Gerstung rpt to Fish and Game Commission

CALIFORNIA DEPARTMENT OF FISH AND GAME

STATUS AND MANAGEMENT OF SPRING-RUN CHINOOK SALMON[1]

INTRODUCTION

Runs have dwindled in many parts of California and additional protection or management actions are needed to protect the fish from further declines. The following is a report requested by the Fish and Game Commission on the status and current management of spring-run chinook salmon stocks.

Fish counts presented in this report were developed by a variety of methods. Some of them are estimates of total run-size or spawning escapement, while others are indices of abundance derived from counts of maturing fish in their holding areas. It is important to note the stock assessment method used. Index area counts will always underestimate the true run size, often by a very large margin.

BASIC LIFE HISTORY

California supports the southern most runs of spring-run chinook on the Pacific Coast of North America. Larger runs of these fish occur in all of the states or provinces to the north.

Spring-run chinook salmon enter fresh water and migrate upstream to parental spawning areas primarily during April through June. They spend the summer in deep pools with suitable quality water, and they spawn in September and October. Most of the fish spawn at age 3; a significant segment males spawn at age 2 and a significant segment (males and females) spawn at age 4. The age composition of coded-wire-tagged (CWT) spring chinook salmon of the 1976-84 broods returning to the Trinity River Hatchery was 11% age 2, 54% age 3, and 35% age 4 (USFWS 1990).

Eggs deposited in the gravel (or placed in hatchery troughs) hatch in January or February. The young fish rear in the stream or estuary (or hatchery pond) until April through June when, as fingerling fish (about 3 inches long), they migrate to and enter the sea. A very few fish may hold over in fresh water until the following spring and enter the sea as yearling (6-inch) fish. Hatchery-reared spring chinook salmon are released at various sizes or times of the year to migrate to the sea (depending on strategies based on marking study

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results). Many hatchery fish are trucked and released at downstream points in the system to increase their rates of freshwater survival.

HISTORIC AND PRESENT DISTRIBUTIONS AND RUN SIZES

California's major spring chinook salmon runs have been lost to barrier dams (Table 1 and Figures 1 and 2). Other, much smaller runs, have been lost to other causes such as degraded habitat.

The demise of the San Joaquin run, is largely attributable to Friant Dam which was completed in 1948. Previously, this run had been one of the largest chinook salmon runs anywhere on the Pacific Coast. Historical population levels were never measured, but were possibly in the range of 200,000 to 500,000 spawners annually. The largest escapement actually measured was 56,000 spawners in 1945 (Fry 1961).

Hatcheries are in place to mitigate for major chinook salmon runs blocked by barrier dams, except for Friant Dam on the San Joaquin, for which no hatchery or other significant offsetting measures were provided. Hatchery spring-run programs exist at Coleman National Fish Hatchery on the upper Sacramento River, and Feather and Trinity river hatcheries. The Feather and Trinity river programs have been very successful in recent years (Figures 3 and 4), while the Coleman program is difficult to assess because of mixing of fall- and spring-run stocks. The upper Sacramento River "spring" chinook run, which includes many Coleman Hatchery fish, has fluctuated widely with an overall slightly downward trend since 1967 (Appendix Table 1, Figure 5).

The Trinity River spring run above Junction City has risen sharply in recent years (Figure 6). This increase has probably been due to improved habitat conditions and flow regime below Lewiston Dam, combined with excellent survival rate of hatchery fish, many of which spawn in the river. (Trinity River fall chinook have also had excellent survival rates in recent years and have returned to the river and hatchery in large numbers).

During the last century, stocks of naturally-spawning spring chinook were probably more abundant than their fall-run counterparts in most river systems. Historical commercial gillnet fishery landings for the Central Valley indicate a peak catch of over 600,000 spring chinook in 1883 (CFGC 1885). Most of the fish were believed to originate in the upper Sacramento River, above the current Shasta Dam location, and in the San Joaquin system. There is some evidence that the Klamath River spring run may have historically been larger than the fall run in that system (Snyder 1931).

Today, spring-run chinook occur in 24 streams (Table 2). The viable, potentially self-sustaining runs are found in Mill and Deer creeks, tributaries to the upper Sacramento River, and the South Fork Trinity and Salmon rivers in the Klamath River system. The remaining streams support either remnant runs, consisting of a very few fish, or runs that appear to be heavily affected by hatchery production (including hybridization with fall stocks). Unhybridized, naturally-produced spring chinook stocks generally spawn in stream reaches not frequented by fall stocks. Dams on the Sacramento, Feather, and Trinity rivers have stopped spring stocks from reaching their ancestral spawning grounds, thus forcing the two stocks (springs and falls) to utilize the same spawning areas. At one time, the spring and fall runs spawned 4 to 6 weeks apart, thus reinforcing a distinct genetic separation. A great deal of spawning overlap now occurs both spacially and temporally between the runs.

The status of the last remaining runs of self-sustaining spring chinook stocks in the State (Table 3) are summarized in the following:

Mill Creek (Sacramento system): Spring-run chinook counts have been conducted intermittently over the years. In some seasons visual counts were made. Other estimates were made by counting carcasses. There has been a downward trend in the runs from an average of about 2,000 fish in the 1940's and 1950's; to 1,500 in the 1960's, to 1,300 in the 1970's; and to about 300 annually in the 1980's (Figure 7).

