CHAPTER 14.
FISH LOSSES

14.1 FISH LOSS DEFINED

The following definitions apply in the discussion of fish losses:

- **Anadromous Fish**—Fish that live in the ocean and return to fresh water to spawn.
- **Ex-Vessel**—Price obtained by commercial fisherman directly off the vessel, without further processing.

14.2 GENERAL BACKGROUND

Humboldt County coastal and inland areas are rich in sport and commercial fish. Bays and estuaries and other tidal inlets provide a variety of habitats supporting many species of anadromous and ocean fish. Humboldt Bay is second only to San Francisco Bay in size among California's coastal estuaries. It is an important habitat for many invertebrates, fish, birds, and mammals and is one of the largest producers of commercial oysters in the state.

The inland area of Humboldt County is home to a wealth of fish and wildlife due to relatively undeveloped watersheds, ample rainfall and the mild, consistent climate of the region. The sparse development in Humboldt has allowed nearly 400,000 acres of the County's inland and coastline to be absorbed into the State and National Park systems, leaving large tracts of existing habitat untouched.

Humboldt's wild rivers, Humboldt Bay, and the ocean off the coast of Humboldt County all support fisheries. However, in recent years the Humboldt County fishing industry has reduced it's pressure on local fisheries. Fishermen, the resource agencies, and the legislature implemented limited entry programs that reduced the amount of vessels participating in each coastal fishery. Additionally, harvest limits, and other regulations were put in place to protect sensitive species. In many cases these strategies have aided in population recovery. Some species, however have not shown any population recovery and continue to be listed as threatened or endangered and are protected by the Federal Endangered Species Act.In the 1970s, more than half of the fish produced and consumed in California were landed in the Humboldt Bay Area (Humboldt County, 1979). The bay provides critical habitat to over 100 fish species and other wildlife. The five major fisheries based in Humboldt Bay are groundfish, salmon, shrimp, crab, and albacore. Inland, sport fishing in Humboldt's many wild rivers should be rich and plentiful, but each year fewer and fewer adult fish return from the sea to spawn as a result of habitat damage from logging, water diversions, road building, grazing, and mining, over-fishing, and well-intended but flawed hatcheries. The decline in the population of several species of salmon and trout has resulted in them being listed as threatened or endangered under the Endangered Species Act. Table 14-1 lists all federal and state listed species for the County.

14.2.1 Local Basins and Watersheds

Humboldt County is part of the Klamath-North Coast Hydrologic Basin Planning Area, which includes all basins draining into the Pacific Ocean from the Oregon border to the Russian River Basin. The County's 12 planning watersheds, covering between 73,000 and 333,000 acres each (see Table 14-2), are shown in Figure 14-1. These can be grouped into four larger basins: Klamath-Trinity, Mad-Redwood, Eel, and

Mattole. Each of these basins is further described in the following sections. Much of the information provided is taken from the Humboldt County General Plan (Humboldt County, 1984).

TABLE 14-1.
FEDERAL AND STATE LISTED FISH SPECIES IN HUMBOLDT COUNTY

Scientific Name	Common Name
Eucyclogobius newberryi	Tidewater Goby
Oncorhynchus kisutch	Coho Salmon
Oncorhynchus mykiss	Northern California Steelhead Trout
Oncorhynchus tshawytscha	Chinook Salmon
Acipenser medirostris	Green Sturgeon

TABLE 14-2.
HUMBOLDT COUNTY PLANNING WATERSHED AREAS

Watershed	Basin	Total Acres within County	Total Acres
Lower Klamath	Klamath-Trinity	332,787	493,453
Lower Trinity	Klamath-Trinity	192,286	654,967
South Fork Trinity	Klamath-Trinity	73,205	596,497
Redwood Creek	Mad-Redwood	187,788	187,819
Trinidad	Mad-Redwood	83,684	83,684
Mad River	Mad-Redwood	221,337	322,143
Eureka Plain	Mad-Redwood	124,617	124,617
Van Duzen	Eel	234,899	274,083
Lower Eel	Eel	191,052	191,052
Middle Main Eel	Eel	138,509	333,345
South Fork Eel	Eel	200,395	441,213
Cape Mendocino	Mattole	311,774	319,628
Total		**2,292,332**	**4,039,132**

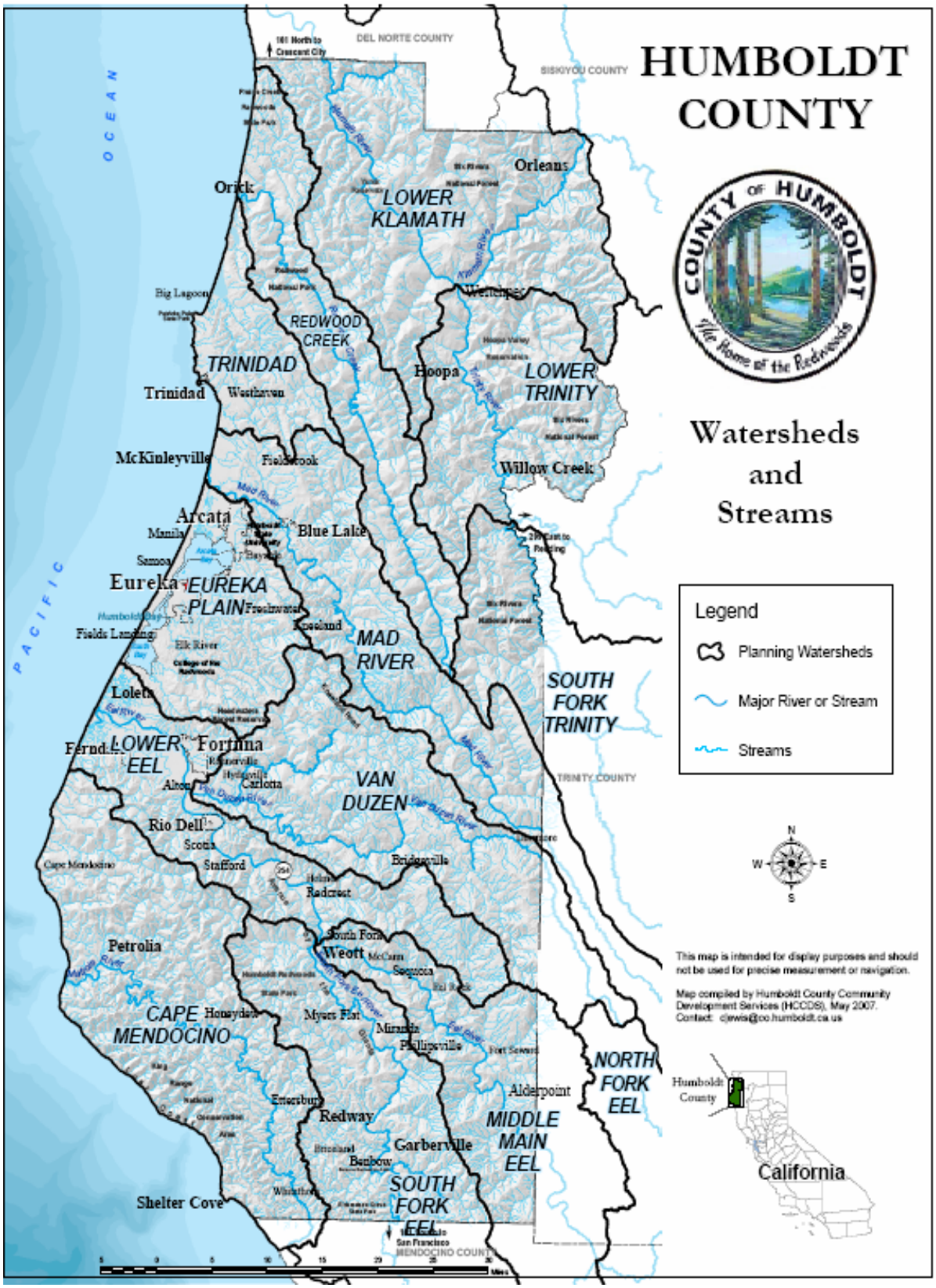

Figure 14-1: Humboldt County watersheds.

Klamath-Trinity Basin

The Klamath-Trinity Basin includes the Lower Klamath, Lower Trinity, and South Fork Trinity planning watersheds, and covers the northeastern quarter of Humboldt County. A large portion of this area is under the jurisdiction of the Six Rivers National Forest and the Hoopa Indian Reservation.

Lower Klamath Planning Watershed

The Klamath River is the main waterway in the Lower Klamath planning watershed, which covers northernmost Humboldt County; its main tributaries are the Shasta, Scott, Salmon, and Trinity Rivers. Numerous other, smaller tributaries enter the Lower Klamath River along its entire length. The Shasta, Scott, and Salmon rivers do not flow through Humboldt County and are not addressed here. The Klamath is California's second largest river, draining a watershed of approximately 979,816 acres in three counties. The Lower Klamath River planning watershed, draining 332,787 acres in Humboldt County, has 1,832 miles of waterways. Records indicate that flows have ranged from 7,432 cubic feet per second (cfs) to 39,830 cfs. The Lower Klamath planning watershed encompasses that portion of the Klamath River and its tributary watershed downstream from the Scott River to the Pacific Ocean (excluding the Trinity River), and is 2,564 square miles in area. Included in the watershed are the Salmon River, Blue Creek, numerous smaller perennial streams, and the Klamath River delta/estuary. The area is largely rugged, steep forest land with highly erodible soils. The population of the area is small and scattered. Its discharge point is in Del Norte County near the town of Klamath, approximately 10 miles north of the Humboldt County border.

Fish

According to the California Department of Fish and Game (CDFG), the Lower Klamath River supports a number of anadromous fish species including spring, fall and late fall-run Chinook salmon, Coho salmon, fall, winter and summer-run steelhead trout and coastal cutthroat trout. Resident fish species also include rainbow trout, three-spined stickleback, speckled dace, and Klamath small-scale sucker. The main stem Lower Klamath River provides habitat for all life stages of Chinook salmon, Coho salmon, and steelhead trout, pacific lamprey, and green sturgeon.

The Six Rivers National Forest portion of the Lower Klamath planning watershed includes several important spawning tributaries for salmon and steelhead. The CDFG estimates that an escapement of as much as 106,000 fall-run Chinook salmon is needed to adequately occupy the currently available spawning habitat in the Klamath-Trinity River system. Although both quality and quantity of available spawning habitat have declined, the low number of fall Chinook salmon returning to spawn is presently the dominant constraint upon recovery of this population. The reasons for the decline of Klamath fall Chinook have been conjectured to be flow reductions caused by drought conditions, reduced ocean productivity, over-harvest, and high-seas drift net fisheries. Coho occur in low numbers in forest tributaries of the Lower Klamath planning watershed. The Coho population in the Klamath is primarily supported by a hatchery program. The available habitat for naturally spawning Coho currently is underutilized.

Summer temperatures (reaching a high of 80º Fahrenheit) and low dissolved oxygen have combined to form an environment often lethal to riparian salmon. The U.S. Bureau of Reclamation's Klamath Project controls most of the flow in the Klamath River, and has typically provided water for irrigation without regard to downstream deliveries during below-average water years. Due to the Bureau's diversions, the minimum flows mandated by the Federal Energy Regulatory Commission have frequently not been met.

Lower Trinity Planning Watershed

The Lower Trinity planning watershed lies within the area known as the Klamath Province, including headwater reaches of the Trinity Alps. The highest point in the analysis area is in the northern headwaters in the Trinity Alps on Sawtooth Mountain, elevation 8,888 feet. The lowest point, at the confluence of the North Fork Trinity River, is 1,475 feet in elevation. Virtually the entire watershed area is mountainous, with steep V-shaped valleys formed by the tributaries.

Approximately 29 percent of the watershed lies within Humboldt County. The largest single private land owner is Simpson Timber; however, much of the watershed is under the management of the U.S. Forest Service, which accounts for open space and parks as the dominant land use. The Trinity River, flowing 172 miles, drains 1,304,179 acres of watersheds in Humboldt and Trinity counties. On average, 56% of water in the Trinity Watershed is exported to the Central Valley Project by the Bureau of Reclamation (BOR), however up to 90% has been diverted in past. A 70% diversion leaves 30 percent of the available inflow above Trinity Dam to be allocated for in-river purposes. The DFG estimates that minimum releases during the year total 340,065 acre-feet. The current minimum flow requirements adopted by the BOR are 300 cfs in winter, rising to a peak of 2000 cfs in late spring and falling to 450 cfs in summer. The U.S. Fish and Wildlife Service has recommended that instream flows be increased to 47 percent of inflow (from the current 30 percent), but no action will be taken until a conclusive EIR is prepared. The major tributaries to the Trinity River are the South Fork Trinity River, New River, French Creek, North Fork Trinity River and Canyon Creek, though many smaller tributaries enter the Trinity throughout its reach. The Trinity River flows east to west and is the largest tributary to the Klamath River, converging with the Klamath at Weitchpec, 40 river miles from the ocean. The Trinity basin as a whole is among the three largest California anadromous river systems north of San Francisco, second to the Klamath and similar to the Eel River in volume and drainage area. The portion within Humboldt County comprises approximately 14 percent of the entire Trinity River Basin.

