary and larger sloughs where there is little fresh water influence. Shiner perch, surf smelt, greenling and Pacific herring also frequent the brackish delta waters. Redtail perch and shiner perch occupy channel areas in the lower estuary year-long. Shiner perch have been observed spawning during July.

Pacific herring occupy the estuary from September through April. The shallow estuarine waters provide some spawning habitat for this important forage species. Filter feeding northern anchovies, a marine species, are attracted to the plankton rich delta from spring through fall. Anchovies also serve as an extremely important forage for salmon. Sardines, now rare, were once reported to be quite numerous in the upper reaches of the estuary (Murphy and Dewitt, 1951). Longfin smelt are known to use the estuary for spawning during fall and winter months, while the lower estuary provides a nursery area for surfsmelt and topsmelt during much of the year.

Bay pipefish, saddleback gunnels and cabezon are found on the channel bottoms in the lower estuary, but species such as starry flounders, Pacific staghorn sculpins and threespine sticklebacks are found on channel bottoms and mudflats throughout most of the estuary. Generally, the upper estuarine areas are preferred by bottoms dwellers such as the Humboldt sucker, prickly sculpin, western roach and Aleutian sculpin.

Also resident in fresh water but able to live in brackish or salt water are rainbow and coastal cutthroat trout. Both are highly prized sport fish and along with the sea run varieties are the most sought after game fish on the North Coast.

The threespine stickleback is equally at home in fresh and brackish water. It can tolerate conditions (pollution, high temperatures, etc.) which the other species cannot. It is found in nearly all the waters of the delta and is by far the most common fish encountered there. The threespine stickleback is important as a link in the food chain between aquatic insects and the larger more desirable species of fish.

Anadromous Species

Of the aquatic resources, the anadromous fish are the species most highly prized by man. They include the sea-run forms of the rainbow trout, or steelhead, and the coastal cutthroat trout. Because of the close genetic relationship between these two species they readily hybridize. In the same stream one may find what appears to be pure rainbow trout and pure coast cutthroat trout and many variations in between. The Eel River Delta is the southern limit of the coastal cutthroat trout's range.

Also in the anadromous group are the king and silver salmon; the basis for one of the largest industries on the North Coast, the ocean salmon fishery. Juvenile king salmon and steelhead have been found in most areas of the estuary during fall, winter and spring months. Apparently some of these downstream migrants use the estuary as a nursery area throughout the year (Don La Faunce, Dept. Fish & Game, pers. comm.).

Green sturgeon, American shad and Pacific lamprey complete the list of the anadromous fish species which must spawn in fresh water after having matured in the ocean. American shad initiate their spawning runs by entering the estuary in the spring. Adult Pacific lampreys ascend the river during spring to spawn and young lampreys have been found in the lower river from June through September.

Invertebrates

Not much is known of the invertebrate life in the Eel River Delta, however a few noteworthy species do occur. The delta provides a nursery area for Dungeness, or market crab (*Cancer magister*). The ocean off the mouth of the Eel River is a major commercial crabbing area. Crabs reared in the delta estuaries contribute to the offshore fishery.

Yellow shore crabs (*Hemigraspus oregonensis*) are found under stones on mudflats and the soft shell clam, accidently introduced to California with oyster seed, is found in areas of low salinities. Both crabs and clams provide a sport fishery for local anglers. Bay shrimp (*Crago* sp.) are abundant in the estuary waters and provide food for several delta fish. Amphipods (Gammaridea), isopods (Isopoda) and barnacles (*Balanus* sp.), find shelter among rocks, debris and algae attached to the substrate.

Bottom muds are occupied by many invertebrates such as polychaete worms. The smaller invertebrates are important links in the Eel River estuarine food chain.

ECOLOGY

By definition, ecology is the study of the interrelations between living organisms and their environment. A given area in which these interrelations occur, large or small, is described as an ecosystem. The Eel River Delta is considered such an ecosystem. In a larger sense, however, the delta should be viewed as many smaller individual ecosystems which form a composite that gives the area its particular character. And, as an ecological unit, the Eel River Delta also is a part of a much larger system, the coastal wetlands of California.

The waters of the Eel River begin their journey to the sea 140 miles to the south and west in the mountains of the Coast Range. Over most of this journey the river is a typical mountain stream confined by steep canyon walls covered by woodlands and conifer forests. When it reaches the lowlands of the Delta it becomes a broad meandering waterway winding its way through green pasture lands, its course marked by groves of tall trees.

As it nears the sea the channel grows wider and its rocky bed gives way to silt and sand. The incoming tides of the sea meet the river waters to form an estuary. Salt marshes fringe the many sloughs and river channels, and broad mudflats are alternately exposed and covered by the changing tides.

During the winter the large expanses of green pastures are broken by shallow ponds and seasonal marshes formed by rain and overflowing streams. For short periods following heavy storms the normally shallow Eel becomes a torrent of racing flood water which periodically spills over banks and levees to cover large areas of delta lowlands.

These various physical features and seasonal moods are basically what makes the Eel River Delta what it is. Even the periodic flooding is essential, for it was the floodwater that created the delta over countless centuries, and it is floodwater that continues to lay down rich soils and sediments, increasing the productivity of the area. This productivity is the basis for all life, for it is in the soils and waters that the seeds of life are sown. The richer the soils and water the greater is the production of living things.

All life subsists on energy. This energy originates only in plants. Through the process of photosynthesis--the action of sunlight in association with chlorophyll and certain enzymes--plants manufacture organic nutrients. In the form of fats, carbohydrates and proteins, these nutrients are passed from organism to organism through a complex food chain. The energy is thus used and re-used by each organism, including man, within the system. The energy is returned to the system by bacteria which aid decomposition of the tissues of dead organisms and return them to their basic organic and inorganic components.

This process can be demonstrated by following the life cycle of one of the river's most important residents--the king salmon. Salmon spend their adult lives at sea. Within the sea, tiny plants (phytoplankton) begin the process of energy production. These one-celled plants are fed upon by other small organisms which in turn are fed upon by larger organisms. This chain eventually produces the small fish which become food for salmon. While at sea the salmon grow and thrive on these ocean resources. Eventually they return to the Eel River and its tributaries to spawn. During

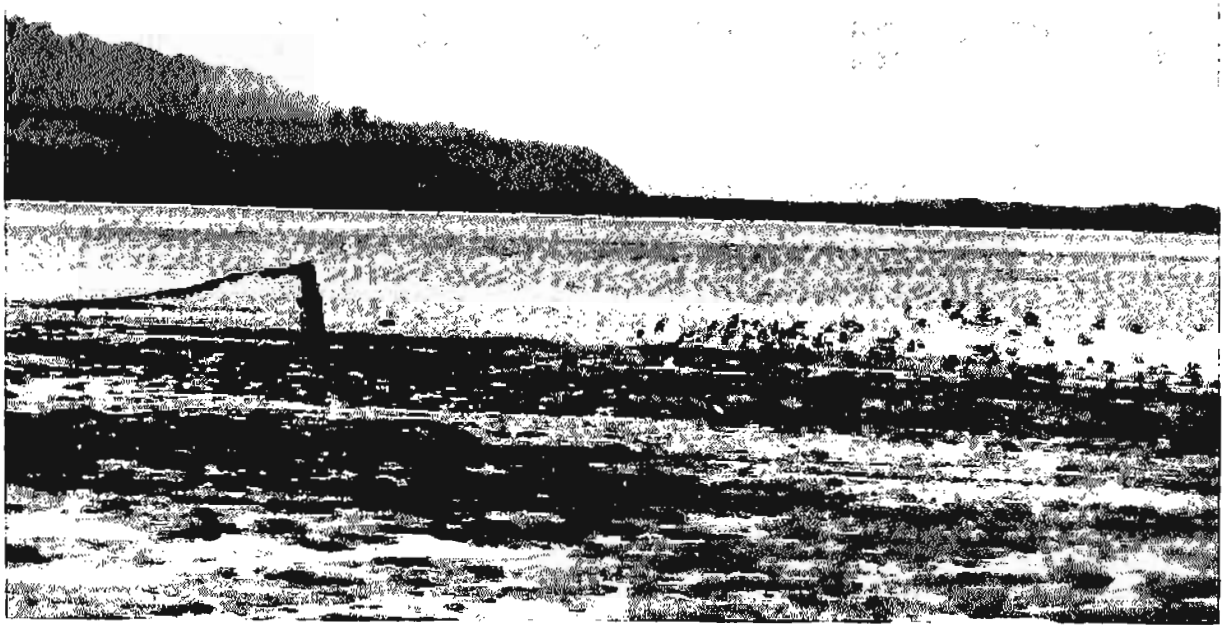
their upstream migration some fall prey to predators and many are caught by fishermen. Those that safely reach their chosen gravel bar lay their eggs, and spent, soon die.

But death itself does not end the cycle. The flesh of the dead and dying fish provides nourishment for other life forms. Bears, raccoons, eagles, vultures and other creatures feed upon the carcasses. Bacteria begin the task of decomposition, and soon little evidence of the salmon remain. What is left is carried off to enrich the waters of the river and the sea. In time the eggs hatch and a new generation of salmon begin the cycle over again.

And so, the never ending process continues. From life to death--and from death to new life. Nothing in nature is truly wasted. All is used again and again, ever changing, but never lost.

Animal life is distributed throughout the delta according to habitat preferences and the availability of food. The periodicity of use is influenced by the seasons, tides, weather and other factors including human activity. Food habits are as diverse as there are food items to be consumed.