Deer Creek (Sacramento system): This creek has been surveyed frequently since 1940. Similar to the other runs, this stock has fluctuated widely, with a downward trend similar to that for Mill Creek (Figure 8). Average run sizes during the 40's, 50's, 60's, 70's,and 80's were 1,900; 2,400; 2,000; 2,800; and 700, respectively.

Salmon River (Klamath system): Snorkel diving counts for this stream and its major spring chinook holding and spawning area, Wooley Creek, are available for most years since 1981. Except for 1989, a steady upward trend in abundance was indicated, from a count of 300 in 1981 to about 1,000 in 1988 (Figure 9). The 1989 count was only 250 fish.

South Fork Trinity River (Klamath system): Prior to 1964 and after the demise of the San Joaquin run, this probably was the most productive spring chinook stream in the State. For example, the estimated run size was 11,000 fish in 1963. Landslides triggered by 1964 storms filled in the holding pools and buried the spawning areas. The situation only slightly improved during the next 15 years. A few of the holding areas became usable again and spring-run chinook were again observed

in these isolated pools. Since 1979, fish have been observed during snorkel diving surveys conducted by various groups in the primary holding areas. These counts (made principally of fish holding in the areas above Hayfork Valley) have averaged about 115 fish, with several counts of over 300 fish (Figure 10). The 1989 count was only 7 fish, the second lowest count on record; the lowest count was 2 fish in 1973. The two lowest counts were during dry years.

FACTORS AFFECTING PRODUCTION AND RETURNS

Fishing

Spring-run chinook are impacted as adult (or near-adult) fish in ocean and in-river fisheries. The ocean commercial fishery has the major fishery impact on the adult returns. The ocean distributions of the spring-run stocks, as determined from ocean fishery landings of coded-wire tagged (CWT) fish, are very similar to those of the fall-run chinook from the same systems. The upper Sacramento River stocks are most abundant south of Point Arena to about Morro Bay; the Klamath system stocks are most abundant between about Cape Blanco, in southern Oregon, to about Point Arena (Figure 11). Spring-run chinook are less impacted by the ocean fisheries than fall-run stocks because of their generally shorter time of availability as legal-size fish to the commercial fishery (beginning at 26 inches, total length) during the normal May-September commercial season. Maturing fish leave the ocean during April through June and escape the ocean summer fishery.

Native Americans (Indians) are permitted to harvest spring chinook using gill nets in the lower Klamath and Trinity rivers, while all non-Indian users use hook-and-line gear.

Actual ocean and in-river harvest rate estimates have been developed for Trinity River Hatchery spring-run chinook of the 1976-84 broods, as follows:

	Age 2	Age 3	Age 4	Total
Ocean fisheries	0.00	0.27	0.15	0.30
In-river fisheries	0.06	0.18	0.13	0.12
Totals	NA	0.37	0.26	0.42

The above estimates were based on fish released as fingerlings (USFWS 1990), the usual outmigration size for the stock. Harvest rate totals have been computed for age 3 ocean recruits and expressed as "potential adults". They indicate the fisheries reduced the runs of adult spring-run chinook of hatchery origin by about half.

Actual harvest level estimates for spring-run stocks have been developed for the Indian fisheries of the Klamath system, and the sport fisheries of the upper Sacramento and Trinity rivers. The combined Indian fisheries since 1979 landed an annual average of about 3,200 fish with an annual range of from 600 to 6,700 fish (Table 5). The upper Sacramento sport fishery landed an average of about 300 fish with an annual range of about 40 to 900 fish during 1975-84. The Trinity River sport fishery landed an average of about 3,400 fish with an annual range of about 400 to 9,400 fish during 1980 through 1988 (Table 6).

The Sacramento River stocks have probably been impacted to a greater extent than the Klamath stocks by the ocean fisheries. This has been due to greater harvest constraints placed on Klamath-Trinity system fall-run chinook. These harvest constraints have been in place in the ocean off northern California and southern Oregon (Klamath Management Zone or "KMZ") under the annual plan developed by the Pacific Fishery Management Council. This is shown in the greatly reduced ocean landings in the KMZ in recent years (Figure 12). The trend in the harvest rate index for Central Valley chinook stocks ("CVI", PFMC 1990) has actually increased in recent years (Figure 13). The CVI had been relatively stable from 1970 through 1982, dropped off in 1983 and 1984, then began to increase starting in 1986. The recent 4-year average CVI of 0.74 is 17% higher than the previous 16-year average of 0.63.

Habitat

Between 1850 and 1880, placer mining severely damaged spring salmon habitat in the Scott, Salmon, Trinity, Feather, Yuba, American, and Tuolumne rivers. Salmon runs were reduced to remnant levels for decades but later rebounded as silt gradually flushed from the rivers.

Water development, with its associated obstruction to migrating fish and downstream diversions, has had a greater long term impact on spring salmon. Hydroelectric dams on the Oregon portion of the Klamath River and extensive irrigated agriculture on the Shasta and Scott rivers eliminated spring salmon from these streams before the turn of the century.

More recently, the Trinity River Project severely reduced production of naturally-produced spring stocks in the Trinity River after ancestral spawning grounds were cut off in 1962, and severe flow reduction impaired natural production downstream from the dam. Natural stocks have been largely replaced by an artificially maintained population. Within the San Joaquin River drainage, dams and diversions on the Stanislaus, Tuolumne, and Merced rivers eliminated significant populations of spring salmon before the turn of the

century. The upper mainstem of the San Joaquin River, in contrast, supported good runs of spring salmon until 1948 when diversions from Friant Dam virtually dewatered the river.