Fish

According to the CDFG, the Trinity supports several anadromous fish populations, including Chinook salmon, Coho salmon, steelhead trout, and Pacific lamprey. Resident fish species also include rainbow trout, three-spined stickleback, speckled dace, and Klamath small-scale sucker. Eastern brook trout and brown trout have been introduced as sport fish. The Klamath-Trinity Watershed supports the second largest run of Chinook salmon in the state, second only to the Sacramento River watershed. Historical accounts of huge salmonid runs are typical of the rivers of the Pacific Northwest. Major reductions in anadromous fish populations have occurred in the river. By 1980, it is estimated that in comparison to a 1950 base, the upper river steelhead population had declined by 90 percent and the lower river by 80 percent. According to the Six River National Forest Draft Environmental Impact Statement for the National Forest Plan, the natural Chinook salmon populations have declined by 85 percent. The hatchery at Lewiston has mitigated for some loss, especially with regard to spring-run Chinook. Factors commonly cited as possible causes of salmonid reductions include the construction of Trinity Dam (and subsequent reduced stream flows), the 1964 flood, over-harvest of salmon, and intensive logging practices.

South Fork Trinity Planning Watershed

The South Fork Trinity is the planning watershed with the smallest area within Humboldt County; the Humboldt County portion also represents a small portion of the entire watershed. The South Fork originates in the North Yolla Bolly Mountains about 50 miles southwest of Redding, and runs northwest for approximately 90 miles before reaching its confluence with the Trinity River near Salyer. It flows mostly through Trinity County, forming the boundary between Trinity and Humboldt Counties in its lower 12 miles. The South Fork Trinity River is the largest undammed river in California, and constitutes

31 percent of the Trinity River sub-basin, and 6 percent of the Klamath basin (USDA FS 1998). The 56 mile stretch from Forest Glen to the mouth is protected by the California Wild and Scenic Rivers Act.[1]

Using the Strahler stream order classification system, there are 2,522 miles of streams in the South Fork Trinity planning watershed with 2,310 miles in Trinity County and 212 miles in Humboldt County. In the Strahler stream classification system, as an Order 1 stream connects with another Order 1 stream, the stream becomes an order 2 stream; as an Order 2 stream connects with another Order 2 stream, the stream becomes an Order 3 stream, and so on. In Humboldt County, approximately 78 percent of the streams fall in Orders 1 or 2 (the smallest tributaries). Only 13 percent of the streams are classified in Orders 4 - 7. For comparison, the largest planning watershed in Humboldt County, the Lower Klamath River planning watershed, has 920 miles of streams in Humboldt County with 75 percent of the streams in Orders 1 and 2, and 12 percent in Orders 4 - 8.

Fish

The US EPA TMDL study of 1998 summarized the status of the fishery in the South Fork Trinity River as follows:

Six known stocks and runs of anadromous fish utilize the South Fork Trinity River watershed. The most abundant historically is the spring-run Chinook salmon (*Oncorhynchus tshawytscha*). The second most abundant, historically and currently, is the fall-run Chinook, which is also a significant indicator of the fish population in the basin. Other cold-water species include winter and summer steelhead (*O. mykiss*), Coho salmon (*O. kisutch*), and pacific lamprey (*Lampera pacifica*). Chum salmon (*O. keta*) have been infrequently observed in the watershed (U.S. Environmental Protection Agency 1998). The fishery in the South Fork has declined dramatically since the flood of December 1964. Unstable geology and erosion-producing land use practices have been blamed for the many mass wasting events triggered by that flood, which resulted in dramatic in-stream changes, including channel widening, aggradation, and loss of pool depth, all of which adversely affect the fishery. Since that time, further channel changes suggest improvements in some locations, while continued, chronic sediment inputs may be hindering a more complete or faster recovery overall.

The overall quantity of sediment delivery to the stream has decreased since the 1964 flood, but chronic inputs of sediment from roads as well as episodic inputs from washouts and mass wasting continues. Water quality problems from accelerated erosion rates have been worst in the more erodible portions of the basin in the Upper and Lower South Fork sub-basins, particularly west of the main stem, and in areas where land management practices are most intense. Smaller tributaries generally have been affected less severely than main stem lower gradient reaches. The impacts have been most notable in the Hyampom Valley, with most of the sediment being delivered from South Fork Mountain tributaries, which have been heavily logged since the 1940s. The logging boom expanded through the basin in the 1960s, and probably exacerbated the detrimental effects of the 1964 flood. In particular, many logging practices on the erodible geology of the western basin altered the natural hillslope hydrology—e.g., through construction of roads and stream crossings—causing additional erosion and sediment impairment. Continued accelerated sediment production is found in many of these areas, particularly where large-scale forest fires have further exacerbated the problems. Some continued in-channel changes are also part of the natural cycle of adjustments to natural and management-induced events that would be expected following a major disturbance such as the 1964 flood. The Chinook salmon spawning run has increased slightly in the last several years, and sediment slugs continue to move downstream, which may suggest the beginnings of a trend toward recovery.

[1] U.S. Environmental Protection Agency, Region 9, *South Fork Trinity River and Hayfork Creek Sediment Total Maximum Daily Loads*, December 1998.

Mad-Redwood Basin

The Mad-Redwood Basin includes the Mad River, Redwood Creek, Eureka Plain, and Trinidad planning watersheds. The average annual runoff for the combined basin is estimated to be 1,000,000 acre-feet. These watersheds lie completely within the Coast Ranges geologic province, mainly composed of highly unstable and easily eroded rock units, which contribute a large amount of sediment to the streams. Combined with timber harvest, road construction, and grazing activity, the region has one of the highest erosion rates in the United States.

Redwood Creek Planning Watershed

The Redwood Creek planning watershed is a narrow, elongated fault-controlled basin that drains an area of 282 square miles, from the center of Humboldt County to its northwestern corner. The creek flows for 65 river miles from its headwaters, located near Board Camp Mountain in central Humboldt County, to the Pacific Ocean near the town of Orick. Redwood National Park occupies the northern half of the watershed. Stream flow averages 255 cfs near Blue Lake and 1,290 cfs as it passes Orick near its outlet to the Pacific Ocean. The Redwood Creek watershed consists mostly of mountainous, forested terrain from sea level to about 5,300 feet elevation. Primary land uses are tourism and fishing on parklands and timber and livestock production on lands upstream of Redwood National Park. The watershed is narrow and elongated, about 65 miles in length, from 4 to 7 miles wide. The lower basin includes the Park area and the middle and upper basin are located upstream from the Park.

Redwood Creek is the main waterway in the watershed; it is fed along its length by a few dozen smaller creeks. Stream flow in Redwood Creek is highly variable from year to year as a result of annual rainfall variations. Stream flow also varies seasonally, owing to the highly seasonal distribution of rainfall. Winter flood flows can be as much as four orders of magnitude higher than summer low flows. Floods are critical events for the resources of Redwood Creek because they erode hillslopes, reshape channels, and transport large proportions of fluvial sediment loads. Recent large floods occurred in 1953, 1955, 1964, 1972 (two floods), and 1975.

No large floods occurred after 1975 until January 1997. The relatively small 11-year return period January 1997 flood initiated debris torrents of mud, boulders and whole trees directly into Redwood Creek adjacent to Tall Trees Grove; the effects of a major storm would probably be much more severe. Using the Strahler stream order classification system, there are 544 miles of streams in the Redwood Creek planning watershed. Approximately 79 percent of the streams fall in Orders 1 or 2. Only 13 percent of the streams are classified in Orders 4 and 5.

Fish

Redwood Creek supports Chinook salmon, Coho salmon, and steelhead and cutthroat trout. Except for cutthroat trout, these species are all federally protected in Redwood Creek. The cold water fishery is identified by the Regional Water Board as a beneficial use of the Redwood Creek watershed. In 1965, the CDFG roughly estimated spawning escapement of 5,000 Chinook, 2,000 Coho, and 10,000 winter steelhead.

Sedimentation due to natural geologic instability, the 1964 flood, past and present land use practices, and other factors has contributed to the reduction and loss of habitat necessary to support cold water fish including salmonids. The second most abundant, historically and currently, is the fall-run Chinook, which is also a significant indicator of the fish population in the basin. Various studies have found that in recent years, spawning habitat is improving slowly as gravels are cleaned of fine sediment. Anadromous and resident salmonid populations in Redwood Creek are much reduced in comparison to historic levels. Habitat conditions are probably still quite degraded relative to pristine conditions, but are showing signs

of improvement. Although channel deepening and pool development have been observed in all but the lower few miles of the Creek, the mainstem generally lacks an adequate pool-riffle structure and cover. The last 3.4 miles of Redwood Creek are entrapped by levees constructed for flood control. The construction of the levees has eliminated the historically present estuary at the mouth of Redwood Creek.

Trinidad Planning Watershed

The Trinidad Planning Watershed covers 83,684 acres, making it the second smallest watershed in Humboldt County. Maple Creek, extending 18.3 river miles (with a north fork of 7.8 river miles), and Little River, extending 19.6 river miles, are the main waterways in the Trinidad Watershed, which is spread along the northern Humboldt County coast. Maple Creek and Little River arise at the foot of the Coast Range— the latter in a crook between the Mad and Redwood watersheds. Little River discharges to the Pacific Ocean three miles south of the city of Trinidad, while Maple Creek empties to an estuary north of Trinidad Head. Patrick's Point State Park occupies a small area of the watershed north of the City of Trinidad.

Fish

The anadromous salmon and trout present in neighboring watersheds are can also be found in the Trinidad planning watershed. However, for the most part, the watershed consists of smaller coastal streams that do not have the inland reach of other watersheds. Much of this coastal fisheries habitat is protected as parks and open space.

Mad River Planning Watershed

The Mad River flows through Trinity and Humboldt Counties 100 miles to the Pacific Ocean, draining a watershed area of 497 square miles. The easternmost portion of the watershed is part of Six Rivers National Forest. Mad River County Park occupies a small area in the northwest portion of the watershed. Average flows in the Mad River range from less than 300 cfs to flood stages of up to 81,000 cfs. Mean discharge is 1,381 cfs, ranging from 45 cfs in late summer to 3,646 cfs midwinter. Headwaters of the Mad River originate at the southeast end of the watershed at an elevation of 6,070 feet. The watershed runs diagonally across the county from the central eastern border northwest to the Pacific Ocean just north of the Humboldt Bay area. The Mad River has numerous tributaries throughout its run. Humboldt Bay Municipal Water District operates five water pumps in the mad River stream bed. These wells pump water from over 65 feet down to customers in Humboldt County.

Fish

The Mad River supports runs of anadromous salmonids including Chinook salmon, Coho salmon, and steelhead and cutthroat trout. Except for cutthroat trout, all anadromous salmonids in the Mad River are federally protected. Anadromous fish spawning takes place in the main channel and in several main tributaries. Downstream from the Mad River Hatchery, the main spawning tributaries are Warren Creek, Lindsay Creek, Mill Creek, and the North Fork of the Mad River. Lindsay Creek appears to be extremely important for both coastal cutthroat and Coho salmon. The section of river upstream of Mathews Dam no longer supports anadromous fish populations.

Eureka Plain (Humboldt Bay) Planning Watershed

Humboldt Bay is the largest estuary in California north of San Francisco. The planning watershed is 223 square miles in area, though the Bay's smaller tributaries only drain a total of approximately 35 square miles. Public landholdings are the Headwater Forest Reserve, Humboldt Bay National Wildlife

Refuge, Mad River Wildlife Area, and Lanphear Dunes. Eureka Plain is also host to more urban land than any other watershed in the county. Stream flow in the Humboldt Bay planning watershed peaks in the winter (November through March) and is lowest during the summer. Maximum flow at the Jacoby Creek inlet is about 737 cfs, with a range of peaks between 380 cfs and 2,510 cfs. Sand spits separate Humboldt Bay from the ocean; the Bay (officially categorized as a multi-watershed coastal lagoon) is split into the South Bay, Entrance Bay, and North Bay. The headwaters of the Bay's tributaries originate in nearby hills, which separate the watershed from the Eel and Mad River watersheds to the south and north. This plain consists of both tidal marshes and stream floodplain surrounding the Bay's edge.

The four major streams of the Eureka Plain are Jacoby Creek (draining 17 square miles), Freshwater Creek (draining 31 square miles), Elk River (draining 29 square miles), and Salmon Creek (draining 17 square miles). Jacoby and Freshwater Creeks drain into Arcata Bay to the north, Elk River into Entrance Bay near Eureka, and Salmon Creek into South Bay. Smaller streams flow primarily into the North Bay. Although the Mad River delta is cradled in its own planning watershed to the north, its floodplain and slough extend south to Arcata Bay.

Fish

There are five species of salmon and trout found in the Eureka Plain planning watershed: Coho salmon, Chinook salmon, chum salmon, steelhead trout, and coastal cutthroat trout. Steelhead trout and cutthroat trout are found in all streams capable of supporting salmonids. All of the main streams of the Eureka Plain planning watershed that flow into Humboldt Bay support wild populations of salmon, steelhead trout, and cutthroat trout. The deltas of the Elk River and Mad River Slough support commercial and sport shellfish production and harvesting.