Within the bottom sediments of the river and its estuary clams and other bivalves, along with a multitude of worms, worm-like creatures, amphipods, isopods and crustaceans, compete for living space and food. In the waters above, fish of many sizes and descriptions swim about freely. Some are residents, others are visitors from the sea. Still others, like the salmon and steelhead, enter the river in search of ancestral spawning beds upstream. Some fish use the estuary for spawning or nursery areas.



MUDFLATS IN THE LOWER DELTA ARE IMPORTANT HABITAT FOR SHOREBIRDS AND SUPPLY MUCH OF THEIR FOOD. DEPT. FISH AND GAME PHOTO - SEPTEMBER 1974

THE REMNANT TIDAL SALT MARSH NEAR THE MOUTH OF THE EEL RIVER IS VITAL TO WATER-ASSOCIATED BIRDS THAT NEED SPECIALIZED HABITAT FOR THEIR LIVING REQUIREMENTS. DEPT. FISH AND GAME PHOTO - SEPTEMBER 1974

Many of the fish and shellfish caught in the sea by fishermen are produced or spend a part of their life in coastal rivers and estuaries.

During low tide the exposed mudflats and river bars are covered by shorebirds probing with their long bills in search of invertebrate food organisms. Others can be seen feeding in salt marshes and wet pastures. Egrets and herons stand motionless at the water's edge waiting for passing fish or search the pastures for small rodents and amphibians.

Waterfowl are found in all water associated habitat types but are most numerous in the lower reaches of the delta. Many of the diving ducks feed on marine organisms in the sloughs and estuaries. The puddle ducks prefer plant foods which they obtain in freshwater marshes and flooded pastures. Birds are constantly trading back and forth between feeding resting areas. When bothered by hunters large flocks of waterfowl may move offshore to rest on the open ocean waters.

Rails and bitterns are found in the heavy cover of dense salt marshes and freshwater marshes. Other water-associated birds such as loons, grebes and cormorants dive for food in deep water channels. Pelicans, murres, guillemots, fulmars, terns, petrels, albatrosses and others are at home along the ocean beaches or the open sea. Gulls scavenge for food wherever it can be found in a variety of habitat types.

Most mammals, with the exception of marine species, are year-long residents. Although they are seldom seen, mammals of many kinds make their home in the delta. Their nocturnal habits and wariness make them difficult to observe, but sign indicate they forage for food and fiber through the riparian and marsh habitats. Otters, seals and sea lions rest and feed in the river and its tributaries.

Rodents, rabbits and other small mammals are the most abundant animal species. Although less spectacular than the larger mammals, these creatures along with the many small land birds are a vital part of the delta's biological community. These smaller animal forms provide food for hawks, owls, furbearers and other carnivores.

Each plant and animal form has developed its own particular environmental requirements through evolutionary processes. Therefore each habitat type has its own particular combination of plant and animal species which are found within its confines. All of these living things are interdependent--each upon its physical environment and each upon the other living things around it. In summary then, any substantial change in either the physical or biological environment can disrupt the entire system. For example, if a salt marsh is filled,the plants and animals which composed that particular ecosystem will be destroyed. The effects, however, extend far beyond the immediate area of the marsh. The loss of the marsh reduces the ability of the adjacent estuary to support life. The resulting loss of estuarine productivity in turn reduces the biological input to the sea. The long term effects may be felt by man through a decline in the commercial fish catch on the ocean.

Only by recognizing and understanding these complex relationships between living things and their surroundings can man hope to preserve, maintain and wisely use the fish, wildlife and habitats which make up the rich natural resources of the Eel River Delta and similar coastal wetlands.

RESOURCE USE

Recreational Use

Coastal areas have always been attractive to recreational users. The unique combination of redwood forests, rocky headlands, sandy beaches and estuaries make the Humboldt County coastline particularly attractive. The use demand is demonstrated by ever-increasing numbers of visitors to the north coast. As the pressures of our complex society become greater, more and more people from metropolitan areas will seek relaxation in rural surroundings.

The public need for outdoor recreation is well documented. For counties that have the natural resources to provide such recreation, and in which industrial diversity is limited, this need can prove to be of great economic benefit. The importance of recreation to the economy of Humboldt County is high. The Greater Eureka Chamber of Commerce reports that tourism is second only to the forest products industry and represents about 14 percent of the total economy.

The Eel River Delta contains a wealth of actual and potential recreational opportunities, most of which are associated directly or indirectly with natural resources. Patterns of recreational use in the delta area, as elsewhere on the north coast, are governed largely by weather. Because of fog, rain and cool temperatures, certain types of recreation found in other coastal areas are not in great demand here. Swimming, water skiing or other water contact activities are extremely limited because of cold air and water temperatures. Boating is largely oriented towards sport fishing or hunting. The realization of the areas' recreational potential is therefore dependent on the preservation of the natural resources.

Resource uses are classified as appropriative or non-appropriative. Appropriative uses involve the actual removal of individual units, such as fish or game, from the eco-system, through hunting, fishing or other related activities. The non-appropriative user may enjoy the same resources without actually removing any resource units. Nature study, wildlife observations and sightseeing are examples of non-appropriative use.

Both kinds of use are equally important since a wide variety of recreational interests exist. Through proper planning the various recreational uses can continue without serious conflict and the full recreational potential of the Eel River Delta eventually realized.

Hunting

Waterfowl hunting is the most significant appropriative wildlife use in the delta area. Hunting opportunities for the general public are largely confined to the waterways traversable by boat or to the few levees where hunting trespass is permitted. Many local residents obtain permission from landowners to hunt on private lands. Others belong to private clubs that lease lands specifically for waterfowl hunting.

In order to estimate hunter days use on areas other than private clubs, hunter car checks were conducted on sample areas of the lower Eel during the 1968-69 season. An average of 2.5 hunters per car based on field observations was used to determine total hunters. Weekend hunting, accounting for twenty-six days of the eighty-five day season, averaged 37.5 hunters per day for a total of 975 hunter days. Week days averaged 14.4 hunters per day for fifty-nine days for a total of 850 hunter days.

Total seasonal use, based on this survey, indicates that a minimum of 1,825 hunter days use were expended in the pursuit of waterfowl on areas other than duck clubs.

However, the results of this survey represent only a minimum use figure by waterfowl hunters on selected sites. During census, other waterfowl hunting activity was observed and there are indications that considerable waterfowl hunting effort is expended by local residents on their own lands. At least ten private waterfowl hunting clubs were operating during this same period. The average membership for each club was twelve, for a total club membership of 120 persons not including guests. Host clubs hunt on Wednesdays, Saturdays and Sundays for a total of three days each week. The 1968-69 waterfowl season covered 85 days and included some 36 club shoot days. If at least half of the club members hunted each shoot day this represents some 2,160 hunter days use.

The combined estimate for all waterfowl hunting use is something over 3,985 hunter days based on the preceding information. Again, it is emphasized that this figure is a minimum figure reflecting only hunting use on certain selected areas of the lower Eel, and does not necessarily illustrate total waterfowl hunting use within the delta area as a whole. The actual total use is probably much higher.

Hunting use of species other than waterfowl is much more difficult to estimate. However, snipe hunting, deer hunting, and upland game hunting occur in the delta. Estimates based on visual observation, personal interview and records of hunting success indicate that this type of use is in excess of 400 user days annually.

WATERFOWL HUNTING IS THE MOST SIGNIFICANT APPROPRIATIVE USE OF WILDLIFE IN THE DELTA.

ANADROMOUS FISH LIKE THE COASTAL CUTTHROAT TROUT, STEELHEAD AND SALMON ARE HIGHLY PRIZED BY EEL RIVER DELTA FISHERMEN.
DEPT. FISH AND GAME PHOTOS BY JOHN SPETH - SEPTEMBER 1974

Trapping

Although no estimate of trapping use is available, some trapping effort is expended within the Eel River Delta. Fur trapping is usually conducted during winter months, often by persons who augment their income at a time of year when other work is not available. It also provides an outdoor experience and modest income for young people still attending school.

Sport Fishing

The 136 miles of waterway within the Eel River Delta offer a diversified fishery for the sportsman. Favored species are trout, salmon, shad, redtail perch, and Dungeness crab.

Nearly all the trout fishing occurs in the small streams tributary to the Eel River. Those draining into the north side of the Eel produce only steelhead rainbow trout while streams entering on the south contain a mixture of coastal cutthroat and rainbows. Resident trout in these streams often attain a length of 12 to 16 inches.

In April, 1953, three streams near the city of Ferndale; Francis, Williams, and Reas creeks,were declared a junior fishing reserve by legislative action. They were regularly stocked with catchable trout from Humboldt County's Prairie Creek Hatchery until 1966. Stocking since 1966 has been limited to Francis Creek in which 657 rainbow trout were planted in 1972. Another small plant was made in 1973.

Fishing for salmon and steelhead occurs mainly in the Eel River's Singley pool near Fernbridge. It is reported that 2,572 king salmon, 731 steelhead and 2 silver salmon have geen caught there during a 45 day period

(Day, 1968). This is the most popular, albeit, short-lived, fishery on the delta.

Crab fishing, once popular in the vicinity of Crab Park on Mosley Island, has declined in recent years.

Shad and redtail perch fishing with a minor amount of clamming make up the remainder of the sport fishery. Shad appear in the river in June. Fishing for them is quite productive downstream from the mouth of the Van Duzen River. Although considered a low quality food fish shad do offer the angler high quality sport.