Within the Sacramento River drainage, the spring salmon was eliminated from the American River in 1955 by Folsom Dam and from the Little Sacramento, McCloud, and Pit rivers by Shasta Dam in 1947. A naturally-produced run in the Feather River was replaced by an artificially-maintained run when Oroville Dam was completed in 1966. Englebright Dam on the Yuba River, constructed during the late 1930's, severely reduced the spring run in that river. Hydroelectric development on Battle Creek eliminated a big spring salmon run on that stream during the early 1900's.

Butte Creek still supports a small run of spring chinook during and following above-average water years when upstream and downstream migrants are less affected by the numerous irrigation diversions which dewater and increase the temperature of lower Butte Creek.

The mainstem Sacramento River downstream from Shasta Dam has maintained a relatively stable population of spring chinook since the 1940's. However, there is increasing evidence that hatchery practices and river spawning time and location overlap between spring and fall races are resulting in hybridization or homogenization of these races. The same may be occurring in the Feather River and Butte Creek due to straying of hatchery fish into the natural spawning areas on both streams.

Naturally-produced spring chinook still occur on Deer and Mill creeks, two Central Valley tributaries that have not been altered by large dams. Since spring chinook spawn in these two streams well upstream from fall-run chinook spawners, the stocks are less likely to hybridize. Spring chinook salmon runs in Mill and Deer creeks have seriously declined during the last decade. A series of dry years and a change in irrigation practices have resulted in much poorer flows during the April through June adult and smolt migration period. During some dry years, the lack of water may prevent adults from entering Deer or Mill creeks altogether.

Habitat damage resulting from watershed degradation has been an important problem on two spring-run chinook waters; the Trinity and South Fork Trinity rivers. On the former, the Trinity River Project has severely reduced the frequency and magnitude of flood flows needed to flush sediment from the river. As a result, a great deal of sediment has accumulated in the river channel downstream from Grass Valley Creek, (the principal contributor of the sediment) and other feeder streams. The

watershed of Grass Valley Creek is comprised of exceptionally erosion-prone soils that have been destabilized by extensive logging during and after the 1950's.

Massive landslides, triggered by storm events in 1964 and exacerbated by failing logging roads and heavily cut-over steep slopes, severely aggraded the South Fork Trinity River. Until then, the river had been the largest single producer of spring-run chinook in the Klamath system.

Water Conditions

Stream flows have a major effect on the production of spring chinook, and anadromous salmonids in general. Extremely high fall and winter flows can wash out incubating eggs or cover redds with sediment, while extremely low flows during the spring adult migration can impair or even terminate upstream migration. Low flows during the spring can also severely reduce the survival of smolts migrating downstream. The impact of low runoff on spring chinook salmon production is most significant in streams that have been modified by water development, particularly where a substantial portion of the flow is reduced by diversions. Within the Central Valley, diversions may totally dewater spring chinook salmon streams during spring and summer months, thus eliminating any holding adults or the past year's production of yearling fish. This diversion issue has been most frequently encountered in recent years on Mill, Deer, Antelope, Chico, and Butte creeks.

Within the Klamath River drainage, the primary impact of low flows on spring salmon is one of high summer temperatures within the spring chinook holding areas. Summer water temperatures frequently reach the high 70's during low runoff years in the South Fork Trinity and Salmon rivers. Such high temperatures stress the fish and can lead to high adult mortalities and low spawning success.

Floods and droughts are the factors primarily responsible for annual variations in salmon run sizes in these streams.

MANAGEMENT PROGRAMS

Resource Assessment

Spring chinook salmon counts from inland areas are collected annually by snorkel, carcass, redd and weir surveys. Actual run size enumerations are made at hatchery and dam ladders. These activities involve personnel from Regions 1 and 2 and Inland Fisheries Division. Survey cooperators include the U.S. Fish and Wildlife Service, the U.S. Forest Service, U.C. Davis, and California State University, Chico. These are ongoing surveys and have a high priority in terms of Department

funding. The information collected in the surveys is used not only for resources assessment purposes, but also for evaluating the success of management activities, such as downstream trucking of hatchery fish and regulation of ocean or in-river fisheries.

Habitat Restoration

The Department of Fish and Game has ongoing and newly developed habitat restoration programs and management programs designed specifically for spring-run chinook. There are also a wide variety of other Department activities, often identified only as salmon restoration, that benefit spring chinook. Activities of general benefit to spring-run chinook include enforcement of laws and regulations affecting direct and indirect users of the resource, installation and maintenance of many water diversion screens and fish ladders throughout the State, review of proposals and plans potentially affecting spring-run chinook habitat, response to the public and media about resource questions and issues, and coordination with the various entities whose activities in the watershed or use of water potentially affect spring-run chinook production.

Sacramento River System

The Department, in cooperation with the Department of Water Resources, is developing alternate sources of water for Mill and Deer creeks' water users during critical salmon migration periods. Several wells have been developed on Mill Creek. Department efforts during the Federal Energy Regulatory Commission relicensing process have resulted in the expansion of spawning and rearing habitat in Butte Creek above the Centerville Powerhouse where P.G.&E. must now bypass 30 cfs below their diversion dam for fish. This stream reach, which had been dewatered for many years, will now be available for salmon holding and spawning. Several screens and ladders are maintained on Butte Creek, and Region 2 performs fish salvage operations during dry years.