Eel River Basin

The Eel River is the third largest river system in California, encompassing 3,684 square miles and 3,488 miles of streams within Humboldt, Mendocino, Trinity, and other Northern California counties. The Eel Basin covers much of the southern half of Humboldt County, excepting the southwestern coast. Within the county, the Eel River system contains four major planning watersheds (from north to south): the Van Duzen (367 square miles), Lower Eel (298.5 square miles), Middle Main Eel (216.4 square miles), and South Fork Eel (313.1 square miles). The Lower Eel River begins at the confluence of the Middle Main Eel and South Fork Eel; the Van Duzen River flows into the Lower Eel at approximately halfway to the Pacific Ocean.

Mean annual discharge for the Eel River is approximately 6 million acre-feet. Ninety-three percent of this stream flow is discharged between November and April. Discharges normally range from 145 cfs in September to 19,560 cfs in February, with a record low flow of 54 cfs recorded in September 1994 and a record high of 752,000 cfs measured in December 1964. Headwaters arise at elevations between 6,000 and 8,000 feet in the neighboring counties of Trinity, Lake, and Mendocino. Waters from the Eel River flow through alluvial valleys and tidal plains 14 miles south of the City of Eureka to its estuary at the Pacific Ocean.

High seasonal rainfall combined with a rapid runoff rate on unstable soils delivers large amounts of sediments to the river. As a result, the Eel River may transport more sediments than any other river of its size in the world, due to heavy winter rainfall running through highly unstable soils. These sediments are deposited throughout the lower gradient reaches of the system.

Van Duzen River Planning Watershed

The Van Duzen River planning watershed is located in California's North Coast Range, primarily in Humboldt County, and encompasses a total area of approximately 428 square miles: 367 square miles in Humboldt County and 61 square miles in Trinity County.

For purposes of characterizing watershed conditions and water quality concerns, the U.S. EPA has divided the watershed into three distinct areas: lower basin, middle basin, and upper basin. The lower basin encompasses approximately 129 square miles from the confluence with the Eel River to the confluence with Grizzly Creek, including the lower Yager Creek and Lawrence Creek tributary, but excluding the North, Middle, and South Fork of Yager Creek. The middle basin encompasses approximately 202 square miles ranging from the upper Yager Creek Basin to the confluence of Grizzly Creek. The upper basin encompasses approximately 98 square miles and includes the remainder of the upper portions of the watershed. The 1999 U.S. EPA study summarized water quality concerns based on the three identified basins (USEPA, 1999):

- **Lower Basin**—Intensive management activities, particularly timber harvest and road-related, have exacerbated delivery rates and pose a continued threat, particularly in critical spawning and rearing reaches such as Lawrence Creek, Grizzly Creek and Cummings Creek. Continued sediment reduction efforts in the lower basin, particularly road storm-proofing and less intensive management on steep unstable areas, could yield beneficial results for anadromous fish habitat more quickly than in other areas of the basin.
- **Middle Basin**—Although natural sediment sources contribute the majority (84 percent) of sediment from the middle basin, certain road and timber related management activities have historically represented a risk to water quality and fish habitat. Continued sediment reduction efforts, particularly road inventories, storm-proofing and maintenance, would reduce the risk of sediment delivery to low gradient spawning reaches in the middle and lower basin.
- **Upper Basin**—Fine sediment levels, as indicated by embeddedness measurements, may be impacting spawning gravel and pool habitat for steelhead in the South Fork Van Duzen. The steep headwater areas of the South Fork Van Duzen and West Fork Van Duzen are capable of supplying large volumes of sediment to the lower depositional reaches, thereby impacting steelhead-spawning habitat. The main concern in the upper basin is to avoid additional disturbance of sensitive hillslope areas and to correct potential sediment delivery problems associated with existing roads, thereby protecting downstream resources.

Using the Strahler stream order classification system, there are 808 miles of streams in the Van Duzen planning watershed in Humboldt County and 128 miles in Trinity County. In Humboldt County, approximately 79 percent of the streams fall in Orders 1 or 2. Only 13 percent of the streams are classified in Orders 4, 5 and 6.

Fish

The Van Duzen planning watershed maintains an aquatic habitat that supports Coho and Chinook salmon, steelhead trout, particularly summer stocks, rainbow trout, Pacific lamprey, west coast three-spined stickleback, Sacramento sucker, coast range sculpin, prickly sculpin, coastal cutthroat trout, California roach (introduced), speckled dace (introduced), and Sacramento pike minnow or squawfish (introduced).

According to the 1999 U.S. EPA study, the salmon industry that thrived in the 19th century declined through the 20th century, and a spawning reconnaissance study of Chinook salmon carried out by the U.S. Fish and Wildlife Service in 1959 in the Van Duzen indicated that the basin had the capability to support

7,000 Chinook and reported 1,500 occupied redds (spawning grounds). In 1965, CDFG estimated that the annual adult salmon runs in the Van Duzen numbered 2,500 Chinook and 500 Coho.

Lower Eel River Planning Watershed

The Lower Eel planning watershed includes the region draining into the Eel River from the confluence of the Middle Main Eel and South Fork Eel to the Pacific Ocean; all land draining to the Van Duzen River is considered part of the Van Duzen planning watershed. Covering 191,052 acres, the Lower Eel planning watershed is the only watershed in the Eel River Basin completely located within Humboldt County. At the western end of the watershed lies the 33,000 acre Eel River Delta. Over 200 species of birds have been observed using the Eel River delta, and it is considered a vital link of the coastal flyway. Riparian corridors also attract many types of land birds, including song birds, upland game birds, and raptors.

Using the Strahler stream order classification system, there are 639 miles of streams in the Lower Eel planning watershed. Approximately 85 percent of the streams fall in Orders 1 or 2. Only 5 percent of the streams are classified in Orders 4, 5, and 6.

Fish

The Eel River supports the largest remaining native Coho salmon population in California, as well as fall-run Chinook salmon, steelhead trout, coastal cutthroat trout, green sturgeon, and Pacific lamprey.

According to the National Marine Fisheries Service, the Eel was once the largest producer of Chinook and Coho salmon in the state, and second largest of steelhead trout. Commercial fishing along the Eel was once a million dollar industry. The canneries of the Lower Eel reported 100,000 salmon per year with a maximum annual harvest estimated at 500,000 fish in the early 1900s. In 1988, the CDFG estimated there were 31,000 fish in the entire Eel River System. They are now listed as threatened under the Endangered Species Act.

The Lower Eel portion of the watershed is of little significance as spawning ground for anadromous fishes, but is important as a migration route to upstream spawning grounds and as a return route to the ocean for surviving adult steelhead, juvenile trout, and salmon. Salmon use the downstream pools as holding areas until there is sufficient flow from fall rains to permit upstream passage. It is also likely that some downstream juvenile migrants use the estuary as a nursery area throughout much of the year, since juvenile king salmon and steelhead have been found there during fall, winter, and spring months.

Middle Main Eel River Planning Watershed

The Middle Main Eel River (upstream of its confluence with the South Fork Eel) encompasses 482,136 acres (753.3 square miles) within Humboldt and Mendocino counties. Average precipitation per year is 56.86 inches. Public landholdings include part of Six Rivers National Forest.

Using the Strahler stream order classification system, there are 504 miles of streams in the Middle Main Eel planning watershed. Approximately 81 percent of the streams fall in Orders 1 or 2. Twelve percent of the streams are classified in Orders 4 and higher.

The EPA has classified the Middle Fork Eel as having “less serious problems.” As with the Lower Eel River watershed, the Middle Eel River has high seasonal rainfall combined with a rapid runoff rate on unstable soils that delivers large amounts of sediments to the river. With or without changes in the channel from increases in coarse sediment, salmon are negatively affected by the additions of fine sediment. Fine sediment smothers spawning sites, reducing the ability of salmon to reproduce successfully.

Fish

The Eel River supports the largest remaining native Coho salmon population in California, as well as fall-run Chinook salmon, steelhead trout, coastal cutthroat trout, green sturgeon, and Pacific lamprey. The abundance of salmon and steelhead in the Eel River system has been declining over the past 60 years. Factors contributing to the declines are habitat loss caused by timber harvesting practices, associated road building following World War II, as well as certain types of grazing practices, water diversion, and over-fishing.

South Fork Eel River Planning Watershed

The South Fork Eel River planning watershed covers 690 square miles in northern Mendocino and southern Humboldt counties. The watershed surrounds the South Fork of the Eel River, winding from approximately 58 miles from the Laytonville area of Mendocino County, up U.S. Highway 101 through Humboldt Redwoods State Park. The river itself winds for nearly 100 miles, flowing northward joining the Eel River near Weott.

Using the Strahler stream order classification system, there are 1,527 miles of streams in the South Fork Eel River planning watershed, with 838 miles in Mendocino County and 689 miles in Humboldt County. In Humboldt County, approximately 79 percent of the streams fall in Orders 1 or 2 (the smallest tributaries). Only 14 percent of the streams are classified in Orders 4 - 6.

Fish

The Eel River supports the largest remaining native Coho salmon population in California, as well as fall-run Chinook salmon, steelhead trout, coastal cutthroat trout, green sturgeon, and Pacific lamprey. The South Fork Eel in particular is considered to have significant remnant populations of Coho salmon (CDFG, 1996). University of California fisheries experts (Brown, 1994) found that the South Fork Eel population is significant because it has very little hatchery influence and thus is important for the genetic integrity of the stock.

The EPA has classified the South Fork Eel as having “less serious problems.” The major concerns for the South Fork Eel are sedimentation and temperature. For the South Fork Eel, the major sources of sediment were found to be road-related, including roads associated with timber harvest. More specific issues identified as concerns for sediment loading are road surface erosion, road crossing failures and gullies, and skid trails, as well as landslides from roads and harvest.

Stream temperatures have been measured at many locations in the South Fork Eel and it is well documented that many locations have summer temperatures that exceed the tolerances of cold water fish. In the South Fork Eel, the most sensitive period for salmon is the summer-rearing period, when young Coho and steelhead stay in freshwater streams while they mature.

Mattole River Basin

The Mattole River Basin encompasses the Cape Mendocino planning watershed in the southern portion of Humboldt County.

Cape Mendocino Planning Watershed

The Cape Mendocino planning watershed (also known as the Mattole Watershed) is located in California’s North Coast Range. The watershed is immediately east of the “triple junction” of the American, Pacific, and Gorda tectonic plates, a highly active geologic province, and encompasses a total area of 319,628 acres. Almost all (98 percent) of it lies in Humboldt County and the remainder is in

Mendocino County. The Cape Mendocino planning watershed is largely circumscribed by mostly steep mountains. Headwater elevations range from 1,350 feet to 4,087 feet.

The Mattole River is the main waterway in the watershed; it receives water from over 74 tributary streams. There are approximately 545 perennial stream miles in the watershed. The main stem Mattole is 62 miles long, and its watershed encompasses 304 square miles, most of which is within Humboldt County south of the Eel Basin. Kings Range National Conservation Area occupies the southwestern coast of the County. According to the Mattole Restoration Council, the Mattole River's winter stream flow averages between 1,710 and 4,170 cfs; summer and fall flows are often below 60 cfs, with a minimum measured flow of 20 cfs.

The Cape Mendocino watershed has 40 sub-watersheds, with 1,062 miles of streams in the Humboldt County portion. Based on the Strahler stream order classification system, approximately 80 percent of the streams fall in Orders 1 or 2.

The Mattole River enters the Pacific Ocean 10 miles south of Cape Mendocino. During most summers, a sand spit encroaches all the way across the river mouth to form a bay mouth barrier, which creates a lagoon behind it. Generally the barrier remains until runoff from fall rains breeches it. However, in some years large swells at times of high tide overtop the barrier and a new outlet channel is carved through the barrier.

Fish

Fishery resources of the Cape Mendocino planning watershed include fall-run Chinook salmon, Coho salmon, and steelhead trout, although both Chinook and Coho salmon are thought to be in decline. A wide variety of fish utilize the estuary for spawning and juvenile rearing habitat.

According to the North Coast Watershed Assessment Program (NCWAP), two notable fish species that have apparently gone extinct in the Mattole Basin are spring- run Chinook salmon and green sturgeon. Many fish in the Mattole Basin use the estuary for spawning and juvenile rearing habitat. Excessive logging is historically responsible for reducing fish production, primarily from oversiltation.

NCWAP notes that Chinook salmon juveniles are detained in the estuary at the mouth of the Mattole River because of the creation of lagoon conditions early in the summer. This prevents them from going to the ocean until it reopens in the fall. Unfortunately, conditions in the estuary through the summer are not hospitable and studies conducted by Humboldt State University within the past 15 years have shown high, and perhaps total, mortality in some years.

The watershed sits at the confluence of three tectonic plates, putting great stress on the area's rock. Mattole rock therefore breaks down very easily and is highly susceptible to erosion, which contributes large amounts of sediments to the river. High winter rainfall and rapid runoff on unstable soils delivers large amounts of sediment to the river, and as a result, the Mattole River transports huge sediment loads. Road construction throughout the watershed contributed to the erosive forces and high volume of sediment in the river and its tributaries, perhaps up to 76 percent of the total sediment load.