Redtail perch are caught near the mouth of the Eel River. They are a fine food fish but not noted as a particularly game fish. A small commercial fishery exists along the coast for this species, but constitutes the only significant commercial operation in the delta at present.

The sport fishery for all species in the delta seems to be declining at the present time. Increased siltation due to watershed misuse; pollution (or contamination) from domestic and agriculture sources; habitat degradation and destruction; and, an increasing demand upon the resources by both the sportsman and commercial fishing industry are several reasons accounting for the decline. To reverse this trend, the public is going to have to decide which is the more important, economic progress or natural resources.

Nature Study

Non-appropriative use of the delta is much greater than the appropriative use. Included in this category are various forms of nature study,

wildlife observations and photography. These activities are enjoyed by residents and visitors alike, and provide many user days of outdoor recreation.

Interest in ecology and conservation has increased dramatically over the last decade. Evidence is readily apparent in newspapers, magazines and other similar media. The numbers of people who engage in wildlife oriented activities are growing every day. Membership in such groups as the Audubon Society is increasing and new conservation oriented organizations are being formed.

Memberships in formal organizations is not necessarily typical of those who participate in non-appropriative uses, however. Many people with no organizational ties are enthusiastic students of natural history. An even larger segment of the public enjoys wildlife as a part of the total outdoor recreation experience. The large number of people who pass through the north coast country do so primarily to enjoy the character of its natural resources. Wildlife sighting is a meaningful and enjoyable part of this experience.

Although there are no quantitative data on non-appropriative use, there are many indications of its magnitude. Studies in other areas indicate that non-appropriative uses exceed appropriative uses by at least twice the user days. By applying this measure to the Eel River Delta, non-appropriative use would be in excess of 8,000 user days annually. In a larger sense, however, the number of people who enjoy and benefit from the area's wildlife must very nearly equal the total number of individuals who pass through the delta, whatever their purpose.

The current non-appropriative use of the Eel Delta is far below the potential. Future use can be increased many-fold by proper planning for the preservation of the natural resources. And,this use can provide substantial economic benefit to the county.

Boating

Most boating activity is associated with hunting or fishing use; however, pleasure boating for other purposes is evident and increasing. Because of shallow water and numerous sand bars, boating is confined to skiffs and similar small craft. Launching facilities are provided at three locations--Crab Park and another on Cannibal Island and one on Cock Robin Island.

Scientific and Education Use

The Eel River Delta offers many possibilities for the study of natural history, ecology and related subjects. The proximity of California State University, Humboldt and the College of the Redwoods makes the delta particularly valuable for such purposes. College and university natural sciences classes visit the delta for field studies and trips as well as to gather zoological and botanical specimens. In addition, students use the delta for individual study and to fulfill class assignments.

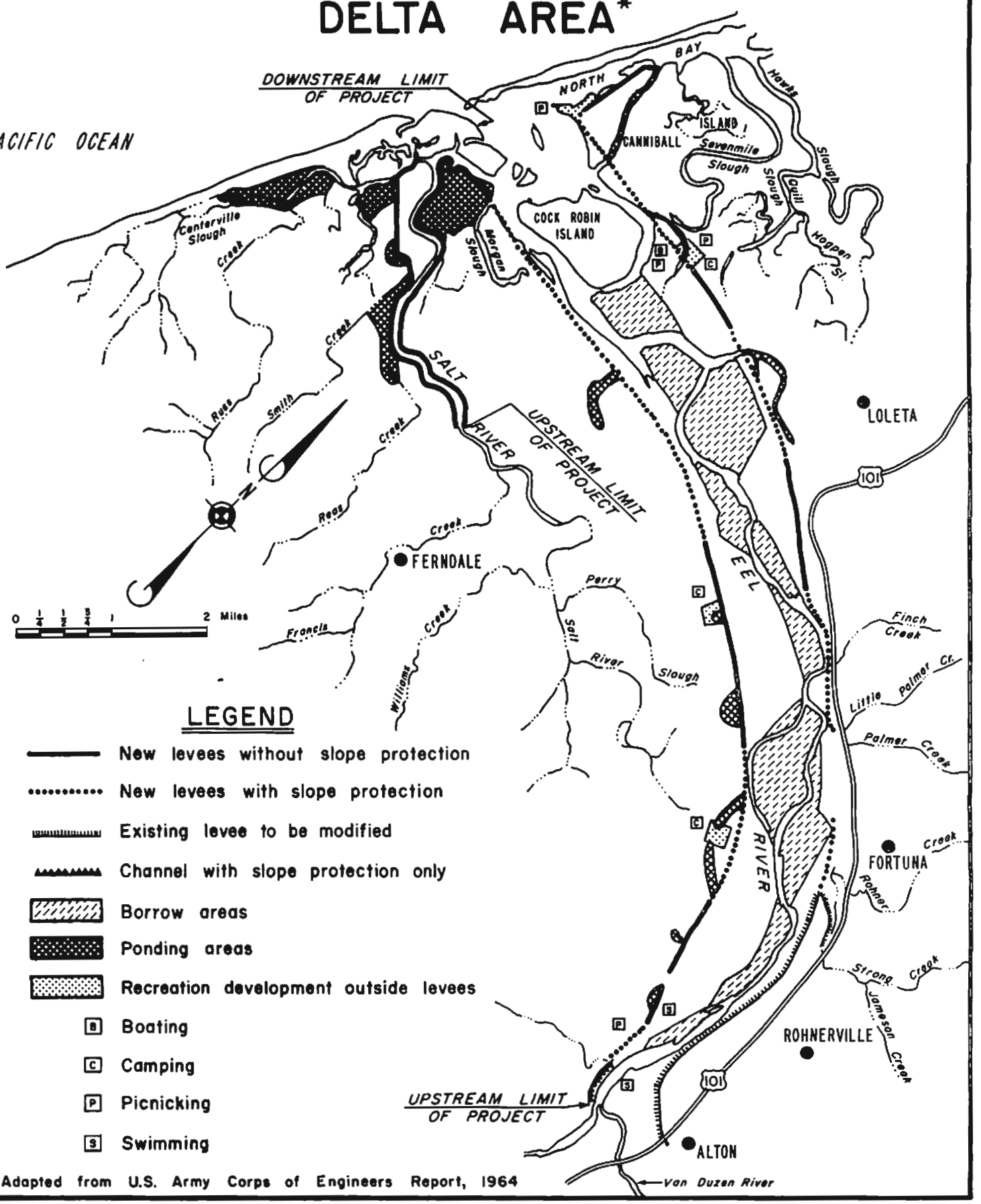
High school and grammar school instructors also utilize the delta and its resources for field trips and classroom work. The addition of environmental subjects in state schools has stimulated educational interest and a demand for outdoor classroom sessions.

Scientific use is also made of the area by government agencies, independent foundations and private industry. Studies involving fish, wildlife, plants, geology, pollution and many other fields have been conducted.

The coastal tidelands are a well used, productive and a valuable part of the coean shore. Their continued availability for scientific and educational use can lead to a greater understanding of the world around us and benefit mankind in many ways.

PLATE 6

PLAN OF IMPROVEMENT DELTA AREA*



LEGEND

- New levees without slope protection
- New levees with slope protection
- Existing levee to be modified
- Channel with slope protection only
- Borrow areas
- Ponding areas
- Recreation development outside levees
- [B] Boating
- [C] Camping
- [P] Picnicking
- [S] Swimming

*Adapted from U.S. Army Corps of Engineers Report, 1964

PROBLEMS AND CONFLICTS

Sedimentation

Sedimentation is the most significant factor currently affecting water quality in the Eel River. Soils of the drainage basin are highly erodable and unstable. When vegetation is removed or land features are altered, the already high erosion rates are substantially increased.

The result of erosion is demonstrated by the siltation of the lower Eel, which at one time was navigable by shallow draft commercial vessels. By the early part of this century silt deposits rendered the river unsuitable for shipping. Rapid siltation of the river coincides with the early period of intense logging activities. Although logging has been the primary cause of erosion, other factors such as road construction, subdivision activities and extensive livestock over-grazing have contributed large amounts of silt to the river system.

Unfortunately little is known about current siltation rates or about all the effects of siltation on natural resources of the delta. However, it is known that siltation adversely affects anadromous fish by compacting spawning gravels, filling pools, raising average temperature, lowering dissolved oxygen and smothering food organisms. The productivity of the river in terms of salmon and steelhead has been much reduced by such problems.

It is also known that turbidity influences angling success. When turbidity levels are high, fishing is poor and angler effort declines. The number of days the river is fishable is therefore largely determined by the clarity of the water. The presently high turbidity during

winter months precludes realization of the river's full recreational potential.

Although sedimentation problems are recognized, it is doubtful that much can be done in the near future to solve them. The ultimate solution lies in better land use controls and a broad program of watershed management. The emphasis of such programs should be directed toward reducing erosion from logging, road construction, land subdivisions and livestock grazing. As interim measures, tributary streams should be protected by green belt buffer strips between logging operations and the streams. Roads should be kept a safe distance from streams whenever possible.

Flood Control

Due to the relatively large watershed and normal pattern of heavy winter precipitation, the Eel River Delta is periodically subject to severe flood conditions. Consequently, flood control has always been a consideration of those publics and agencies having an interest in the delta. Dams on the upper Eel watershed and channelization of the river through the delta have been the means most commonly proposed to bring the Eel River under control.