On Chico Creek, the Department chemically treated the stream to remove nongame fish species in 1989. Spring-run chinook fry are being stocked annually and the stream is being managed for anadromous rather than resident salmonid production. Because of heavy pumping at the mouth of the creek, downstream migrants are being trapped and trucked to downstream release sites.

On the Yuba River, the Hallwood-Cordua canal is being annually screened to prevent loss of juvenile salmon, including spring run. Attempts are also being made to increase maintenance flows down the river; this would benefit all races of salmon.

Klamath River System

In order to preserve fisheries and other values within the Klamath River drainage, the river and major tributaries such as the Trinity River and its South Fork and the Salmon River were added to the National Wild and Scenic River System. The designation prohibits additional water development.

On the mainstem Trinity River, an extensive fisheries restoration program, aimed at benefiting both races of chinook salmon, is underway. The program involves the Bureau of Reclamation, Fish and Wildlife Service, Forest Service, Bureau of Land Management, Bureau of Indian Affairs, Indian tribal organizations, Department of Water Resources, and the Department. Several million dollars have been spent to correct the problems created by the Trinity River Project, and many more projects are scheduled to be implemented in the near future. Thus far, stream flow releases have been increased below Lewiston Dam and spawning gravels have been restored above the mouth of Grass Valley Creek. In order to control sediment production from Grass Valley Creek, several sediment traps are being operated on this stream and a reservoir is under construction. In addition, sediment has been dredged from the mainstem Trinity and adult holding pools have been excavated. Also, new concrete rearing ponds and other improvements have been added to Trinity River Hatchery. Additional habitat improvement projects on line for the Trinity include more spawning riffles, habitat improvement structures, and additional watershed restoration work. Studies are currently being conducted to determine stream flow needs below Lewiston Dam. Increased spring chinook salmon return to the Trinity River in some years are partly attributable to these efforts.

The South Fork Trinity River which prior to 1964 supported a very large spring chinook run, now supports only a remnant population. The decline in the fishery is largely due to massive watershed deterioration. The Department of Fish and Game (DFG) and U.S. Forest Service (USFS) are actively pursuing a program to restore the South Fork drainage. Currently, problems in the watershed are being identified and documented and initial steps are being taken to stabilize portions of the drainage, particularly logging roads. After major fires burned through the area in 1987, a watershed recovery program involving revegetation and construction of erosion control structures was initiated. Proposed timber sales within unusually unstable watersheds or excessively disturbed subdrainages have been indefinitely deferred. State and federal agencies are proceeding also with a program to improve anadromous fish habitat in tributary streams. Proposals for spawning gravel improvement in the mainstem of the South Fork are under consideration.

The Salmon River currently supports the largest naturally-maintained spring chinook run in the Klamath system.

In order to preserve fisheries and other values, several tributaries, mostly of Wooley Creek, and the head waters of the North and South forks of the Salmon River were added to the National Wilderness Preservation System as part of the California Wilderness Act of 1985. This latter action precludes road construction and logging in steep and sensitive headwater areas.

During 1987, many acres of the Salmon River drainage were burned by wildfires. In response to this situation, the Klamath National Forest, with DFG review and consultation, developed a large-scale fire salvage and recovery plan. It involved the establishment of numerous erosion control structures, sediment traps, grass seeding, riparian vegetation reestablishment, and extensive tree planting. Much of the work was completed by the end of 1989. Currently little damage has occurred to fisheries habitat stemming from the fires. This was due, in part, to the recovery effort, and the occurrence of only moderate storms and runoff since 1987.

During the 1980's an extensive program of salmon habitat improvement was conducted in the Salmon River drainage by the USFS with DFG funding. Spring-run chinook primarily benefited from the work. As of 1990, 412 boulder and rootwad structures have been emplaced in the South Fork Salmon upstream from Cecilville and 90 structures have been completed on the East Fork Salmon. These include, in addition to boulder clusters, hydraulic deflectors and weirs to improve spawning and nursery habitat. Fish passage on the South Fork Salmon River has been improved over the years by removal of barriers to adult migration. During the 1950's, several mining dams were removed from the stream by blasting. More recently, several rock barriers, which were partial obstacles to migrating adults, were modified by blasting. During the late 1980's, two large tributaries to the Salmon River, Knownothing and Nordheimer creeks, were made accessible to salmon. An old dam was removed on the former stream, while a fish ladder was constructed on the latter stream. Spawning salmon have been observed in both streams. Fall-run salmon pond rearing facilities have been proposed for the Little North Fork and upper South Fork of the Salmon. These facilities might be available for future rearing of spring chinook; however, past attempts to hold adults in captivity for egg collection have not been successful. The increased spring-run chinook escapements into the Salmon River in recent years is believed in part to be the result of management activities in the drainage in recent years. This is most noticeable in the South Fork where most of the emphasis has been placed. The South Fork counts have been: 163 (1980),

272 (1981), 365 (1982), 429 (1985), 515 (1986), 443 (1987), and 650 (1988). No such increase has been noted for the North Fork where no habitat work has been performed.

Artificial Propagation

Spring-run chinook are spawned and reared as distinct stocks of chinook at the Feather and Trinity river hatcheries (FRH and TRH). The adult spawning escapement goals for these facilities are 2,000 and 3,000 fish, respectively. Annual spring chinook runs have averaged 2,400 adults and ranged from 800 to 7,200 fish since 1980 at FRH. The TRH runs during the same period averaged 4,730 fish and ranged from 500 to 13,900 fish. The runs at both facilities have been increasing (Figures 2 and 3). Spring chinook production at TRH has ranged from 1 to 4 million juveniles, while juvenile production at FRH has ranged from 2 to 3 million in these same years.