14.2.2 Pacific Fisheries

Despite diminishing resources, aquaculture and commercial fisheries remain a viable industry for Humboldt County. The commercial fisheries still employ approximately 400 people in the county, and hundreds of other jobs throughout the county depend on the millions of dollars in revenue these men and women generate. Fish landings on the entire North Coast in 2004 exceeded 38 million pounds, for a market value of roughly $36 million, according to the CDFG. In 2005, Humboldt County had 135 vessels

participating in any fishery and 37 dealers, generating $4,865,220 in revenue (2.2 percent of coast-wide revenue) (see Figure 14-2).

Primary Fisheries

Groundfish, tuna, salmon and other fish species remain part of the annual haul, but Dungeness crab represents by far the area's largest catch (See Figure 14-3). Humboldt Bay is also California's largest producer of oysters, with local farmers harvesting around 75,000 gallons each year.

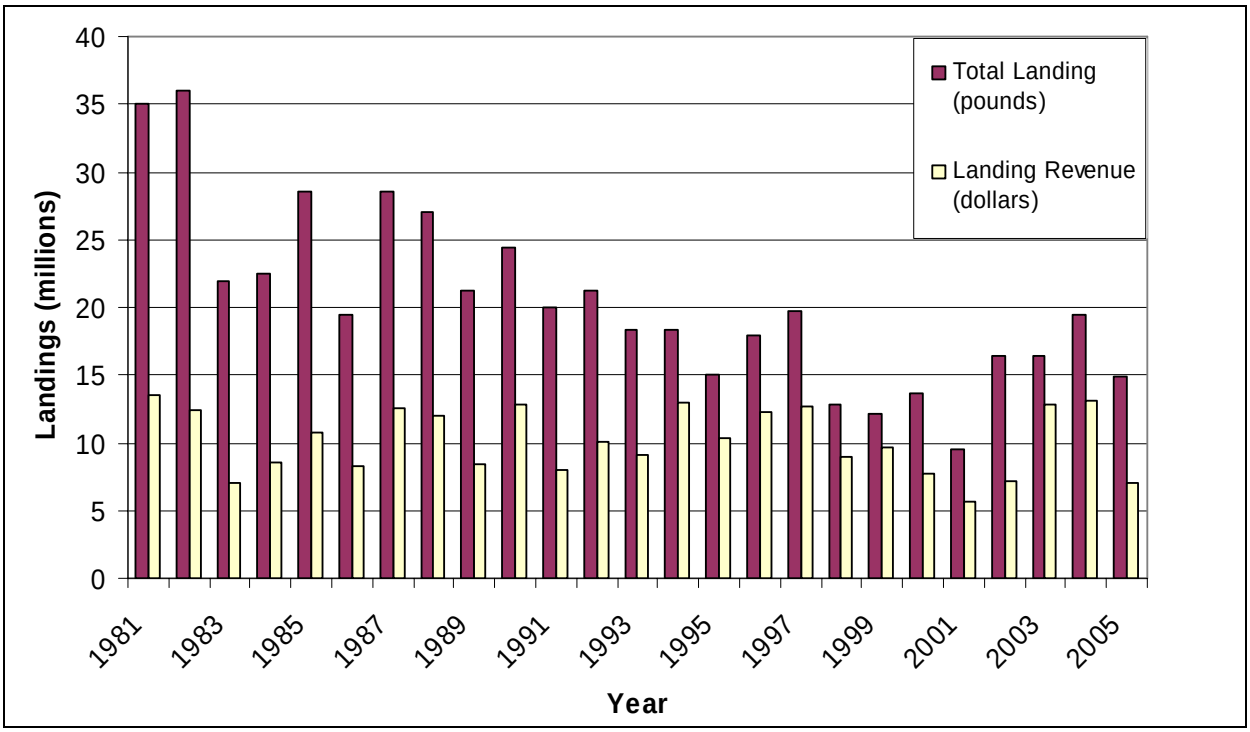

Figure 14-2: Eureka Port Landings and Corresponding Revenue since 1981 (NOAA 2005)

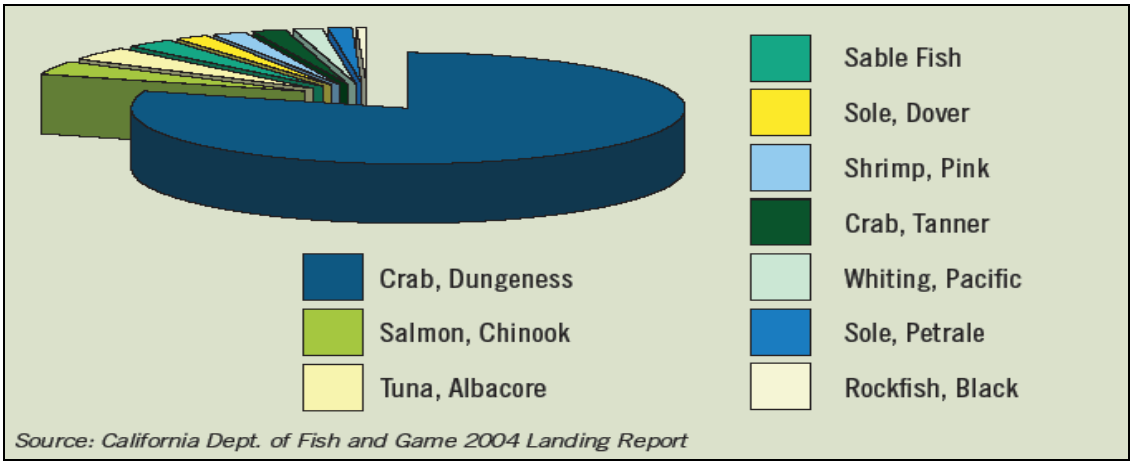

Figure 14-3: Top Ten Species by Economic Value for Eureka Ports

Commercial fishing is still dealing with the aftermath of the industry buildup in the 1970s that led to over-fishing, tightening regulation and industry decline. Today, federal management plans govern the North Coast fisheries of groundfish, salmon and tuna; the State of California manages Dungeness crab.

Table 14-3 outlines the poundage and value of fish caught out of Eureka area ports in 2005. Crab is the mainstay of the local industry. Despite having been fully exploited for decades, the crab fishery has remained stable with only limited management. However, according to a 2005 report by Humboldt State University researchers David Hankin and Steven Hackett, co-authored with Christopher Dewees of UC-Davis, the present focus on Dungeness crab and an increased fishing effort in the future will "likely create new biological conservation concerns" for the fishery.

TABLE 14-3.
POUNDAGE AND VALUE OF LANDINGS BY PORT, EUREKA AREA DURING 2005

Species	Pounds	Value	Species	Pounds	Value
Herring, Pacific – roe	1,202		Rockfish, widow	11,396	$4,975
Crab, Dungeness	1,657,575	$2,566,783	Rockfish, redbanded	3,026	$2,683
Sablefish	825,001	$1,004,249	Sole, sand	4,074	$1,546
Sole, Dover	1,759,090	$661,121	Flounder, starry	3,006	$1,021
Sole, petrale	695,425	$597,825	Sanddab, Pacific	2,944	$972
Shrimp, ocean (pink)	1,160,005	$535,796	Crab, rock unspecified	536	$804
Whiting, Pacific	6,755,908	$332,175	Rockfish, unspecified	1,525	$760
Tuna, albacore	261,282	$306,312	Rockfish, group small	1,472	$471
Salmon, Chinook	63,576	$169,351	Rockfish, group rosefish	1,468	$470
Thornyhead, shortspine	116,843	$116,634	Rockfish, blackgill	470	$399
Sole, English	307,964	$98,589	Rockfish, group red	735	$368
Thornyhead, longspine	255,495	$91,805	Rockfish, yellowtail	731	$365
Sole, rex	148,476	$59,390	Flounder, unspecified	837	$293
Smelt, night	164,243	$51,142	Rockfish, canary	577	$289
Surfperch, redtail	27,191	$28,263	Halibut, California	71	$212
Sanddab	77,791	$25,671	Rockfish, splitnose	608	$197
Skate, unspecified	141,899	$21,720	Surfperch, barred	183	$183
Rockfish, chilipepper	58,265	$20,590	Rockfish, black	127	$118
Smelt, surf	48,015	$16,332	Rockfish, group shelf	139	$64
Lingcod	12,770	$8,233	Rockfish, greenstriped	134	$44
Grenadier	76,473	$7,647	Rockfish, bocaccio	81	$33
Rockfish, group slope	15,479	$7,535	Shrimp, coonstriped	15	$15
Flounder, arrowtooth	63,366	$6,336	Rockfish, greenspotted	3	$2
Thornyheads	8,522	$6,056	Rockfish, rosy	2	$1
Rockfish, darkblotched	12,993	$5,292	Rockfish, Pacific ocean perch	33	$15
			Port Totals	**14,749,041**	**$6,761,144**

Source: CDFG, 2006.

Keeping with the historical landing trend, Fort Bragg, Eureka, and Crescent City consistently land the majority of Dungeness crab in the California despite the delayed opening. During the 2002-03 season,

nearly 70 percent of all landings were from the northern ports. Boats fishing out of northern ports are generally larger than vessels to the south and are able to deploy more traps per trip, fish at night, and withstand rougher seas. In the last few years several of these larger vessels have traveled south to participate in the southern opener on November 15. This relatively new trend has caused concern with some in the industry that too many traps are being deployed on fishing grounds at one time, especially in central California waters. Legislation proposed by the industry to address this and other fishery related concerns is pending.

Salmon fishing on the North Coast, dependent largely on the Klamath River, is constrained by the year-to-year condition of the fishery. Of the five species of Pacific salmon found on the West Coast, Chinook and Coho are most frequently encountered off California. Small numbers of pink salmon are landed on occasion. Chum salmon and sockeye salmon are rarely seen in California. The poor state of the fishery in 2006 prompted a federal moratorium on commercial salmon fishing off the Humboldt coast. Most salmon fisherman must supplement their income by setting crab pots during the winter and spring months.

Economic Impact

The fishing communities of the North Coast once represented some of our country's most productive salmon rivers, generating more than $1.25 billion for the regional economy. But declining fish numbers and poor water conditions along many of these rivers have forced the federal government to all but shut down commercial fishing along California's North Coast. This closure has cost coastal communities nearly 80 percent of the region's job base, or over 7,000 family wage jobs.

Figure 14-4 shows California commercial landings of ocean salmon from 1981 through 2005. In 2003, commercial fishing opportunities for ocean salmon were expanded off the coast of California as a result of the forecasted abundance of Klamath River fall Chinook, the NOAA Fisheries 2002 biological opinion for Sacramento River winter Chinook, and the implementation of a new Klamath Ocean Harvest Model developed by CDFG and NOAA Fisheries (all species except Coho; commercial fishery landings of Coho salmon have been prohibited since 1992 to protect Coho salmon stocks). In 2003, for the first time in many years, a nearly complete commercial fishery was allowed in the Fort Bragg area with only the month of June closed and a portion of the July fishery conducted under a landing limit. Commercial fisheries were also allowed from May through September from Bodega Bay southward, and there was an October fishery off San Francisco to target Central Valley fall Chinook.

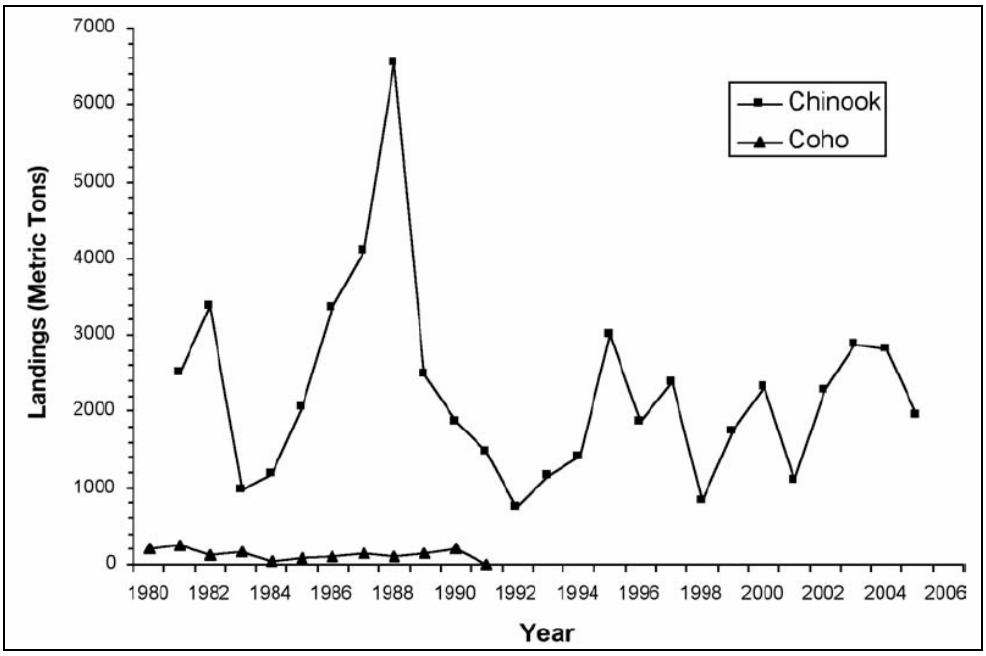

Figure 14-4: California commercial landings of ocean salmon, 1981-2005 (CDFG, 2006)

Statewide commercial landings in 2003 increased by 27 percent from the previous year, despite a 10 percent decrease in fishing effort. The commercial fleet landed 2,883 metric tons of dressed Chinook (488,800 fish) for 15,600 days fished in 2003 compared to 2,271 metric tons of dressed Chinook (391,700 fish) for 17,300 days fished in 2002. Ex-vessel prices for dressed salmon averaged $1.90 per pound, and the total ex-vessel value of the commercial fishery was approximately $12.1 million.