At one time the U. S. Army Corps of Engineers proposed and received congressional authorization to construct approximately 30 miles of levees on the lower Eel extending from the mouth of the Van Duzen River to the ocean (Plate 6). This proposed project (U. S. Army Corps of Engineers, 1964), in conjunction with dams proposed on the upper Eel, was designed to reduce winter flooding of reclaimed lowlands within the delta area. Recent state legislation, based on environmental concerns,

has placed a 12-year moratorium on dam construction on the Eel River. Without the upstream flood control impoundments, the proposed delta levee project is not feasible.

Any levee or channelization of the Eel River would be detrimental to the area's wildlife populations in two ways: first, through actual physical destruction of habitat; and second, from long-term land-use changes that generally occur as a result of flood protection. For instance, the proposed Corps project would have caused the estimated direct loss of 1,978 acres of delta habitats, with the accompanying loss of an estimated 335,000 bird-days of use, involving waterfowl, shorebirds and wading birds. These estimates of loss include 13% of the delta wetlands and 44% of the riparian habitat in the lower Eel and its tributaries. Riparian habitat is extremely vital to fur-bearers, deer, upland game, raptors and even some wading birds.

Indirect effects, while more subtle, are equally as detrimental to fish and wildlife populations. Drainage and loss of winter overflow eliminate shallow marshes which provide feeding and resting areas for water-associated birds. Further drainage would encourage agricultural practices unfavorable to wildlife maintenance and also would make further urban and industrial development feasible. Proposed levees would cause serious problems for anadromous fishes unless appropriate passage facilities were provided to tributary streams. Any proposals for flood control on the Eel River Delta should be carefully planned, if fish and wildlife resources and the habitat upon which they depend are to be preserved and maintained.

A plausible alternative to flood control structures is a flood plain management

system. Flood plain management involves non-structural methods of reducing flood damage, such as zoning flood plain land to uses compatible with periodic inundation, building regulations, preventing the placement of structures in the flood plain and differential flood insurance rates favoring agricultural and other compatible uses.

Pollution

Pollution is not a major problem in the Eel River at the present time. Some pollution does exist, however, and any increase in current development or human use that involves waste discharges could cause water quality problems if the discharges are not properly controlled.

Pollution can result either from the chronic discharge of waste products or from accidental or intentional spill of some deleterious substance. Chronic pollution can result from many sources, including direct discharges of untreated wastes, inadequately-treated domestic wastes, septic system leakage and livestock wastes.

Within the Eel River drainage the principal industries are related to wood products. Pollutants associated with this industry are lignins, tanins and wood fibres. They have entered the river directly or through its tributaries from log ponds, mill yards or drainage ditches. The magnitude of this type of pollution does not appear to be great at this time, but every effort should be made to eliminate that which does occur.

Sewage effluent from community treatment facilities enters the river at several locations. Although treated, this effluent has caused high bacteria counts below the points of discharge. The extent of the

pollution involved is not serious at present; however water quality control efforts should be directed toward eliminating these sources and planning to handle any future increases in sewage disposal needs.

Drainage from inadequate septic systems has caused a chronic pollution problem. Situations do exist along the Eel and its tributaries where septic wastes enter basin waters. The extent of this pollution is not presently known. Proper land use, zoning and building codes, along with enforcement of stringent water quality standards would minimize or prevent such problems in the future.

A source of pollution of which the public is less aware is livestock waste. Much of the delta is utilized for pasturing dairy cattle, beef cattle, sheep and horses. Corrals and stock pens where animals are concentrated are often located along streams or ditches which drain into the Eel River. In addition, milking barns and other service buildings are washed down and wastes are carried into streams. Collectively the total mass of this nutrient rich material which enters the Eel River waters may be substantial.

The effects of chronic pollution on natural resources are usually more subtle and gradual than those associated with intentional or accidental spills of toxic material. In most cases the loss of fish or wildlife occurs over a long period of time as a result of chronic water quality decline. The end result of such pollution is generally much more serious, since the ability of waters to support life may be virtually destroyed.

When highly toxic material is permitted to pass into streams, the effects are often immediate and dramatic. Large losses of fish and other aquatic life as well as mammals and birds may be evident. Although such losses are serious and cannot be condoned, the problem is usually short-lived and the stream's ability to support life over the long term may not be seriously impaired. Toxic materials known to have caused fish and wildlife losses in this particular area include oil products, glues, fungicides and other chemicals. Spills may be intentional or accidental. Accidental spills are often the result of negligence or poor judgement. Fortunately, incidents of this kind have been infrequent within the Eel River Basin.

Urban and Industrial Expansion

The Eel River Delta is not expected to experience any major expansion of urban and industrial land use within the immediate future. For the most part, the delta lands are subject to periodic flooding which renders them unsuitable for development. Any expansion that does occur is expected to be in areas surrounding the communities of Fortuna, Ferndale, Fernbridge, Loleta and Port Kenyon. Most of the land which will be involved is presently in well drained pasture and row crops.

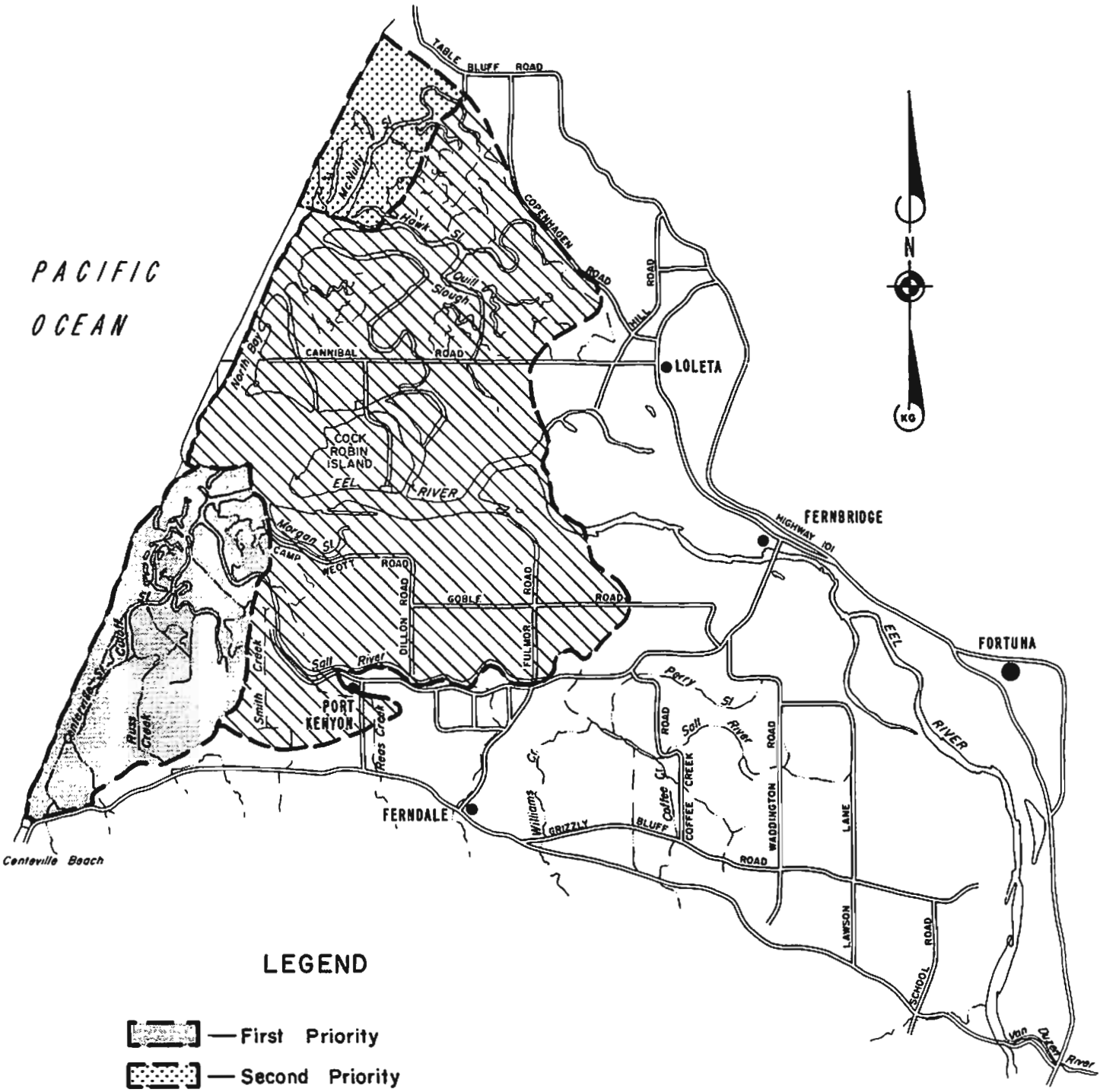
However, if the river is channelized and other measures are taken to prevent flooding, it is conceivable that urban and industrial development could be accelerated to the point that wildlife and fish would be seriously affected. Consequently the Department endorses the adoption of land use plans that would insure preservation of fish and wildlife habitat areas in the delta.