CONCLUSIONS

Self-sustaining runs of spring chinook are a small fraction of their historic levels; those runs that are stable or increasing are generally those that are affected by artificial propagation. The only natural stock that appears to be stable or increasing is the South Fork Salmon River run. The others appear to be at dangerously low levels and either stable or declining. Care must be taken to not allow hatchery stocks to mix with the few remaining "wild" fish on the spawning grounds. This is because the run timing of the hatchery fish is becoming similar to that of the fall-run chinook in the same areas. It is also apparent that action programs must be accelerated to reverse the declining trend in abundance of the spring chinook stocks of Mill and Deer creeks and the South Fork Trinity and Salmon rivers.

LITERATURE CITED

CFGC (California Fish and Game Commission). 1885. Biennial report of the Fish and Game Commission, 1883-1884. Calif. Dept. Fish and Game, Sacramento, 95814.

Fry, D.H.,Jr. 1961. King salmon spawning stocks of the California Central Valley, 1940-1959. Calif. Fish and Game, 47(1):55-71.

Moyle, P. B., J.E. Williams, and E.D. Wikkramanayake. 1989. Fish species of special concern of California. Final report to the Calif. Dept. of Fish and Game, Sacramento, 95814. 222 p.

Snyder, J.O. 1931. Salmon of the Klamath River. Calif Dept. Fish and Game, Fish Bull. 34. 130 p.

USFWS (U.S.Fish and Wildlife Service). 1990. Klamath-Trinity river basin spring chinook salmon stock evaluation and run-size forecast. USFWS, Fish. Assist. Office, Arcata 95521. 29 p.

Table 1. Former Spring Chinook Salmon Producing Streams

	Relative Size of Historic Run
Sacramento River Drainage:	
Above Shasta Dam:	
McCloud River	A
Pit River including Hat Creek	A
Little Sacramento River	A
Above Stoney Gorge Dam	
Stoney Creek	C
Cow Creek Tributaries (numerous Diversions)	C
Above Oroville Dam	
North Fork Feather River	A
Middle Fork Feather River	B
South Fork Feather River	B
West Branch Feather River	B
Thomas Creek	C
Above Englebright Dam	
Middle and South Forks Yuba River	B
North Fork Yuba River	A
Above Folsom Dam	
South Fork American River	A
North and Middle Forks American River	A
San Joaquin River Drainage:	
Above Don Pedro Dam	
Tuolumne River	A
Above Friant Dam	
San Joaquin River	A
Above Melones Dam	
Stanislaus River	A
Klamath River Drainage:	
Above Copco Dam	
Sprague River (Oregon)	A
Williamson River (Oregon)	A
Shasta River (Numerous diversions)	A
Scott River (Numerous diversions)	A
Above Trinity Dam	
Stuart Fork, Trinity River	B
East Fork Trinity River	B
Coffee Creek	B
Upper Trinity River (above Lewiston)	A

Legend:

A = Probably more than 5,000 adults
B = Probably 1,000 to 5,000 adults
C = Probably less than 1,000 adults

Table 2. California Streams Currently Supporting Spring Chinook Salmon

Sacramento River Drainage	1980–89 Mean Run Size
Battle Creek	few
Antelope Creek	few
Cottonwood (Beegum) Creek	few
Mill Creek	400
Deer Creek	600
Chico Creek	8
Butte Creek	500
Yuba River	200
Clear Creek (Sacramento)	few
Sacramento River	11,700 (hybridized)
Cow Creek	few
Feather River	1,400 (hatchery origin)
Klamath River Drainage:	
Elk Creek	few
Indian Creek	few
Clear Creek	few
Mainstem Salmon River	220
North Fork Salmon River	80
South Fork Salmon River	280
East Fork South Fork Salmon River	few
Wooley Creek	20
South Fork Trinity River	115
New River	12
North Fork Trinity River	9
Hayfork Creek	few
Canyon Creek	44
Mainstem Trinity River	16,900 (mostly hatchery origin)

Table 3. Recent Population Trends in Naturally Maintained, Largely Pure Spring Chinook Salmon Stocks

	Deer Creek	Mill Creek	Salmon River[1/]	South Fork Trinity[1/]
1970	2,000	1,500	—	100+
1971	1,500	1,000	—	98
1972	400	500	—	13
1973	2,000	1,700	—	2
1974	3,500	1,500	—	53
1975	8,500	3,500	—	299
1976	—	—	—	342
1977	467	563	—	—
1978	1,200	925	—	—
1979	—	—	—	301
1980	1,500	500	—	25
1981	—	—	256	—
1982	1,500	700	285–400	166
1983	400	200	565	—
1984	—	—	—	—
1985	300	121	—	275
1986	543	62	453–580	183
1987	291	90	613–743	—
1988	—	572	1,003	59
1989	81	563	250	7
1990	123	844		
1991	149	319		
1992	300	237		

[1/] Instantaneous estimate of fish present in the entire index area based on snorkel surveys.