The Fishery Economic Assessment Model (FEAM) developed by the Pacific Fishery Management Council (PFMC) estimated that California coastal community and State personal income impacts of the 2003 ocean salmon fishery exceeded $43 million, with $30.3 million from the commercial fishery and $13.3 million from the recreational fishery. This is a slight increase from the 2002 FEAM estimate of $41 million, with $20.9 million from the commercial fishery and $20.1 million from the recreational fishery.

In addition to the loss of jobs from the closure of fishing waters, the commercial fishing industry is facing rising infrastructure cost without a relative increase in revenue. The cost of fuel for a commercial fisherman in Humboldt County has increased 236 percent since 1999 while the selling price of commercially caught fish has increased 116 percent since 1999 (see Table 14-4). Because of the diminishing profit structure, Humboldt County fishermen are more vulnerable to fluctuations in fish populations.

TABLE 14-4.
EX-VESSEL PRICE AND FUEL COST TRENDS

	Prices Relative to 1999						
	Whiting	Flatfish	Sablefish	Rockfish	**Total Groundfish**	Revenue/hour	Fuel
1999	100%	100%	100%	100%	**100%**	100%	100%
2000	125%	122%	122%	115%	**122%**	108%	126%
2001	100%	131%	117%	127%	**125%**	99%	130%

2002	125%	125%	114%	141%	**117%**	94%	104%
2003	125%	128%	122%	138%	**125%**	118%	120%
2004	100%	122%	101%	145%	**114%**	133%	120%
2005	125%	117%	107%	132%	**116%**		236%

In response to the poor condition of the stocks and the resulting economic impact on the fishing industry (see Table 14-5), California established a Groundfish Disaster Relief Program supported primarily by federal funds. It consisted of three projects: reimbursement for safety equipment, enhancement for data collection, and a groundfish disaster/job re-training stipend. Research projects included a near-shore rockfish tagging study and testing of a non-lethal assessment technique for cowcod rockfish using a remotely operated vehicle. About $2.5 million in federal and state funds have been allocated to aid displaced workers and vessel owners in California. Job retraining stipends account for approximately $1.2 million of this; stipends may total up to $1,500 per month to qualifying individuals.

TABLE 14-5.
CALIFORNIA GROUNDFISH LANDING TRENDS (SOURCE CDFG 2005)

	California Commercial Groundfish Landings (metric tons)			% Change	
	2005	2004	1995	Since 2004	Since 1995
Flatfish					
Dover Sole	2,216	2,421	6086	-8%	-64%
English Sole	244	307	499	-21%	-51%
Petrale Sole	771	490	592	57%	30%
Rex Sole	213	210	688	1%	-69%
Sanddabs	236	358	677	-34%	-65%
Other flatfishes	134	128	223	5%	-40%
Flatfish Subtotal	***3,814***	***3,914***	***8765***	***-3%***	***-56%***
Rockfish					
Thornyheads	862	900	3641	-4%	-76%
Widow	6	9	1697	-33%	-100%
Chilipepper	66	63	1279	5%	-95%
Bocaccio	7	9	762	-22%	-99%
Canary	2	1	155	100%	-99%
Darkblotched	16	34	367	-53%	-96%
Splitnose	122	187	295	-35%	-59%
Other rockfishes	358	558	3428	-36%	-90%
Rockfish Subtotal	***1,439***	***1,761***	***11624***	***-18%***	***-88%***
Roundfish					
Lingcod	63	63	538	0%	-88%
Sablefish	1,625	1,410	2806	15%	-42%
Pacific Whiting	3,105	4,742	4091	-35%	-24%
Grenadier	133	139	477	-4%	-72%

Cabezon	31	50	88	-38%	-65%
Other roundfish	2	1	1	100%	100%
Roundfish Subtotal	***4,959***	***6,405***	***8001***	***-23%***	***-38%***
Other Groundfish	**135**	**175**	**266**	**-23%**	**-49%**
Total	**10,347**	**12,225**	**28656**	**-15%**	**-64%**

The groundfish fishery is overcapitalized, with too many vessels fishing for a limited allowable catch; this has made it difficult to establish effective management measures that provide for a profitable fishery while also protecting groundfish stocks from over-fishing. Eureka ports in particular have seen revenue from groundfish landings fall considerably in the last three years (See Figure 14.5). A federally sponsored buyback program has just concluded and has reduced the number of groundfish trawl permits by approximately 35 percent, which should help address this issue.

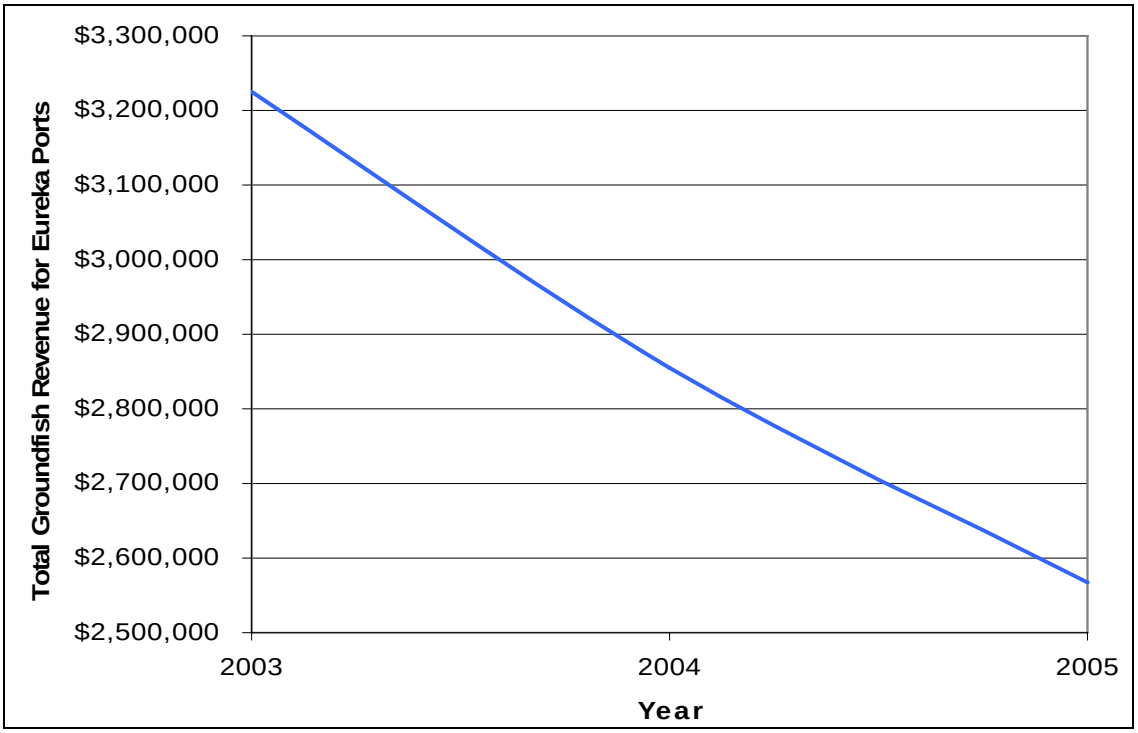

Figure 14-5: Total Groundfish Revenue for Eureka Ports

Shellfish

The 2006 Northern California crab season was delayed due to a fishermen-led strike over price, which was lowered because of the high volume of crab landed in the central coast the previous month. The northern season finally got underway 22 days after the official opening date (December 1) with an agreed price per pound of $1.40. Toward the end of the season, the price briefly rose to over $3.50 a pound. However, because of the high volume of crab available, 63 percent of the catch was purchased at under $2.00 per pound. There were 400 vessels that made landings during the 2002-03 California season, up slightly from the 385 boats that fished the previous season.

The natural environment and high water quality of Humboldt Bay is ideal for shellfish aquaculture, particularly the cultivation of oysters. The Bay's Harbor Revitalization Plan identifies aquaculture as a growth industry. Greg Dale, southwest operations manager for Coast Seafoods, the Bay's largest oyster producer, agrees that there could be growth, noting that a bay the size of Humboldt Bay in Washington State would support 10 or 15 farms. In Humboldt Bay, where no fewer than nine federal, state and local agencies directly or indirectly oversee aquaculture, only a handful of companies harvest shellfish. As the largest, Coast was the first target for a new permit mandate from the U.S. Army Corps of Engineers, the California Coastal Commission and other agencies—a costly process that lasted a decade.

The company, headquartered in Bellevue, Washington, harvests primarily Pacific oysters in Humboldt Bay that it ships by truck to a plant in Washington. It also grows premium Kumamoto oysters, which are processed in Eureka and sent whole to markets in Seattle and San Francisco. Although Coast has been in Eureka since the 1950s, the recent regulatory burden reduced its local area in production by two-thirds, to about 300 acres. Its employment in Eureka decreased to about 30 jobs, and the company made additional cutbacks in infrastructure, including the cancellation of plans for a new $3.5 million building in 1995. Since 1997, oyster production has changed from bottom to off-bottom culture methods. In 2004, 559,505 pounds of oysters were produced in Humboldt Bay (Figure 14-6).

SPECIES	2001	2002	2003	2004
PACIFIC OYSTER	547,851	687,527	700,000	559,505
KUMOMOTO OYSTER	9,261	19,260	20,000	41,750

Source: California Dept. of Fish and Game Regional Marine Aquaculture Report

Figure 14-6: Humboldt Bay Oyster Production by Weight (pounds)

In 2006, tissue samples taken from commercially grown oysters in Humboldt Bay showed contamination from dioxin. Dioxin pollution is a widespread but lesser-known problem associated with lumber mills on the North Coast. Numerous mills and lumber yards in Humboldt County are highly contaminated with dioxin, posing serious health hazards to people who work at the sites, those who consume seafood that is contaminated, and the fish, birds, and wildlife that are exposed. If the oyster farms are found to be contaminated with enough dioxin to become a threat to humans through consumption, the oyster farms would be forced to shut down.

Summary

Over the past three decades there has existed a downward trend in commercial fishing viability off the coast of Humboldt County. Despite many National and State regulations on fishing practices, both the salmon and groundfish industries continue to suffer. The Dungeness crab industry continues to be the largest revenue generator for the Eureka Ports, but intense fishing pressure has begun to impact the fishery. Oyster production has proven to be a valuable sustainable aquaculture, but the fishery is threatened by pollution entering the bay. Overall the Humboldt County fishing industry is relying on the success of the crab industry and is susceptible to fluctuations in the crab market.

14.2.3 Effects of Human Activities

Numerous factors can impact the yield of fresh and saltwater fisheries, from the natural cycling of fish populations due to krill and other food source cycling, to changes of habitat due to global warming. Human activities that are most applicable to the Humboldt County area are identified in the Humboldt County General Plan and in the North Coast Regional Water Quality Control Board's (NCRWQCB) Watershed Management Initiative for the Middle Eel River (NCRWQCB, 2005):

- **Stream Sedimentation**. Changes in channel morphology have resulted from increased sedimentation; shallower, wider channels experience increased sunlight penetration, decreased flow velocity and increased deposition of very fine material. Sedimentation of small streams in the Eel River delta has caused localized flooding and accelerated erosion in some cases from redirected stream channels. Gravel extraction is also a concern. Regulation of gravel extraction is primarily under the Corps of Engineers and CDFG.
- **Timber Harvest Practices**. Logging has decreased the tree canopy over streams and rivers. Lack of canopy increases the solar radiation reaching the water and increases water temperature. High water temperatures are detrimental to cold water fisheries' reproduction.
- **Dairies and Grazing**. Concern has been raised regarding impacts on the watershed from direct discharges of animal waste and/or whey, animals in the creeks and waterways, trampling of stream banks, and other erosion mechanisms. Dairies should be brought up to Title 27 standards. Grazing issues include erosion, sedimentation, and water chemistry issues.
- **Herbicide Application**. The applications of herbicides for farming practices can have a significant impact on water quality.
- **Interbasin Transfers of Water and Regulated Flows from Dams**. These activities affect sediment, flow, and temperature and may contribute to the impairment of beneficial uses.
- **Urban runoff.** Urban runoff from all watersheds draining to Humboldt Bay conveys indicators of bacterial contamination that impacts shellfish harvest. Seasonal and rainfall-based shellfish harvesting closures are in effect to mitigate the effects of nonpoint source runoff. A shellfish Technical Advisory Committee was established in November 1995 to address nonpoint source runoff issues.

Human activities also impact marine fisheries, including those summarized by the National Oceanic and Atmospheric Administration and the UN in their "Atlas of the Oceans" website (www.oceansatlas.org):

- Land based sources of pollution.
- Off shore and marine-based pollution.
- Habitat destruction.
- Sand mining and dredging.
- Direct impacts of over-fishing.
- Modifying community species composition and genetic diversity through selective targeting of species and size classes.
- Impacts on non-target species through low selectivity of certain gears.
- Incidental mortality from lost or abandoned gear
- Direct impact on the sea bed through trawls and dredges.
- Destructive illegal "fishing gear" such as dynamite and poisoning.