If and when urban and/or industrial encroachment, and harmful land use changes, seriously threaten the natural resources of the delta, the Department proposes that the certain delta wetlands be acquired and

PLATE 7

WETLAND ACQUISITION

(CONTINGENCY PROPOSAL)



LEGEND

— First Priority

— Second Priority

— Third Priority

LOW POORLY DRAINED PASTURE LANDS IN THE LOWER DELTA WILL BE GIVEN HIGH PRIORITY IF PUBLIC ACQUISITION OF DELTA LANDS IS NECESSARY TO PRESERVE VITAL FISH AND WILDLIFE HABITAT. DEPT. FISH AND GAME PHOTOS - SEPT. 1974

placed in public ownership. Acquisition should take place on a priority basis (outlined on Plate 7); i.e. the tidelands first and low poorly-drained pasture lands next. Public acquisition and management is the surest way to perpetuate the natural resources of the delta and to increase their biological productivity and recreational potential.

Access

The only areas of the delta presently open to public use without restriction are tidewaters of the river and its estuaries and the state-owned North Spit. Boat access is provided from launching sites at Crab Park, Cannibal Island and Cock Robin Island. This access is probably sufficient for the current level of water-oriented recreational use within the lower reaches of the river.

Upstream access for fishing is restricted by surrounding private lands. Some of the best salmon and steelhead fishing opportunity is in this area. At the present time, some access for fishermen is available through private land at two locations near Fernbridge. The permanence of this access is not in any way guaranteed for the future. Public access could be stopped at any time. Humboldt County is attempting to acquire public access rights on a permanent basis at one of these sites.

To provide for optimum recreational use of the Eel River Delta's natural resources, additional access should be provided at other locations along the river between Cannibal Island and Fernbridge. Additional recreational opportunity, particularly hunting, could be provided by public acquisition of wetlands in the lower delta (Plate 7), or through a program of public hunting on private lands.

BOAT LAUNCHING SITES ARE PROVIDED BY THE COUNTY IN THE LOWER DELTA; HOWEVER, ADDITIONAL ACCESS TO THE UPPER DELTA WOULD ENHANCE THE AREA'S RECREATIONAL POTENTIAL.

IT WILL TAKE THE UNDERSTANDING AND COOPERATION OF ALL LAND OWNERS, PUBLIC AND PRIVATE, TO ENSURE THE PRESERVATION AND PROTECTION OF RIPARIAN HABITAT IN THE DELTA. DEPT. FISH AND GAME PHOTOS - SEPTEMBER 1974

Stream Rehabilitation

Historically, all tributaries of the Eel River Delta were capable of supporting anadromous fish. However, stream channeling, road culvert blockages, water control practices, sedimentation and silting, have reduced the capacity of the delta system to support the highly prized anadromous fishes.

Since most streams tributary to the delta are important nursery and spawning areas for anadromous fish, expecially the coastal cutthroat trout, the Eel River Delta system of tributaries should be returned to a more productive state with stream rehabilitation. Because of the complexity of the problem, each tributary probably would have to be considered on its own merit. However, upstream problems (erosion, siltation, etc.) would have to be solved first, if problems in the delta are to be solved. Returning the tributary system to something approaching original capacities to support a good anadromous fishery will require initiation of active programs to remove barriers, improve road culverts and modify water controls and diversions to allow fish passage.

Reclamation of Delta Wetlands and Riparian Habitat

In addition to the need for cessation of the degrading and destruction of Eel River tributaries there is a need to discourage the unauthorized degradation and destruction of state-owned tidelands and riparian habitat.

Riparian habitat in private ownership also should be preserved wherever possible. Riparian vegetation along the river, streams and sloughs, already well documented as vital wildlife habitat, is being pushed back and destroyed to create more arable or pasture land. Riparian habitat,

throughout California, as well as in the delta, is one of the most productive and threatened wildlife habitats. It should be protected by every means possible.

Reclamation of wetlands under tidal influence, including areas of mudflats, salt marsh and dead-end sloughs, has been a serious problem in the past but is less common today. A simple dike or levee pushed up by a tractor can isolate several acres of tidal wetlands. Drainage of isolated wetlands reclaims the area for other land uses, resulting in the destruction of additional habitat suitable for estuarine fish and wildlife. Unauthorized reclamation should be prohibited.

OVERVIEW

Of all the earth's creatures, man is the only one that has the ability to substantially alter his environment to serve his own needs. Because of this power, man has been able to inhabit many parts of the world which otherwise would be inhospitable to him. As man has sought to improve his own living conditions, he has brought about great changes in natural systems which, in turn, have profoundly affected biological resources.

Through evolutionary processes all living things have developed morphological and physiological characteristics which enable them to survive under certain environmental conditions. For some the range of environmental conditions under which life is possible is quite large. For others life requirements are so specific that they survive in only very limited areas.

The area in which each organism lives is determined in part by such physical features as soils, moisture, climate and elevation, and by the other living organisms which inhabit the same area. The relationships between the organisms themselves and their physical and biological habitat form a very complex ecological system in which all things are interdependent. As man alters these systems through habitat changes, organisms which cannot adapt to the changes are lost. In some cases, where changes are substantial and cover the entire distribution of a particular species, the result is the extinction of that species. The list of wildlife forms already lost forever is impressive and the number of species rapidly approaching the point of no return is substantial.

It is difficult for most people to understand the relationship between an animal and its habitat. All too often their reaction to habitat loss is a sincere but erroneous belief that the wildlife displaced will just move somewhere else. Unfortunately this is not the case. Each parcel of habitat is capable of supporting only so many living things. The amount of each habitat type therefore determines the number of individual organisms of any given species that can exist. Unless new habitat is created elsewhere, the displaced animals are lost in proportion to the amount of habitat lost.

The key to the preservation of fish and wildlife thus becomes the ability and willingness of all people to preserve sufficient quantities and qualities of habitat to insure the existence of all living forms. The Eel River Delta is a classic example. The decision to preserve, maintain and wisely use, or to destroy or degrade the natural resources of the delta, will have to be a local decision. What is left of the Eel River Delta for future generations to enjoy will depend upon that decision.

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APPENDIX A

Common Plants of the Eel River Delta

Algae

Green algae, *Cladophora*
Green algae, *Enteromorpha*
Sea lettuce, *Ulva*

Flowering Plants

Alder, *Alnus rubra*
Alkali bulrush, *Scirpus robustus*
Arrow grass, *Triglochin maritima*
Bayberry (wax myrtle), *Myrica californica*
Beach-bur, *Franseria chamissonis*
Beach morning-glory, *Convolvulus soldanella*
Beach pine, *Pinus contorta*
Beach strawberry, *Fragaria chiloensis*
Bearberry, *Arctostaphylos uva-ursi*
Bird's beak, *Cordylanthus maritimas*
Blackberry, *Rubus vitifolius*
Black cottonwood, *Populus trichocarpa*
Black twin-berry, *Lonicera involucrata*
Blue blossom, *Ceanothus thyrsiflorus*
Bluegrass, *Poa douglasii*
Bracken fern, *Pteris aquilina*
Brass button, *Cotula coronopifolia*
Bulrush, *Scirpus criniger*
Bush lupine, *Lupinus* sp.
Cascara, *Rhamnus purshiana*
Cattail, *Typha* sp.
Chain fern, *Woodwardia radicans*
Chinquapin, *Castanopsis chrysophylla*
Ladino Clover, *Trifolium repens*
Red Clover, *Trifolium pratense*
Salina Clover, *Trifolium gragiferum*
Sour Clover, *Trifolium fucatum*
Cordgrass, *Spartina foliosa*
Cotton-batting, *Gnaphalium chilense*
Cottonwood, *Populus* sp.
Coyote brush, *Baccharis pilularis*
Dandelion, *Taraxacum officinale*
Deer brush, *Ceanothus integerrimus*
Dock, *Rumex* sp.
Douglas fir, *Pseudotsuga menziesii*
Duck weed, *Lemna minor*
Dune tansey, *Tanacetum camphoratum*
Elderberry, *Sambucus racemosa*
European dunegrass, *Ammophila arenaria*
Evening primrose, *Oenthera cheiranthifolia*

APPENDIX A (cont'd)

Fat-hen, *Atriplex patula*
Fire-weed, *Epilobium angustifolium*
Flowering current, *Ribes sanguineum*
Gum plant, *Grindelia stricta*
Himalaya-berry, *Rubus thrysanthus*
Horsetail, *Equisetum hyemale*
Huckleberry, *Vaccinium ovatum*
Ice plant, *Mesembryanthemum crystallinum*
Indian paintbrush, *Castilleia latifolia*
Indian plum, *Osmaronia cerasiformis*
Jaumea, *Jaumea carnosa*
Juncus, *Juncus lesueurii*
Lady fern, *Athyrium filix-foemina*
Laurel, *Umbellularia californica*
Leather fern, *Polypodium scouleri*
Licorice fern, *Polypodium vulgare*
Lupine, *Lupinus* spp.
Madrone, *Arbutus mensiesii*
Maiden-hair, *Adiantum emarginatum*
Mare's tail, *Hippuris vulgaris*
Marsh rosemary, *Limonium californicum*
Monterey cypress, *Cypressus macrocarpa*
Nut grass, *Cyperus* sp.
Oak, *Quercus* sp.
Orchardgrass, *Dactylis glomerata*
Parsnip, *Pastinaca sativa*
Persian wireweed, *Polygonum argyrocoleon*
Pickleweed, *Salicornia ambigua*
Pineapple weed, *Matricaria matricaroides*
Poison-oak, *Rhus diversiloba*
Quackgrass, *Agropyron repens*
Quail brush, *Atriplex lentifolis*
Rabbit's foot, *Polypogon monspeliensis*
Red goosefoot, *Chenopodium rubrum*
Redwood, *Sequoia sempervirens*
Redwood sorrel, *Oxalis oregana*
Ryegrass, *Lolium multiflorum*
Sago pondweed, *Potamogeton pectinatus*
Salal, *Gaultheria shallon*
Salmon-berry, *Rubus spectabilis*
Saltgrass, *Distichlis spicata*
Salt rush, *Juncus lesuerii*
Sand verberna, *Abronia latifolia*
Sedge, *Carex* spp.
Silktassel, *Garrya elliptica*
Silverweed, *Potentilla* sp.
Sitka spruce, *Picea sitchensis*
Spanish broom, *Spartium junceum*
Spike bentgrass, *Agrostis exarata*
Spikerush, *Heleocharis macrostachya*
Tan oak, *Lithocarpus densiflora*
Thimble-berry, *Rubus parviflorus*
Three-square bulrush, *Scirpus americanus*