Table 4. Estimates of Yurok and Hoopa Valley Reservation Indian gillnet harvest, 1977-1989. a/

Year	Area	Chinook Salmon (numbers of fish)					
		Spring Race			Fall Race		
		Jack	Adult	Total	Jack	Adult	Total
1977	Total	b/	b/	b/	2,700	27,300	30,000
1978	Total	b/	b/	b/	1,800	18,200	20,000
1979	Total	b/	b/	b/	1,350	13,650	15,000
1980	Total	20	980	1,000	987	12,013	13,000
1981	Estuary	21	1,320	1,341	912	23,097	24,009
	Resighinni	0	16	16	338	4,293	4,631
	Upper Klamath	19	381	400	766	4,112	4,878
	Trinity River	17	1,090	1,107	449	1,531	1,980
	Total	57	2,807	2,864	2,465	33,033	35,498
1982	Estuary	3	172	175	290	4,547	4,837
	Resighinni	11	789	800	368	3,551	3,919
	Upper Klamath	21	1,479	1,500	827	4,873	5,700
	Trinity River	10	715	725	314	1,511	1,825
	Total	45	3,155	3,200	1,799	14,482	16,281
1983	Estuary	1	59	60	12	800	812
	Middle Klamath	3	322	325	32	2,626	2,658
	Upper Klamath	1	129	130	89	3,074	3,163
	Trinity River	5	75	80	30	1,390	1,420
	Total	10	585	595	163	7,890	8,053
1984	Estuary	2	53	55	132	11,878	12,010
	Middle Klamath	8	147	155	81	2,807	2,888
	Upper Klamath	2	47	49	102	2,815	2,917
	Trinity River	0	380	380	140	1,170	1,310
	Total	12	627	639	455	18,670	19,125
1985 c/	Estuary	29	580	609	132	5,700	5,832
	Middle Klamath	6	184	190	283	1,731	2,014
	Upper Klamath	10	310	320	193	2,194	2,387
	Trinity River	115	1,000	1,115	947	1,941	2,888
	Total	160	2,074	2,234	1,555	11,566	13,121
1986 c/	Estuary	1	40	41	191	15,286	15,477
	Middle Klamath	3	164	167	176	2,501	2,677
	Upper Klamath	10	488	498	201	1,532	1,733
	Trinity River	81	2,022	2,103	586	4,808	5,394
	Total	95	2,714	2,809	1154	24,127	25,281
1987	Estuary Commercial	0	0	0	0	29,040	29,040
	Estuary Subsistance	23	786	809	36	10,938	10,974
	Middle Klamath	5	171	176	30	5,079	5,109
	Upper Klamath	20	689	709	87	3,057	3,144
	Trinity River	122	4,146	4,268	262	4,982	5,244
	Total	176	5,792	5,962	415	53,096	53,511
1988	Estuary Commercial	0	0	0	0	25,782	25,782
	Estuary Subsistance	8	1,669	1,677	138	11,132	11,270
	Middle Klamath	0	710	710	36	6,252	6,288
	Upper Klamath	0	539	539	137	3,415	3,552
	Trinity River	84	2,727	2,811	267	5,070	5,337
	Total	92	5,645	5,737	578	51,651	52,229

Table 4. Estimates of Yurok and Hoopa Valley Reservation Indian gillnet harvest . . . (continued).

Year	Area	Chinook Salmon (numbers of fish)					
		Spring Race			Fall Race		
		Jack	Adult	Total	Jack	Adult	Total
1989	Estuary Commercial	0	206	206	0	27.504	27.504
	Estuary Subsistance	0	644	644	0	9.626	9.626
	Middle Klamath	0	2.008	2.008	65	3.108	3.173
	Upper Klamath	0	1.887	1.887	55	1.853	1.908
	Trinity River	20	1.978	1.998	71	3.474	3.545
	Total	20	6.723	6.743	191	45.565	45.756

a/ USFWS estimates for 1977-1982 and for Klamath River portion in 1983-1989. The Hoopa Valley Business Council has monitored the Trinity River fishery since 1982.

b/ No estimate.

c/ Does not include fall chinook harvested under special ceremonial permit.

Table 5. Estimate of Spring Chinook Landings in the Sport Fisheries of the Upper Sacramento and Trinity rivers 1975-88.

	Upper Sacramento River	Trinity River
1975	469	–
1976	888	–
1977	277	–
1978	234	–
1979	44	–
1980	234	424
1981	370	2,156
1982	282	756
1983	77	---
1984	374	414
1985	–	863
1986	–	4,171
1987	–	9,361
1988	___	8,840