14.2.4 Federal and State Programs Related to Fishing Loss

Federal

The following federal agencies have direct or indirect jurisdiction over fisheries or their habitat.:

- NOAA Fisheries, whose objectives include the following:
  - Maintain healthy stocks important to commercial, recreational, and subsistence fisheries.
  - Eliminate over-fishing and rebuild over-fished stocks important to commercial, recreational, and subsistence fisheries.
  - Increase long-term economic and social benefits to the nation from living marine resources.
- The U.S. EPA has jurisdiction under the Endangered Species Act as well as the Clean Water Act, including the development and enforcement of total maximum daily load (TMDL) limitations and National Pollutant Discharge Elimination (NPDES) regulations, which cover point and non-point source discharges to waters.
- The Army Corps of Engineers has jurisdiction under Section 404 of the Clean Water Act, which requires that a permit be obtained from the Corps of Engineers prior to the discharge of dredged or fill materials into any "waters of the United States."

State

The following state agencies have direct or indirect jurisdiction over fisheries or their habitat.:

- The California Department of Fish and Game (CDFG) is directly responsible for managing the state's fresh and marine fisheries and their habitat for commercial and recreational uses.
- The State Water Resources Control Board holds joint authority for water allocation and water quality protection in California. The State Board oversees nine Regional Water Quality Control Boards (RWQCBs), which develop and enforce water quality objectives and implementation plans that will best protect the beneficial uses of the state's waters. Regional boards develop basin plans for their hydrologic areas, issue waste discharge requirements, take enforcement action against violators, and monitor water quality. The State Board has also developed an Ocean Plan, which the regional boards enforce and which is intended to protect water quality in the Oceans. The North Coast RWQCB has jurisdiction in Humboldt County.
- The State Department of Water Resources prepares and updates the California Water Plan to guide development and management of the state's water resources; operates the State Water Resources Development System to supply good quality water; regulates dams, provides flood protection, and assists in emergency management; educates the public about the importance of water and its proper use; and serves a variety of local water needs.
- The California Coastal Commission regulates the use of land and water in the Coastal Zone and oversees the implementation of the Coastal Act. Local Coastal Plans (LCP) are required by the Coastal Act to be prepared for the County's portion of the coastal zone. The LCP consists of a local government's land use plans, zoning ordinances, zoning district maps, and other implementing actions that meet the requirements of and implement the provisions and policies of the Coastal Act at the local level.
- The CDFG and California Department of Forestry and Fire Protection (CDF) often work in concert with the water boards and Department of Water Resources.

North Coast Watershed Assessment Program (NCWAP)

In 1999, the California Resources Agency and the California Environmental Protection Agency began developing an interagency watershed assessment program for California's North Coast. The purpose of the program is to develop consistent, scientifically credible information to guide landowners, agencies, watershed groups, and other stakeholders in their efforts to improve watershed and fisheries conditions.

The agencies brought together the CDFG, CDF, Department of Conservation's Division of Mines and Geology, Department of Water Resources, and the North Coast RWQCB to identify the appropriate role and objectives of a state assessment program. The resulting North Coast Watershed Assessment Program, or NCWAP, is designed to meet four goals:

- Develop baseline information about watershed conditions.
- Guide watershed restoration programs.
- Guide cooperative interagency, non-profit, and private sector approaches to protect the best through stewardship, easement, and other incentive programs.
- Better implement laws requiring watershed assessments such as Forest Practices, Clean Water and Porter-Cologne Acts, Lake or Streambed Alteration Agreement, and others.

The program provides a process for collecting and analyzing information to answer a set of critical questions designed to characterize current and past watershed conditions. While NCWAP will not produce prescriptions, design projects, analyze cumulative effects of proposed projects, perform risk management, or recommend policy development or regulations, information will be used to guide watershed management and restoration planning, restoration and recovery planning for anadromous fisheries, and implementation of watershed protection policies and regulations.

14.3 HAZARD PROFILE

Damage to the fisheries can have economic impacts on the commercial, industrial and recreational industries and cultural impacts on the fishing families and tribes of the area.

14.3.1 Past Events

The salmon and groundfish fisheries have faced serious declines in recent years. Commercial and recreational salmon fishing has been cut back to protect Klamath River stocks, and groundfish fishing has been cut back to protect and rebuild certain over-fished groundfish stocks. Vessel owners and crew, processors and suppliers are all affected, as well as fishing families and communities as a whole. Under Section 312(a) of the Magnuson-Stevens Act, NOAA Fisheries can declare a commercial fisheries disaster if requested to do so by a governor, or at the Commerce Secretary's discretion. The Secretary must determine that a fishery resource disaster resulted from either natural causes, man-made causes beyond the control of fishery managers, or undetermined causes. Further, if a commercial fishery failure occurred, then it must have resulted from the fishery resource disaster.

Widespread salmon fishery closures affecting an estimated 8,000 fishermen in Washington, Oregon, and northern California led to a fishery resource disaster declaration by the Secretary of Commerce in May 1994 and again in August 1995. The Northwest Emergency Assistance Plan, developed in response to these declarations, provided approximately $25 million in economic aid to salmon fisheries in the states of Washington ($13.6 million), Oregon ($7.7 million), and California ($3.4 million). These funds supported both habitat restoration and data collection job programs in all three states, and a salmon license buyback program in Washington. The Federal Emergency Management Agency contributed an additional $10 million to this region in the form of disaster unemployment assistance; these funds were

also divided among the states of Washington ($6.4 million), Oregon ($2.3 million), and California ($1.6 million). The Small Business Administration provided low-interest loans and debt-restructuring programs, and the Rural Development Administration contributed $3 million in grants used to finance small business development in rural areas.

There have been official disaster declarations in the recent past for both groundfish (2000) and salmon (2006), and a Tribally declared disaster for the Klamath fish kill (2002).

2006 Salmon Season

Both the federal and state governments declared salmon disasters for the 2006 salmon season, opening the way to low interest loans and other programs. On July 6, 2006, the Secretary of Commerce announced a fishery resource disaster. This opened the way for the Small Business Administration (SBA) to provide low-interest (4 percent) Economic Injury Disaster Loans. On August 10, 2006, the Commerce Secretary declared the year's salmon season an economic disaster. This formal declaration makes it possible for members of Congress from Oregon and California to seek up to $80 million in aid. The declaration applied from Cape Falcon on the northern Oregon Coast to Point Sur near Monterey, California.

Governor Schwarzenegger declared a salmon disaster in Humboldt, Del Norte, Marin, Mendocino, Monterey, San Francisco, San Mateo, Santa Cruz, Sonoma and Siskiyou counties. This opened the way for fishermen to qualify for up to $500,000 at between the prime interest rate to the prime interest rate plus 3 percent through the Small Business Disaster Assistance Loan Guarantee Program. The Small Business Disaster Assistance Loan Guarantee Program helps farm and agriculture-related enterprises obtain financing needed to recover from losses caused by disasters in areas declared to be in a State of Emergency by the Governor. To be eligible for assistance, the business needed to be located in a county declared to be in a State of Emergency by the Governor and be directly engaged in the production of Chinook salmon, including raising, harvesting, and processing. An applicant must have suffered physical damage or economic injury as a result of the disaster—"physical damage" means real or personal property damaged or lost; "economic injury" means an economic loss resulting in the inability of a business to meet its obligations and to pay its ordinary and necessary operating expenses. In addition, applicants must not be able to obtain credit on their own. Normally 80 to 95 percent of the loan is guaranteed, with the guaranteed portion of the loan not exceeding $500,000.

2002 Klamath Fish Kill

In 2002, over 34,000 fish died in the worst fish kill in U.S. history after the Department of Interior diverted water to irrigation users in the Klamath Basin. This fish kill resulted in the Yurok Tribe declaring a "state of emergency" over fish kills on the Klamath River. No state or federal state of emergency was declared for this disaster. The CDFG prepared a report that concluded the following (CDFG, 2003):

- During late September 2002, a minimum of 33,000 adult salmon, steelhead trout and other fish species were killed in the lower 36 miles of the Klamath River.
- Of the dead fish collected by CDFG downstream of the mouth of Blue Creek on September 27, 2002, 95.2 percent were fall Chinook salmon, 0.5 percent were Coho salmon and 4.3 percent were steelhead trout. These percentages differ slightly from the preliminary U.S. Fish and Wildlife Service (USFWS) estimates, which covered the entire fish kill survey area from Coon Creek Falls to the mouth of the Klamath River. Out of the 33,000 anadromous fish that were killed, USFWS found that 96 percent were fall Chinook salmon, 1.5 percent were Coho salmon and 2.0 percent were steelhead trout. Carcasses of sculpin, Klamath River small scale sucker, speckled dace, coastal cutthroat trout and green sturgeon were also identified.

- Of the Chinook salmon killed, CDFG estimates that 68 percent were naturally spawned fish and 32 percent were fish produced in one of the two mitigation hatcheries (Iron Gate or Trinity River hatcheries) in the Klamath River system.
- Low flows and other flow related factors (e.g., fish passage and fish density) caused the fish kill. Of the conditions that can cause or exacerbate a fish kill, flow is the only factor that can be controlled to any degree. Flow is regulated by upstream reservoirs operated by the Bureau of Reclamation on both the Klamath and Trinity rivers.
- September 2002 flow releases from Iron Gate Dam (provisional data) were the lowest on record when returning numbers of fall Chinook salmon were at average levels or above. September 2002 flows in the Klamath River were the lowest since the major storm events in 1997 and 1998 when channel conditions in the river could have changed dramatically.

2000 Groundfish Season

In January 2000 the U.S. Secretary of Commerce declared a disaster in the West Coast groundfish fishery. California established a Groundfish Disaster Relief Program, which consisted of three projects: reimbursement for safety equipment, enhancement for data collection, and a groundfish disaster/job retraining stipend. About $2.5 million in federal and state funds were allocated to aid displaced workers and vessel owners in California. Job retraining stipends account for approximately $1.2 million of this.

14.3.2 Extent and Location

A fishing disaster in Humboldt County has the potential to occur in almost any waterway in the county. Most of the rivers and streams in the county contain fish that are economically and socially important to Humboldt County communities. In 2002 the Klamath fish kill was a tribal and state declared disaster due to its impacts on the cultural and economical viability of the tribes inhabiting the Lower Klamath and its tributaries. The 2006 Salmon Season Disaster had widespread effects up and down the California Coast, from Del Norte to Santa Cruz County. The possible extent of a fish disaster depends largely on the species of fish and the location of the disaster. The 2002 Klamath Fish kill contributed to the closing of the commercial salmon season in 2006 along the entire Northern California Coast. The extent of the 2002 Klamath Fish kill will not be known for some time.

14.3.3 Frequency

The frequency with which fish disasters have occurred is difficult to measure, but with the current decline in all commercial fisheries, an increase in fish related disasters can be expected. A fish related disaster has been declared in Humboldt County in the following years: 1994, 1995, 2000, 2002, and 2006. Changing climate conditions and increased pressure on marine fisheries will lead to further declines in marine fishery production and a greater vulnerability to fluctuations in marine fishery populations.

14.3.4 Severity

For coastal communities, a fish disaster can have devastating consequences. The shutdown of the 2006 salmon season resulted in an $80 million dollar aid package for Central and Northern California and affected approximately 8,000 fishermen. Almost $2.5 million in funds were allocated for relief following the declared disaster for the 2000 groundfish season. With so much of the North Coast Fishery dependent on the productivity of the Dungeness crab season, a collapse of the crab fishery would have a crippling effect on the North Coast fishing industry.

14.3.5 Warning Time

The amount of warning time possible to Humboldt County fishermen depends largely on the fishery in question. Crab, salmon, and groundfish all have different seasons and are monitored by different agencies.

Dungeness Crab

The success of the commercial Dungeness crab fishery is based on the quantity of the crab caught and the market price of the crab. California landings vary widely, from a low of 350,000 pounds in 1973-1974 to a high of 30 million pounds in 1978-79. The quantity of crab available in a season is not often known until the season starts. The uncertainty in Dungeness crab populations makes the crab fishermen vulnerable to large swings in crab populations. The market price of crab is set at the beginning of the season and is often a heavily debated topic. With the diminished state of the salmon and groundfish fisheries in Northern California, the reliance on the Dungeness crab fishery has created a situation in which the fishermen are vulnerable to fluctuations in crab populations.

Salmon

The forecasting of upcoming salmon season relies heavily on modeling done by CDFG. CDFG fisheries biologist Wade Sinnen characterized the Klamath River Basin as "probably the most monitored" watershed in California and a lot of resources and money are expended to get the best data possible for managers to make decisions. The extensive monitoring program, translates into earlier warnings of potentially low salmon numbers. Although the CDFG relies heavily on modeling for predicting the abundance of Chinook salmon off the coast of California, information can also be obtained from monitoring the success of the salmon spawning in the Klamath river. The salmon season usually begins in early summer and runs until September. In April 2006, the Pacific Fishery Management Council — an advisory body charged with managing fish stocks on the West Coast — voted to all but cancel the 2006 salmon season. The U.S. Department of Commerce affirmed the decision shortly after. The reason: The population of adult Chinook expected to return to the Klamath in the fall was at a desperate low, and the future of the Klamath fishery — one of the most productive on the West Coast not long ago — appeared to be in grave danger.