APPENDIX A (cont'd)

Trefoil, *Lotus corniculatus*
Velvetgrass, *Notholcus lanatus*
Water buttercup, *Ranunculus aquatilis*
Water foxtail, *Alopecurus geniculatus*
Water hemlock, *Conium maculatum*
Water naiad, *Najas* sp.
Water parsley, *Oenanthe sarmentosa*
Wax myrtle, *Myrica californica*
Widgeon grass, *Rupia maritima*
Wild celery, *Apium graveolens*
Wild radish, *Raphanus sativus*
Willow, *Salix scouleriana*
Wood fern, *Aspidium spinulosum*

APPENDIX B

Birds of the Eel River Delta

Family and Common Name	Scientific Name 1/	
Gaviidae		
Common loon	*Gavia immer*	M 2/
Arctic loon	*Gavia arctica*	M
Red-throated loon	*Gavia stellata*	M
Podicipedidae		
Red-necked grebe	*Podiceps grisegena*	M
Western grebe	*Aechmophorus occidentalis*	M
Horned grebe	*Podiceps auritus*	M
Eared grebe	*Podiceps caspicus*	M
Pied-billed grebe	*Podilymbus podiceps*	M-R
Procellariidae		
Sooty shearwater	*Puffinus griseus*	M
Fulmar	*Fulmarus glacialis*	M
Hydrobatidae		
Leach's petrel	*Oceanodroma leucorhoa*	M
Pelecanidae		
Brown pelican	*Pelecanus occidentalis*	M
Phalacrocoracidae		
Dougle-crested cormorant	*Phalacrocorax auritus*	M-R
Brandt's cormorant	*Phalacrocorax penicillatus*	M
Pelagic cormorant	*Phalacrocorax pelagicus*	M
Anatidae		
Whistling swan	*Olor columbianus*	M
Canada goose	*Branta canadensis*	M
Black brant	*Branta nigricans*	M
White-fronted goose	*Anser albifrons*	M
Snow goose	*Chen hyperborea*	M
Emperor goose	*Philacte canagica*	M
Mallard	*Anas platyrhynchos*	M-R
Gadwall	*Anas strepera*	M

1/ Scientific names from Peterson (1961)
2/ R = resident; M = migrant

APPENDIX B (cont'd)

Pintail	*Anas acuta*	M
Ross' goose	*Chen rossii*	M
American wigeon	*Mareca americana*	M
European wigeon	*Mareca penelope*	M
Shoveler	*Spatula clypeata*	M
Blue-winged teal	*Anas discors*	M
Cinnamon teal	*Anas cyanoptera*	R
Green-winged teal	*Anas carolinensis*	M
Common teal	*Anas crecca*	M
Wood duck	*Aix sponsa*	M
Redhead	*Aythya americana*	M
Canvasback	*Aythya valisineria*	M
Ring-necked duck	*Aythya collaris*	M
Greater scaup	*Aythya marila*	M
Lesser scaup	*Aythya affinis*	M
Common goldeneye	*Bucephala clangula*	M
Barrows goldeneye	*Bucephala islandica*	M
Bufflehead	*Bucephala albeola*	M
Harlequin duck	*Histrionicus histrionicus*	M
Oldsquaw	*Clangula hyemalis*	M
Common scoter	*Oidemia nigra*	M
White-winged scoter	*Melanitta deglandi*	M
Surf scoter	*Melanitta perspicillata*	M
Ruddy duck	*Oxyura jamaicensis*	M-R
Common merganser	*Mergus merganser*	M-R
Red-breasted merganser	*Mergus serrator*	M-R
Hooded merganser	*Lophodytes cucullatus*	M-R
Cathartidae		
Turkey vulture	*Cathartes aura*	M
Accipitridae		
White-tailed kite	*Elanus leucurus*	R
Goshawk	*Accipiter gentilis*	R
Cooper's hawk	*Accipiter cooperii*	R
Sharp-shinned hawk	*Accipiter striatus*	R
Marsh hawk	*Circus cyaneus*	M
Rough-legged hawk	*Buteo lagopus*	R
Red-tailed hawk	*Buteo jamaicensis*	R
Red-shouldered hawk	*Buteo lineatus*	R
Golden eagle	*Aquila chrysaetos*	M
Bald eagle	*Haliacetus leucocephalus*	M
Pandionidae		
Osprey	*Pandion haliaetus*	M-R

APPENDIX B (cont'd)

Falconidae		
Prairie falcon	*Falco mexicanus*	M
Peregrine falcon	*Falco peregrinus* 3/	M-R
Pigeon hawk	*Falco columbarius*	M
Sparrow hawk	*Falco sparverius*	R
Tetraonidae		
Blue grouse	*Dendragapus obscurus*	R
Phasianidae		
California quail	*Lophortyx californicus*	R
Mountain quail	*Oreortyx pictus*	R
Ring-necked pheasant	*Phasianus colchicus*	R
Ardeidae		
Common egret	*Casmerodius albus*	R
Snowy egret	*Leucophoyx thula*	M
Cattle egret	*Bubulcus ibis*	M
Great blue heron	*Ardea herodias*	R
Green heron	*Butorides virescens*	R
Black-crowned night heron	*Nycticorax nycticorax*	R
American bittern	*Botaurus lentiginosus*	R
Rallidae		
Clapper rail	*Rallus longirostris*	R
Virginia rail	*Rallus limicola*	M-R
Sora rail	*Porzana carolina*	M-R
American coot	*Fulica americana*	M-R
Haematopodidae		
Black oystercatcher	*Haematopus bachmani*	M
Charadriidae		
Golden plover	*Pluvialis dominica*	M
Semipalmated plover	*Charadrius semipalmatus*	M
Snowy plover	*Charadrius alexandrinus*	M
Killdeer	*Charadrius vociferus*	M-R
Black-bellied plover	*Squatarola squatarola*	M
Surf bird	*Aphriza virgata*	M
Ruddy turnstone	*Arenaria interpres*	M
Black turnstone	*Arenaria melanocephala*	M

3/ May be extinct as a locally nesting species.

APPENDIX B (cont'd)

Scolopacidae		
Long-billed curlew	*Numenius americanus*	M
Whimbrel	*Numenius phaeopus*	M
Marbled godwit	*Limosa fedoa*	M
Willet	*Catoptrophorus semipalmatus*	M
Greater yellowlegs	*Totanus melanoleucus*	M
Lesser yellowlegs	*Totanus flavipes*	M
Wandering tattler	*Heteroscelus incanum*	M
Solitary sandpiper	*Tringa solitaria*	R
Spotted sandpiper	*Actitis macularia*	R
Rock sandpiper	*Erolia ptilcnemis*	M
Pectoral sandpiper	*Erolia melanotos*	M
Bairds sandpiper	*Erolia bairdii*	M
Least sandpiper	*Erolia minutilla*	M
Western sandpiper	*Ereunetes mauri*	M
Long-billed dowitcher	*Limnodromus scolopaceus*	M
Short-billed dowitcher	*Limnodromus griseus*	M
Knot	*Calidris canutus*	M
Dunlin	*Erolia alpina*	M
Sanderling	*Crocethia alba*	M
Common snipe	*Capella gallinago*	M
Phalacropodidae		
Wilson's phalarope	*Steganopus tricolor*	M
Red phalarope	*Phalaropus fulicarius*	M
Northern phalarope	*Lobipes lobatus*	M
Recurvirostridae		
Black-necked stilt	*Himantopus mexicanus*	M
American avocet	*Recurvirostra americana*	M
Stercorariidae		
Parasitic jaeger	*Stecorarius parasiticus*	M
Pomarine jaeger	*Stecorarius pomarinus*	M
Laridae		
Glaucous gull	*Larus hyperboreus*	M
Glaucous-winged gull	*Larus glaucescens*	M
Western gull	*Larus occidentalis*	M
Herring gull	*Larus argentatus*	M
California gull	*Larus californicus*	M
Ring-billed gull	*Larus delewarensis*	M
Mew gull	*Larus canus*	M
Heermann's gull	*Larus heermanni*	M
Bonaparte's gull	*Larus philadelphia*	M
Sabine's gull	*Xema sabini*	M
Common tern	*Sterna hirundo*	M-R

APPENDIX B (cont'd)