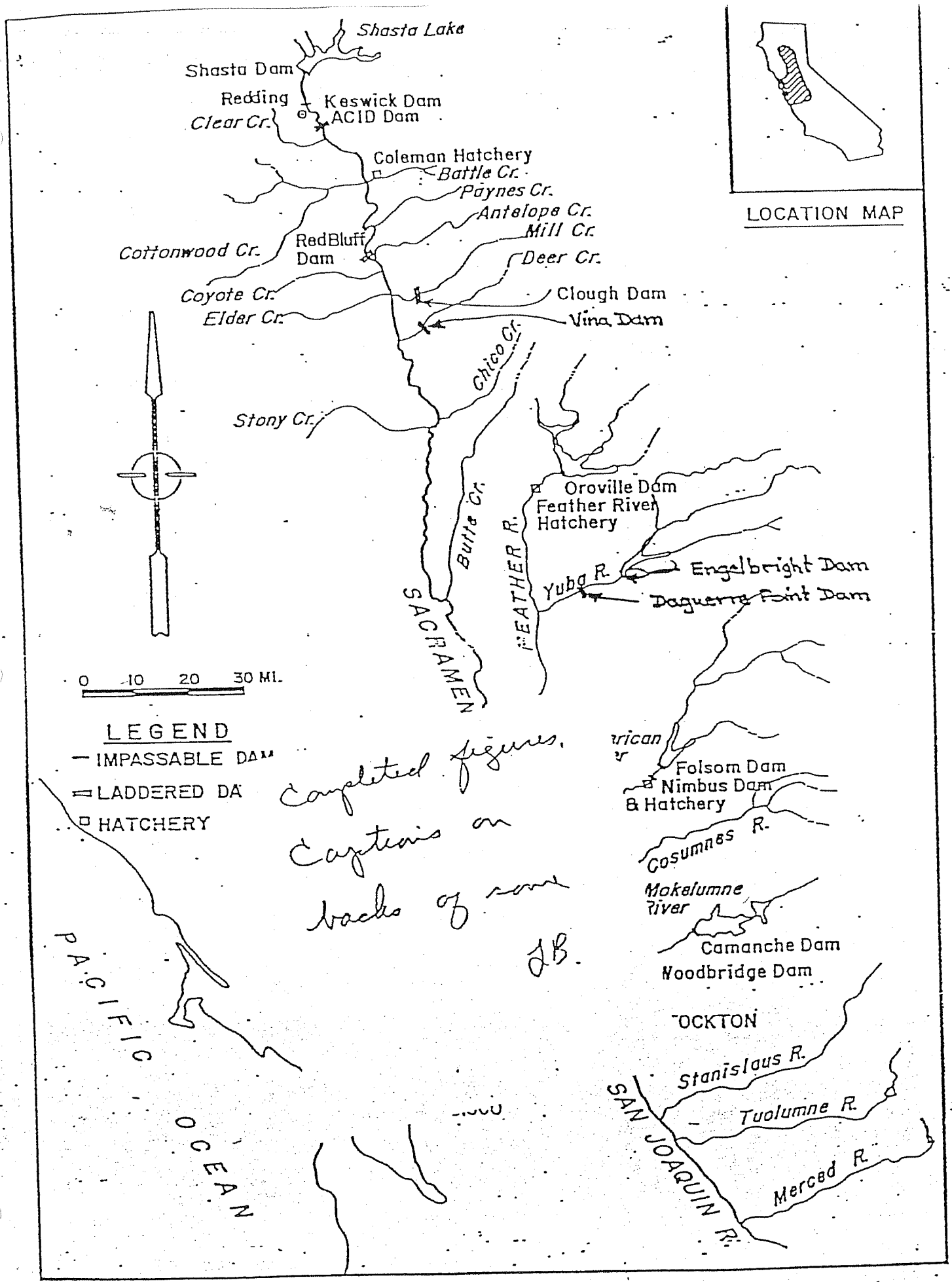


FIGURE 1. Central Valley Location Map

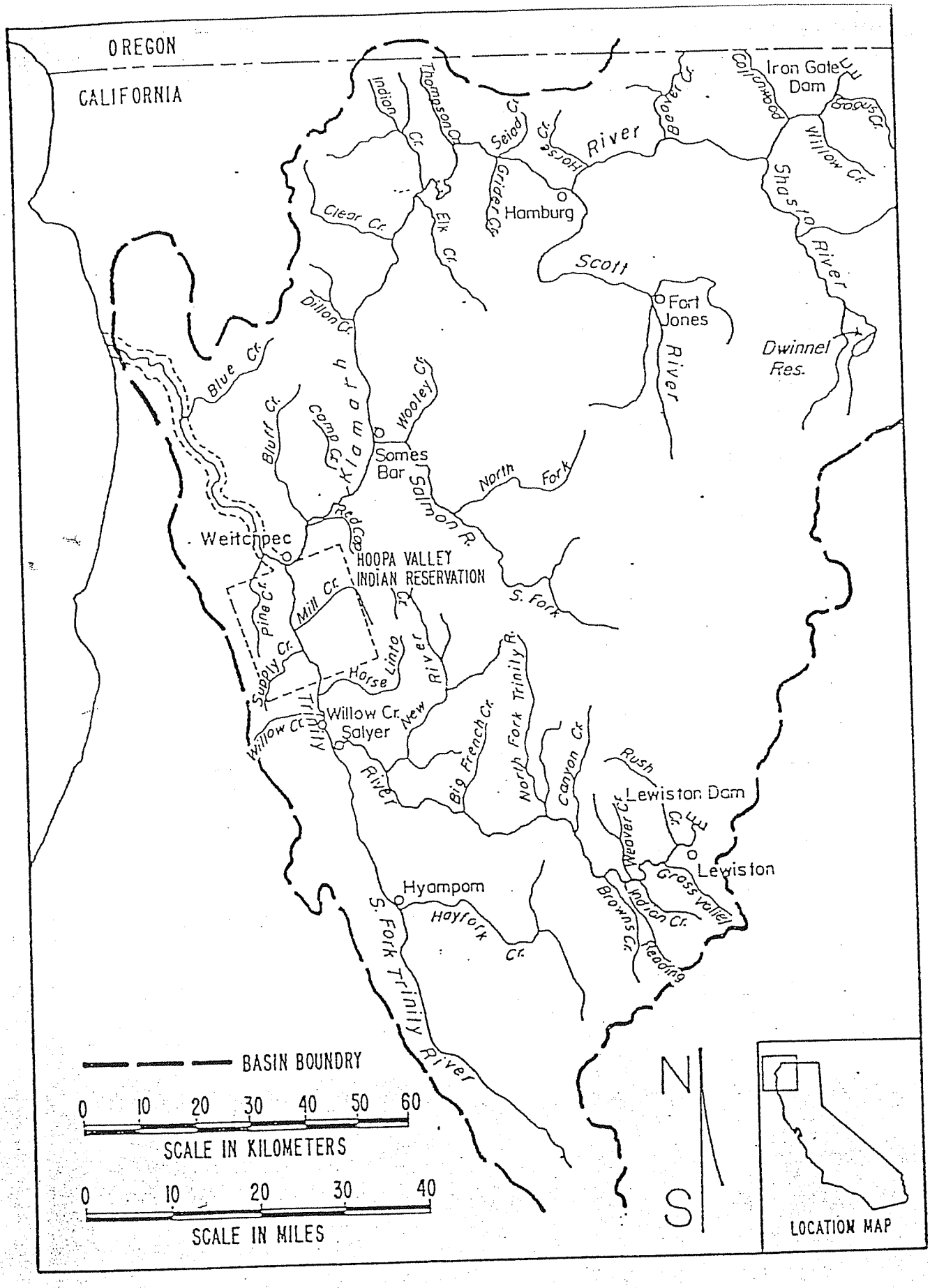


Figure 2. Klamath River Basin Location Map