Although the CDFG relies heavily on modeling for predicting the abundance of Chinook salon off the coast of California, information can also be obtained from monitoring the success of the salmon spawning in the Klamath River. The 2002 fish kill on in the Klamath River was an indicator that the number of salmon returning to spawn in 2006 would be drastically low.

Groundfish

Because groundfish include a wide variety of fish species, evaluating the health of the fishery and determining the proper restrictions on commercial fishing is difficult. In May 2002, the PFMC learned that three species designated as over-fished (yelloweye, canary and bocaccio rockfish) were reproducing more slowly than previously thought. The PFMC has a management criterion that over-fished groundfish must be restored to 40 percent of their unfished populations. As a result, in June 2002 the PFMC closed the majority of sport and commercial bottom fisheries along the entire continental shelf in order to protect these species. The restrictions went into effect in the summer of 2002 and continued into 2003. The closing of the commercial bottom fisheries came with little warning and prompted the federal government to initiate a buyback program to keep fishermen in business. In 2006, commercial fishermen landed approximately 53 percent of the year's allocation in September, resulting in attainment of the quota and thus the fishery closure on Oct. 1.

Oyster

Because oysters are produced in the Humboldt Bay in oyster farms, their availability is much more predictable than that of other fisheries present in Humboldt County. However, if more studies are done that find dioxin levels in shellfish in Humboldt Bay to be a threat, the fishery would be shut down. A collapse of the aquaculture in Humboldt Bay would have significant impacts on the shellfish economy in California and particularly Humboldt County.

14.3.6 Secondary Hazards

Damage to the fisheries can have economic impacts on the commercial, industrial and recreational industries and cultural impacts on fishing families and tribes of the area. The loss of the economic and cultural opportunities is directly related to the hazard; secondary hazards are considered minimal.

14.4 EXPOSURE AND VULNERABILITY

For this hazard, we are considering that all populations and property that is exposed to this hazard are also vulnerable. It is possible that populations that are exposed to a fish loss would not be vulnerable. For example, a fishing guide who, if there is a closure of the salmon fishing season in the area, can easily move their guide service somewhere else that they have clients and contacts. It is beyond the scope of this study to identify those people.

This hazard is different from the other hazards presented in this plan, in that there is no clearly defined area where the hazard occurs that can be intersected with the population and property values in that area to determine the extent of the damage caused by the hazard. In order to determine the exposure and vulnerability to this hazard, the findings from the *Environmental Impact Statement and Groundfish Rebuilding Plan* prepared by NOAA Fisheries and the Pacific Fishery Management Council (PFMC, 2006) were assessed. Although this plan focuses on groundfish, much of the analysis performed can be extrapolated to the fisheries industry as a whole (i.e., if a community is vulnerable to a collapse of the groundfish fisheries, it is vulnerable to fishing hazards).

14.4.1 Population

The population that is exposed and vulnerable to this hazard includes fleet fishermen, seafood processors, the oyster industry, guides and other services dependent on recreational fishing, and the tribes that are dependent on the economic and cultural aspects of the fisheries. The Groundfish Rebuilding Plan used a methodological approach to identify the following:

- "Commercially engaged" communities
- "Commercially groundfish dependent" communities
- "Recreationally engaged" communities
- Communities with "low resilience" to change
- Potentially "vulnerable" communities.

The term "engagement" describes a community's use of a resource (for example, fisheries). "Dependence" means the use of a particular resource (for example, groundfish species), sometimes above a threshold level. The term "resilience" indicates a community's adaptability to change.

Commercially Engaged Communities

The following indicators were used in the plan as proxies for overall community engagement in the Pacific coast commercial fishery (2005 data was used):

- Number of federal and state fishing permits as a percentage of each state's total number of permits (based on owner's mailing address).
- Number of commercial fishing vessels (based on owner's mailing address).
- Revenue from fish landings as a share of coast-wide revenue from fishing landings.
- Number of processors/buyers.

Table 14-6 displays the indicators used to rate the relative engagement of communities in commercial fishing and their representative values and rank among West Coast ports. Table 14-7 displays the number of times the cities scored in the top one-third of the commercial fishing engagement indicators (only the top-scored West Coast cities and those in Humboldt County are shown). Astoria, Bellingham, Coos Bay, Crescent City, Eureka, Fort Bragg, Ilwaco, Newport, San Francisco, San Pedro, Santa Barbara, and Westport all scored highest with a score of four. That is, they all were ranked in the top one-third of all four indicators used to measure engagement in the Pacific fisheries.

Table 14-8 displays the top-scoring West Coast counties with regard to the commercial fishing engagement indicators. Coos, Grays Harbor, and Lincoln counties top the list scoring four out of four. Clatsop, Humboldt, Los Angeles, Mendocino, Orange, Pacific, San Diego, San Mateo, and Whatcom counties also score highly.

TABLE 14-6.
COMMERCIAL ENGAGEMENT INDICATORS AND RANKINGS BY CITY

	Eureka	Ferndale	Fields Landing	McKinleyville	Other Humboldt Co. Ports	Trinidad	Humboldt Co. Total
Total Number of Vessels Participating in Any Fishery in 2005 by Port							
Number	101		9		20	22	135
Rank	22						
Dealers							
Number	21		1		16	12	37
Rank	24				29		12
Permits as a % of state total							
Percent	2.21	2.01		0.91		0.45	4.2
Rank	27	32					8
Groundfish permits as a percentage of the state total							
Percent	2.13	0.28		1.13		0.57	4.1
Rank	35			68			9
Port fish revenue/ Coast-wide fish revenue							
Revenue	2.2					0.4	3.7
Rank	11						11
Port groundfish revenue/ Port fish revenue							
Revenue	52.8				13.4	2.7	0.7
Rank	10						
Port groundfish revenue/ Coast-wide groundfish revenue							

Revenue	5.0		0.1	5.0
Rank	6			

Notes:
- Blank spaces in the indicator value denote that the value is zero or very close to zero.
- Blank spaces in the rankings columns indicate that this city did not score in the top one-third of cities with a value under the indicator.
- Total number of vessels indicates the number of vessels who made at least one landing at the port.
- Not appropriate to sum vessels across ports, as some vessels make landings in multiple ports.
- Total number of dealers indicates the number of dealers who made at least one purchase at the port.

TABLE 14-7.
COMMERCIAL FISHING ENGAGEMENT SCORES BY WEST COAST CITY

City	Number of times the city scored in top one-third of commercial fishing engagement indicators
Astoria	4
Bellingham	4
Coos Bay	4
Crescent City	4
Eureka	**4**
Fort Bragg	4
Ilwaco	4
Newport	4
San Francisco	4
San Pedro	4
Santa Barbara	4
Westport	4
Ferndale	**1**
Other Humboldt County ports	**1**

TABLE 14-8.
COMMERCIAL FISHING ENGAGEMENT SCORES BY WEST COAST COUNTY

County	Number of times the county scored in top one-third of commercial fishing engagement indicators
Coos County	4
Grays Harbor County	4
Lincoln County	4
Clatsop County	3
Humboldt County	**3**
Los Angeles County	3
Mendocino County	3
Del Norte County	2
Marin County	2
Monterey County	2
Sonoma County	2
Tillamook County	2
Ventura County	2
Alameda County	1

Commercially Groundfish Dependent Communities

The following indicators are used to assess community dependence on the groundfish fishery:

- Number of groundfish permits (based on owner mailing address) as a percentage of the state total. Permits were defined as "groundfish" permits if they were one of the following types:
  - Federal LE groundfish permit with a trawl or fixed gear endorsement
  - California deeper nearshore species fishery permit
  - California nearshore fishery by-catch permit
  - California nearshore north central trap endorsement permit
  - California nearshore north central fishery permit
  - California nearshore north fishery permit
  - California nearshore south central fishery permit
  - California nearshore south central trap endorsement permit
  - California nearshore south fishery permit
  - California nearshore south trap endorsement permit.
- Groundfish revenue as a percentage of total community fisheries revenue.
- Groundfish revenue as a percentage of total groundfish revenue coast-wide.

The analysis used indicators (port groundfish revenue as a percentage of total port revenue) that allowed for small cities focusing on groundfish fishing to be identified as relatively dependent. Table 14-9 shows the number of times West Coast cities scored in the top one-third of commercial groundfish dependency indicators. Eureka is the only Humboldt County city that is heavily dependent upon the groundfish resource (scoring three out of three). Table 14-10 displays the top scoring West Coast counties with regard to commercial groundfish dependency, along with Humboldt County.

Recreationally Engaged Communities

The following indicators are used as proxies for overall community engagement and dependence in the Pacific coast recreational fishery:

- Number of charter vessels as a percentage of the total state number of charter vessels.
- Number of private/rental angler trips as a percentage of the total state number of private/rental angler trips.
- Number of private/rental groundfish angler trips as a percentage of the total state number of private/rental groundfish angler trips.
- Number of party/charter trips as a percentage of the total state number of party/charter trips.
- Number of party/charter groundfish trips as a percentage of the total state number of party/charter groundfish trips.

Table 14-11 shows the rankings of the number of charter vessels in regions of California as a percentage of the state total. Table 14-12 shows the relative rankings of the recreational engagement indicators by county group. Table 14-13 shows the number of times the regions/port groups/cities scored in the top one-third of the recreational engagement indicators for California. In general, the Humboldt County area was not found to be highly engaged with recreational fishing, compared to other California areas.

TABLE 14-9.
GROUNDFISH DEPENDENCY SCORES BY WEST COAST CITY

City	Number of times the city scored in top one-third of commercial groundfish dependency indicators
Astoria	3
Bellingham	3
Brookings	3
Coos Bay	3
Crescent City	3
Eureka	**3**
Fort Bragg	3
Morro Bay	3
Newport	3
Port Orford	3
San Francisco	3
McKinleyville	**1**

TABLE 14-10.
GROUNDFISH DEPENDENCY SCORES BY WEST COAST COUNTY

County	Number of times the county scored in top one-third of commercial groundfish dependency indicators
Los Angeles County	3
Clatsop County	2
Coos County	2
Curry County	2
Grays Harbor County	2
Lincoln County	2
Ventura County	2
Del Norte County	1
Humboldt County	**1**

TABLE 14-11.
CALIFORNIA CHARTER VESSELS RANKED BY REGION

Region - CA	Number of charter vessels in California as percentage of state total	Rank
San Diego Mission Bay	28.6%	1
San Fran, San Fran Bay-Delta	13.9%	2
Seal Beach, Long Beach, San Pedro	13.3%	3
Port Hueneme, Oxnard/Ventura, Santa Barbara	9.4%	4
Princeton, Bodega Bay	8.0%	5
Oceanside Dana Harbor	6.2%	6
Monterey, Moss Landings, Santa Cruz	5.6%	7
Newport Beach	5.3%	8
Fort Bragg, Eureka, Crescent City	**4.1%**	**9**
Redondo, Marina del Rey, Malibu	3.8%	10
Avila Beach, Morro Bay	1.8%	11

TABLE 14-12.
CALIFORNIA RECREATIONAL INDICATOR VALUES AND RANKINGS BY REGION

	Private/rental angler trips as a percentage of state total				Party/charter trips as a percentage of state total			
	All Fisheries		Groundfish		All Fisheries		Groundfish	
County Group - CA	%	Rank	%	Rank	%	Rank	%	Rank
San Diego through LA	39.4%	1	12.3%	5	53.5%	1	40.8%	1
San Luis Obispo through Santa Cruz	11.2%	2	23.4%	1	6.1%	5	17.3%	2
Sonoma and Mendocino	9.8%	3	19.9%	3	12.6%	2	1.9%	5
Humboldt and Del Norte	**9.3%**	**4**	**20.5%**	**2**	**0.3%**	**6**	**0.8%**	**6**
San Mateo up through Marin	7.4%	5	14.1%	4	7.7%	3	16.5%	3
Ventura and Santa Barbara	5.1%	6	4.4%	6	7.0%	4	13.8%	4

TABLE 14-13.
CALIFORNIA RECREATIONAL ENGAGEMENT SCORES BY REGION

County Group - CA	Number of times the county group scored in top one-third of CA recreational fishing engagement indicators
San Diego through LA	3
San Luis Obispo through Santa Cruz	3
Humboldt and Del Norte	**1**

Resiliency

The purpose of gauging community resiliency was to determine which communities are least able to adapt to a decrease in harvest. Communities with higher resiliency are defined as those that adapt quickly as indicated by rebounding measures of socioeconomic well-being. Resilient communities have diverse employment opportunities, high employment rates and low numbers of people living below the poverty line, are not in isolated cities, and have the necessary municipal/county infrastructure to enable a rebound from a decrease in harvest. If the local fishing sector in a community with high resiliency experiences a major downturn, unemployment rates will rise only briefly until displaced people find other employment. Communities with low resiliency have more lingering negative impacts, such as unemployment or out-migration rates that remain high for many years.