Caspian tern	*Hydroprogne caspia*	M
Forster's tern	*Sterna forsteri*	M
Black tern	*Chlidonias niger*	M
Elegant tern	*Thalasseus elegans*	M
Arctic tern	*Sterna paradisaea*	M
Alcidae		
Tufted puffin	*Lunda cirrhata*	M
Common murre	*Uria aalge*	M
Pigeon guillemot	*Cepphus columba*	M
Marbled murrelet	*Brachyramphus marmoratum*	M
Ancient murrelet	*Synthliboramphus antiquum*	M
Columbidae		
Band-tailed pigeon	*Columba fasciata*	M
Rock dove	*Columba livia*	R
Mourning dove	*Zenaidura macroura*	M
Tytonidae		
Barn owl	*Tyto alba*	R
Strigidae		
Snowy owl	*Nyetea scandiaca*	M
Screech owl	*Ofus asio*	R
Great horned owl	*Bubo virginianus*	R
Long-eared owl	*Asio otus*	R
Short-eared owl	*Asio flammeus*	M
Saw-whet owl	*Aegolius acadicus*	R
Pygmy owl	*Glaucidium gnoma*	R
Caprimulgidae		
Common nighthawk	*Chordeiles minor*	M
Alcedinidae		
Belted kingfisher	*Megaceryle alcyon*	R
Apodidae		
Black swift	*Cypseloides niger*	M-R
Vaux's swift	*Chaetura vauxi*	M-R
Trochilidae		
Anna's hummingbird	*Calypte anna*	M-R
Rufous hummingbird	*Selasphorus rufus*	M-R
Allens hummingbird	*Selasphorus sasin*	M-R

APPENDIX B (cont'd)

Picidae		
Red-shafted flicker	*Colaptes cafer*	R
Pileated woodpecker	*Dryocopus pileatus*	R
Acorn woodpecker	*Melanerpes formicivorus*	R
Lewis' woodpecker	*Asyndesmus lewis*	R
Yellow-bellied sapsucker	*Sphyrapicus varius*	R
Hairy woodpecker	*Dendrocopos villosus*	R
Downy woodpecker	*Dendrocopos pubescens*	R
Tyrannidae		
Tropical kingbird	*Tyrannus melancholicus*	M
Western kingbird	*Tyrannus verticalis*	M-R
Ash-throated flycatcher	*Myiarchus cinerascens*	M-R
Black phoebe	*Sayornis nigricans*	R
Traill's flycatcher	*Empidonax traillii*	M-R
Hammond's flycatcher	*Empidonax hammondii*	M-R
Dusky flycatcher	*Empidonax oberholseri*	M-R
Western flycatcher	*Empidonax difficilis*	M-R
Western wood pewee	*Contopus sordidulus*	M-R
Olive-sided flycatcher	*Nuttallornis borealis*	R
Alaudidae		
Horned lark	*Eremophila alpestris*	M
Hirundinidae		
Barn swallow	*Hirundo rustica*	M-R
Cliff swallow	*Petrochelidon pyrrhonota*	M-R
Violet-green swallow	*Tachycineta thalassina*	M-R
Tree swallow	*Iridoprocne bicolor*	M-R
Rough-winged swallow	*Stelgidopteryx ruficollis*	M-R
Purple martin	*Progne subis*	M-R
Corvidae		
Steller's jay	*Cyanocitta stelleri*	R
Scrub jay	*Aphelocoma coerulescens*	R
Common raven	*Corvus corax*	R
Common crow	*Corvus brachyrhynchos*	R
Paridae		
Black-capped chickadee	*Parus atricapillus*	R
Chestnut-backed chickadee	*Parus rufescens*	R
Common bushtit	*Psaltriparus minimus*	R
Cinclidae		
Dipper	*Cinclus mexicanus*	R

APPENDIX B (cont'd)

Sittidae		
Red-breasted nuthatch	*Sitta canadensis*	R
Certhiidae		
Brown creeper	*Certhia familiaris*	R
Chamaeidae		
Wrentit	*Chamaea fasciata*	R
Troglodytidae		
House wren	*Troglodytes aedon*	R
Winter wren	*Troglodytes troglodytes*	R
Bewick's wren	*Thryomanes bewickii*	R
Long-billed marsh wren	*Telmatodytes palustris*	R
Turdidae		
Robin	*Turdus migratorius*	M-R
Varied thrush	*Ixoreus naevius*	M
Townsend's solitaire	*Myadestes townsendi*	M-R
Hermit thrush	*Hylocichla guttata*	M-R
Swainson's thrush	*Hylocichla ustulata*	M-R
Western bluebird	*Sialia mexicana*	M-R
Sylviidae		
Golden-crowned kinglet	*Regulus satrapa*	M-R
Ruby-crowned kinglet	*Regulus calendula*	M-R
Motacillidae		
Water pipit	*Anthus spinoletta*	M-R
Bombycillidae		
Bohemian waxwing	*Bombycilla garrulus*	M
Cedar waxwing	*Bombycilla cedrorum*	M-R
Laniidae		
Northern shrike	*Lanius excubitor*	M
Loggerhead shrike	*Lanius ludovicianus*	M-R
Sturnidae		
Starling	*Sturnus vulgaris*	R

APPENDIX B (cont'd)

Vireonidae		
Solitary vireo	*Vireo solitarius*	M-R
Hutton's vireo	*Vireo huttoni*	M-R
Warbling vireo	*Vireo gilvus*	M-R
Parulidae		
Orange-crowned warbler	*Vermivora celata*	R
Nashville warbler	*Vermivora ruficapilla*	M-R
Black-throated gray warbler	*Dendroica nigrescens*	M-R
Palm warbler	*Dendroica palmarum*	M
Yellow warbler	*Dendroica petechia*	R
Myrtle warbler	*Dendroica coronata*	R
Audubon's warbler	*Dendroica audubonì*	R
Townsend's warbler	*Dendroica townsendi*	R
Hermit warbler	*Dendroica occidentalis*	R
MacGillivray's warbler	*Oporornis tolmiei*	M-R
Yellowthroat	*Geothlypis trichas*	R
Yellow-breasted chat	*Icteria virens*	R
Wilson's warbler	*Wilsonia pusilla*	R
Ploceidae		
House sparrow	*Passer domesticus*	R
Icteridae		
Western meadowlark	*Sturnella neglecta*	R
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	M
Red-winged blackbird	*Agelaius phoeniceus*	R
Brewer's blackbird	*Euphagus cyanocephalus*	R
Brown-headed cowbird	*Molothrus ater*	R
Bullock's oriole	*Icterus bullockii*	M
Thraupidae		
Western tanager	*Piranga ludoviciana*	M-R
Fringillidae		
Black-headed grosbeak	*Pheucticus melanocephalus*	R
Evening grosbeak	*Hesperiphona vespertina*	R
Lazuli bunting	*Passerina amoena*	M-R
Purple finch	*Carpodacus purpureus*	M-R
Cassin's finch	*Carpodacus cassinii*	M-R
House finch	*Carpodacus mexicanus*	R
Pine siskin	*Spinus pinus*	R
American goldfinch	*Spinus tristis*	R
Lesser goldfinch	*Spinus psaltria*	R
Red crossbill	*Loxia curvirostra*	M-R
Rufous-sided towhee	*Pipilo erythrophthalmus*	M-R

APPENDIX B (cont'd)

Brown towhee	*Pipilo fuscus*	R
Savannah sparrow	*Passerculus sandwichensis*	R
Vesper sparrow	*Pooecetes gramineus*	R
Slate-colored junco	*Junco hyemalis*	M-R
Oregon junco	*Junco oreganus*	R
Chipping sparrow	*Spizella passerina*	R
White-crowned sparrow	*Zonotrichia leucophrys*	R
Golden-crowned sparrow	*Zonotrichia atricapilla*	R
White-throated sparrow	*Zonotrichia albicollis*	R
Fox sparrow	*Passerella iliaca*	R
Lincoln's sparrow	*Melospiza lincolnii*	R
Song sparrow	*Melospiza melodia*	R

APPENDIX C

Mammals of the Eel River Delta

Family and Common Name	Scientific Name 1/
Didelphidae	
Opposum	*Didelphis marsupialis*
Soricidae	
Pacific shrew	*Sorex pacificus*
Vagrant shrew	*Sorex vagrans*
Marsh shrew	*Sorex bendirii*
Trowbridge shrew	*Sorex trowbridgii*
Talpidae	
Shrew mole	*Neurotrichus gibbsii*
Townsend mole	*Scapanus townsendii*
Coast mole	*Scapanus orarius*
Vespertilionidae	
Little brown myotis	*Myotis lucifugus*
Fringed myotis	*Myotis thysanodes*
California myotis	*Myotis californicus*
Hairy-winged myotis	*Myotis volans*
Long-eared myotis	*Myotis evotis*
Yuma myotis	*Myotis yumanensis*
Hoary bat	*Lasiurus cinereus*
Silvery-haired bat	*Lasionycteris noctivagans*
Lump-nosed bat	*Plecotus townsendii*
Big brown bat	*Eptesicus fuscus*
Leporidae	
Black-tailed hare	*Lepus californicus*
Brush rabbit	*Sylvilagus bachmani*
Aplodontiidae	
Mountain beaver	*Aplodontia rufa*
Sciuridae	
Beechey ground squirrel	*Otospermophilus beecheyi*
Townsend chipmunk	*Eutamias townsendii*
Gray squirrel	*Sciurus griseus*

1/ Scientific names from Ingles (1965).

APPENDIX C (cont'd)

Douglas squirrel	*Tamiasciurus douglasii*
Flying squirrel	*Glaucomys sabrinus*
Geomyidae	
Pocket gopher	*Thomomys bottae*
Castoridae	
Beaver	*Castor canadensis*
Cricetidae	
Western harvest mouse	*Reithrodontomys megalotis*
Pinyon mouse	*Peromyscus truei*
Deer mouse	*Peromyscus maniculatus*
Dusky-footed wood rat	*Neotoma fuscipes*
White-footed vole	*Phenacomys albipes*
Red tree mouse	*Phenacomys longicaudus*
Red-backed mouse	*Clethrionomys occidentalis*
Long-tailed meadow mouse	*Microtus longicaudus*
Oregon meadow mouse	*Microtus oregoni*
California meadow mouse	*Microtus californicus*
Townsend meadow mouse	*Microtus townsendii*
Muridae	
Norway rat	*Rattus norvegicus*
Black rat	*Rattus rattus*
House mouse	*Mus musculus*
Zapodidae	
Pacific jumping mouse	*Zapus trinotatus*
Delphinidae	
Common dolphin	*Delphinus delphis*
Bottle-nosed dolphin	*Tursiops gillii*
Harbor porpoise	*Phocaena phocoena*
Otariidae	
Steller sea lion	*Eumetopias jubata*
California sea lion	*Zalophus californianus*
Harbor seal	*Phoca vitulina*
Canidae	
Gray fox	*Urocyon cinereoargenteus*
Coyote	*Canis latrans*

APPENDIX C (cont'd)

Procyonidae	
Raccoon	*Procyon lotor*
Ringtail	*Bassariscus astutus*
Mustelidae	
Mink	*Mustela vison*
Long-tailed weasel	*Mustela frenata*
Ermine	*Mustela erminea*
Striped skunk	*Mephitis mephitis*
Spotted skunk	*Spilogale putorius*
River otter	*Lutra canadensis*
Felidae	
Bobcat	*Lynx rufus*
Cervidae	
Black-tailed deer	*Odocoileus hemionus columbianus*

APPENDIX D

Water Associated Bird Census

Monthly Average Population 1967-68-69-70

Species	July	Aug.	Sept.	Oct.	Nov.	Dec..	Jan.	Feb.	Mar.	Apr.	May	June	Average May-Aug.	Average Sept.-Apr.	Average All Year	Total Annual Bird Days Use
Black brant	0	0	0	15	1	0	0	0	7	1	0	0				
Mallard	116	194	239	69	265	329	64	473	1,028	333	27	12				
Pintail	0	1,440	1,801	2,482	791	3,725	410	3,412	316	54	0	0				
Wigeon	0	0	3	476	392	2,547	941	6,820	2,082	1,356	4	2				
Gadwall	0	42	7	0	42	10	0	0	21	0	0	0				
Green-winged teal	0	35	8	116	204	119	350	1,008	610	903	2	4				
Cinnamon teal	2	0	34	0	0	50	0	0	8	0	3	0				
Shoveller	0	0	0	48	25	23	0	287	1,008	176	1	0				
Scaup	1	0	0	3	11	22	10	10	2	29	35	0				
Redhead	0	0	0	0	0	2	0	15	2	5	0	0				
Canvasback	0	5	0	0	3	17	0	5	53	10	0	0				
Ringneck	0	0	0	0	0	0	0	0	0	0	0	0				
Goldeneye	0	0	0	0	0	0	0	0	0	10	0	0				
Bufflehead	0	0	0	0	1	16	0	30	25	33	6	0				
Ruddy	0	0	0	2	16	0	12	31	3	8	0	1				
Scoter	10	7	33	70	144	27	47	82	41	56	10	10				
Merganser	15	0	0	1	1	44	0	3	3	51	3	0				
Unidentified ducks	0	0	0	3	195	200	0	4,080	199	158	7	0				
Canada Goose	1	93	3	0	0	0	0	0	2	0	0	0				
Snow Goose	0	0	0	0	1	2	0	0	0	1	0	0				
Swans	0	0	0	0	0	107	530	364	41	0	0	0				
Total Waterfowl	145	1,816	2,128	3,285	2,092	7,240	2,364	16,620	5,451	3,184	98	29	522	5,295	3,704	1,351,960
Godwit	0	119	275	38	45	50	0	10	14	0	0	0				
Curlew	60	5	15	0	20	0	0	0	0	0	0	0				
Willet	22	373	539	313	135	120	55	42	117	117	17	3				
Avocet	0	0	7	0	3	0	0	0	0	0	0	0				
Killdeer	0	0	0	257	323	200	104	80	108	2	1	3				
Other Shorebirds	2,125	2,113	3,730	4,647	6,430	3,920	705	2,220	1,153	2,823	163	36				
Total Shorebirds	2,207	2,610	4,566	5,255	6,956	4,290	864	2,352	1,392	2,942	181	42	1,260	3,577	2,805	1,023,825
Blue Heron	29	16	16	20	20	21	111	20	43	39	49	67				
Night Heron	10	3	2	0	33	0	0	3	27	17	18	6				
Common Egret	28	68	131	84	95	137	35	58	23	17	23	24				
Total Wading Birds	67	87	149	104	148	158	146	81	93	73	90	97	85	119	108	39,420
Coots	0	0	6	209	1,201	1,162	1,170	2,708	766	1,014	5	0				
Grebes	1	0	1	3	46	5	0	9	3	1	1	1				
Loon	0	0	1	1	1	0	0	0	0	1	0	0				
Cormorant	91	91	229	22	3	2	0	1	4	77	86	28				
Pelican	5	0	55	10	9	0	0	0	0	0	1	0				
Total Other Water Birds	97	91	292	245	1,260	1,169	1,170	2,718	773	1,093	93	29	78	1,090	753	274,845
TOTAL	2,516	4,604	7,135	8,889	10,456	12,855	4,544	21,771	7,709	7,292	462	197	1,945	10,081	7,370	2,690,050

APPENDIX E

Streams and Sloughs in the Eel River
Delta and Miles of Fresh and Brackish Water

Name	Freshwater	Saltwater	Total
Barber Creek	2.8	0.0	2.8
Salt River	7.8	6.2	14.0
Little Creek	1.4	0.0	1.4
Stevas Creek	0.8	0.0	0.8
Williams Creek	5.9	0.0	5.9
Coffee Creek	3.6	0.0	3.6
Whitman Creek	1.6	0.0	1.6
Francis Creek	5.6	0.0	5.6
Russ Creek	6.0	0.0	6.0
Smith Creek	3.2	0.0	3.2
Reas Creek	4.0	0.0	4.0
Palmer Creek	1.3	0.0	1.3
Little Palmer Creek	0.5	0.0	0.5
Rohner Creek	5.0	0.0	5.0
Jameson Creek	4.0	0.0	4.0
Strongs Creek	10.3	0.0	10.3
Eel River	6.8	8.6	15.4
Cutoff Slough	5.6	0.4	6.0
Hawk Slough	2.0	3.6	5.6
Hogpen Slough	1.8	1.2	3.0
Quill Slough	2.2	2.8	5.0
McNutty Slough	4.8	3.4	8.2
North Bay	4.8	4.4	9.2
Centerville Slough	4.8	0.0	4.8
Morgan Slough	0.0	1.4	1.4
Ropers Slough	1.4	1.2	2.6
Mosley Slough	0.0	1.4	1.4
Seven Mile Slough	0.0	3.8	3.8
Total Miles	98.0	38.4	136.4

APPENDIX F

Fishes Found in the Eel River Delta

Common Name	Where Found F*	B*	S*
Pacific lamprey, *Lampetra tridentata* 1/	X	X	X
Green sturgeon, *Acipencer medirostris*	X	X	X
Pacific sardine, *Sardinops sagax caerulens*			X
Pacific herring, *Clupea harengus pallasi*		X	X
Northern anchovy, *Engraulis mordax*			X
American shad, *Alosa sapidissima*	X	X	X
King salmon, *Oncorhynchus tshawystcha*	X	X	X
Silver salmon, *Oncorhynchus kisutch*	X	X	X
Coast cutthroat trout, *Salmo clarkii*	X	X	X
Steelhead rainbow trout, *Salmo gairdnerii*	X	X	X
Starry flounder, *Platichthys stellatus*	X	X	X
Surf smelt, *Hypomesus pretiosus*		X	X
Topsmelt, *Atherinops affinis*		X	X
Longfin smelt, *Spirinchus thaleichthys*		X	X
Redtail surfperch, *Amphistichus rhodoterus*			X
Pile surfperch, *Damalichthys vacca*		X	X
Shiner surfperch, *Cymatogaster aggregata*		X	X
Pacific tomcod, *Microgadus proximus*		X	X
Greenling, *Hexogrammus decagrammus*		X	X
Cabezon, *Scorpaenichthys marmoratus*		X	X
Threespine stickleback, *Gasterosteus aculeatus*	X	X	
Bay pipefish, *Syngnathus leptorhynchus*		X	X
Humboldt sucker, *Catostomas occidentalis*	X		
Western roach, *Hesperoleucas symmetricus*	X		
Brown bullhead, *Ictalurus nebulosus*	X		
Speckled sanddab, *Citharichthys stigmaeus*	X	X	X
Saddlebuck gunnel, *Pholis ornata*		X	X
Pacific staghorn sculpin, *Leptocottus armatus*		X	X
Aleutian sculpin, *Cottus aleuticus*	X	X	
Prickly sculpin, *Cottus asper*	X	X	

* F - Freshwater; *B - Brackish water; *S - Saltwater

1/ Scientific names from Frey and Gates (1974)