The basis for gauging resiliency rests on the concept of social well-being, which is sometimes defined as a composite of four factors: economic resiliency, social and cultural diversity (population size, mix of skills), civic infrastructure (leadership, preparedness for change), and amenity infrastructure (attractiveness of the area). For this analysis, indicators were chosen with these factors in mind. The following indicators were used to describe resiliency (2002 and 2003 data was used):

- Industry diversity index—It was assumed that the more types of industries are present in a community, the more resilient the community may be to negative impacts on the fishing industry. The index was used to identify communities with very little employment in industries other than fishing. The index was calculated using all 19 major industry categories used in the U.S. Census. The Shannon-Weiner index was used to measure industry diversification. Greater numbers of employees and more even distribution of employees across industries both increase the index.
- Unemployment rate.
- Percentage of the population living below the poverty line.
- Isolated cities—Identification of isolated cities was made by Langdon-Pollack (2004). The analysis defined geographically isolated cities as cities in coastal counties with a population of 1,900 or less, not located on a major highway and outside of the 35-mile buffer of cities over 20,000. California did not have any geographically isolated cities.
- Population density.

Table 14-14 shows resiliency indicators for Eureka and Trinidad, the only Humboldt County cities that were listed on this table in the Plan. Table 14-15 shows the indicators and values for California counties, with rankings shown for counties that were in the top one-third of each indicator. Table 14-16 shows the number of times Eureka and Trinidad scored in the top one-third of the five resiliency indicators. Table 14-17 displays the number of times each West Coast county scored in the top one-third of the four resiliency indicators (isolated communities indicator does not apply to counties). Del Norte, Grays Harbor, Hood River and Lincoln counties ranked in the top one-third of all resiliency indicators. Coos, Cowlitz, Humboldt, Mendocino, Pacific, Skamania, and Wahkiakum counties can also be described as relatively less resilient according to this analysis.

TABLE 14-14.
RESILIENCY INDICATOR VALUES AND RANKINGS BY CITY

	Industry diversification index (Shannon-Weiner Index)		Total population		Unemployment rate		Poverty rate		
Port	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Isolated City
Eureka	2.363		26,128		5.5%	12	23.7%	5	
Trinidad	1.917	15	311	3	4.2%	24	8.8%		

Note: Blank spaces in the rankings columns indicate that this city did not score in the top one-third.

TABLE 14-15.
RESILIENCY INDICATOR VALUES AND RANKINGS BY COUNTY (FOR CALIFORNIA ONLY)

	Industry diversification index (Shannon-Weiner Index)		Total population		Unemployment rate		Poverty rate	
County	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Alameda	2.50		1,443,741		3.6		11	
Clark	2.38		345,238		4		9.1	
Contra Costa	2.50		948,816		3.1		7.6	
Del Norte	2.22	7	27,507	9	4.9	7	20.2	1
Humboldt	**2.28**	**12**	**126,518**		**5.2**	**3**	**19.5**	**2**
Los Angeles	2.48		9,519,338		5	6	17.9	3
Marin	2.44		247,289		1.9		6.6	
Mendocino	2.30	14	86,265		4.5	15	15.9	6
Monterey	2.42		401,762		5.2	5	13.5	16
Orange	2.52		2,846,289		3.3		10.3	
Pacific	2.14	3	20,984	5	3.9		14.4	9
San Diego	2.47		2,813,833		3.6		12.4	
San Francisco	2.47		776,733		3		11.3	
San Joaquin	2.41		563,598		6.2	2	17.7	4
San Luis Obispo	2.38		401,762		5.2	4	13.5	15
San Mateo	2.53		707,161		2.2		5.8	
Santa Barbara	2.46		399,347		4.2		14.3	10
Santa Cruz	2.41		255,602		4.1		11.9	
Solano	2.33	16	394,542		3.8		8.3	
Sonoma	2.39		458,614		2.8		8.1	

Note: Blank spaces in the rankings columns indicate that this county did not score in the top one-third.

TABLE 14-16.
RESILIENCY SCORES BY CITY

City	Number of times the city scored in top one-third (least resilient) of resiliency indicators
Trinidad	3
Eureka	2

TABLE 14-17.
RESILIENCY SCORES BY WEST COAST COUNTY

County	Number of times the county scored in top one-third (least resilient) of resiliency indicators
Del Norte	4
Grays Harbor	4
Hood River	4
Lincoln	4
Coos	3
Cowlitz	3
Humboldt	**3**
Mendocino	3
Pacific	3
Skamania	3
Wahkiakum	3

Vulnerable Areas

"Vulnerable areas" were defined as communities that are "highly engaged" or "highly dependent" and have relatively "low resilience." If a community appears in the "highly engaged" or "highly dependent" list and the "low resilience" list, then the community is listed as a "vulnerable area." The analysis was done in such a way that communities heavily engaged in commercial fishing in general and groundfish in particular scored higher than communities heavily engaged only in commercial fishing in general. Tables 14-18 and 14-19 show the results of the "vulnerable areas" analysis for Humboldt County cities and West Coast counties, respectively. To qualify as a vulnerable area, a city or county must be listed in the top one-third of ranked indicator values for at least one engagement or dependency indicator and one resiliency indicator. A community ranked in the top one-third of an indicator three times under engagement and/or dependence and resilience is identified as "most vulnerable".

TABLE 14-18.
VULNERABILITY OF CITIES

City	Number of times the city scored in top one-third: Commercial fishing engagement	Commercial groundfish dependency	Resiliency (least resilient)	Vulnerable Area
Eureka	**4**	**3**	**2**	**vulnerable**
Ferndale	1	0	0	
Fields Landing	0	0	0	
McKinleyville	0	1	0	
Trinidad	0	0	3	
Other Humboldt County Ports	1	0	0	

TABLE 14-19.
VULNERABILITY OF COUNTIES

County	Number of times the county scored in top one-third: Commercial fishing engagement	Commercial groundfish dependency	Resiliency (least resilient)	Vulnerable Area
Clallam County		1	2	vulnerable
Clatsop County	3	2	2	vulnerable
Coos County	4	2	3	most vulnerable
Curry County	2	2	2	vulnerable
Del Norte County	2	1	4	vulnerable
Grays Harbor County	4	2	4	most vulnerable
Humboldt County	**3**	**1**	**3**	**most vulnerable**
Lincoln County	4	2	4	most vulnerable
Los Angeles County	3	3	2	vulnerable
Mendocino County	3	1	3	most vulnerable
Monterey County	2	1	2	vulnerable
Pacific County	3	1	3	most vulnerable
San Juan County		1	1	vulnerable
San Luis Obispo County	2	1	2	vulnerable
Santa Barbara County	2	1	1	vulnerable
Tillamook County	2	1	2	vulnerable
Wahkiakum County	1	1	3	vulnerable
Whatcom County	3	1	2	vulnerable

Humboldt Counties has been identified as one of the most vulnerable counties on the West Coast to the loss of the groundfisheries. The city of Eureka was also identified a vulnerable to this loss, however, the other cities in the County for which data was available (Ferndale, Fields Landing, McKinleyville, and Trinidad) were not identified as vulnerable.

This represents a loss of approximately $7 million of total revenue per year to the County in commercial landings in ports, the majority of which are in Eureka (as an approximate ratio for the other areas of the County, the 2005 groundfish revenue by port was reported in PFMC (2006) as Eureka $4,865,220; Trinidad $985,034; Other Humboldt County Ports-$48,518). In addition to the landings losses, there is a loss of revenue by sea food processors, the oyster industry, the recreational fisheries and related industries. This represents a potential loss of approximately $35 million to the entire County (Mullins, 2007). An exact breakdown of the extent of this loss by city and the extent that the actual loss might occur in a given year or due to a given event, is beyond the scope of this analysis.

14.4.2 Property

Under the 2006 salmon season disaster declaration, loans were available to individuals provided: "An applicant must have suffered physical damage or economic injury as a result of the disaster. In this case, 'physical damage' meant real or personal property damaged or lost, including structural losses. 'Economic injury' means an economic loss resulting in the inability of a business to meet its obligations and to pay its ordinary and necessary operating expenses, including production losses." (BTHA, 2007) It is unclear what "physical damage" would result to property that was not caused by the "economic injury" of the disaster and we have therefore not assumed any costs associated with property damage.

14.4.3 Critical Facilities and Infrastructure

There are no critical facilities or infrastructure that is exposed or vulnerable to the fish loss hazard.

14.5 FUTURE TRENDS

As Figure 14-7 shows, the trend in fishing landings for Humboldt County is on the decline. It is unlikely that the trend will reverse; at best it may level off. Extensive efforts have been made in recent years to remove fish barriers in local streams and rivers, reduce sediment discharges to streams, and improve the health of the watershed to attempt to increase and improve spawning and other habitat for anadromous species. It is hoped that this will increase the fish populations in the local rivers and the ocean, although it is unlikely that fish stocks and the economic income associated with them will return to previous levels.

14.6 SCENARIO

Dungeness crab make up a third of the total income per year for Humboldt County ports. As with other species in the marine fisheries, the productivity and price from season to season is unpredictable, but the overall fishery has not seen the dramatic decline that has been observed in the groundfish and salmon industries. The worst case scenario is that the groundfish and salmon industries continue their decline and that the albacore and Dungeness crab fisheries also crash. That would eliminate the remaining fish fleet and processors in the area. A large discharge of contamination into Humboldt Bay, for example from a container truck carrying toxic chemicals crashing on the Samoa Bridge, could greatly impact the oyster industry in the bay—possibly irreparably.

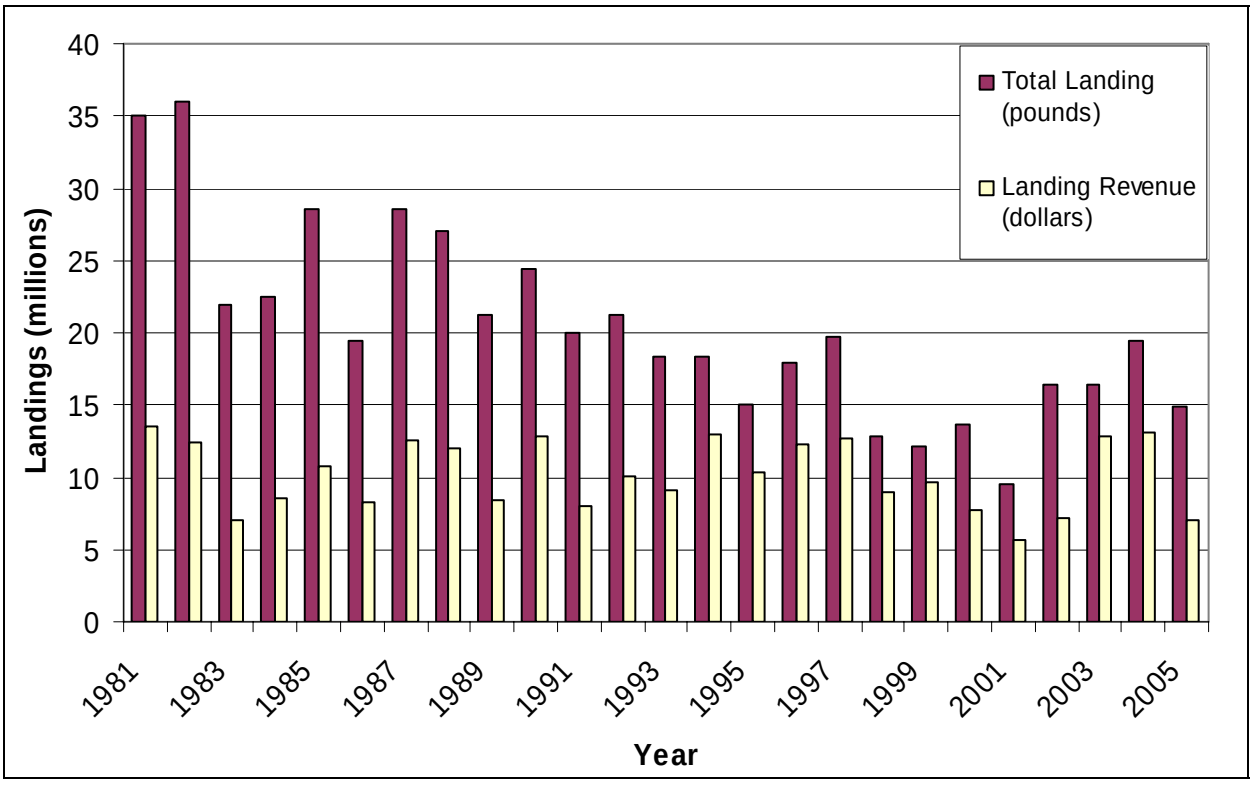

Figure 14-7: Eureka Port Landings and Corresponding Revenue since 1981 (NOAA 2005)

14.7 ISSUES

In evaluating the information contained in this risk assessment of the fish loss hazard, the planning team has identified the following issues that are consistent within the planning area:

- The true degree of exposure and vulnerability is not certain due to the degree of uncertainty in the yields of various species from season to season and in the long term and the number of variables that the industry is dependent on.
- The exact monetary value of an impact to this industry on the County as a whole and on each city in the county is uncertain due to the lack of a detailed comprehensive assessment of all these industries.