Figure 3. Trinity River Hatchery Spring-run Chinook Salmon Counts, 1973-1989

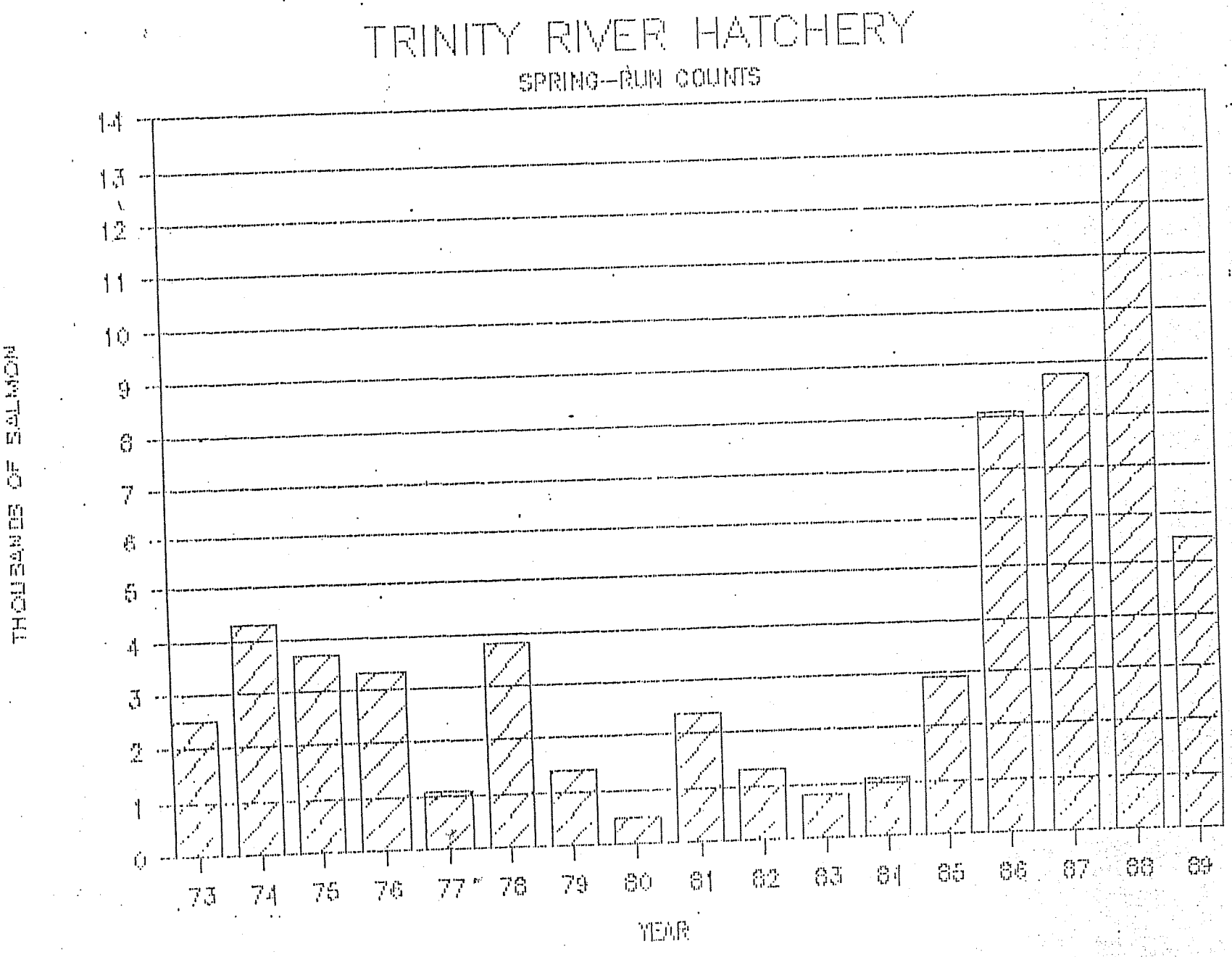


Figure 4. Spring-run chinook salmon counts for the Feather River Hatchery, 1967-1989

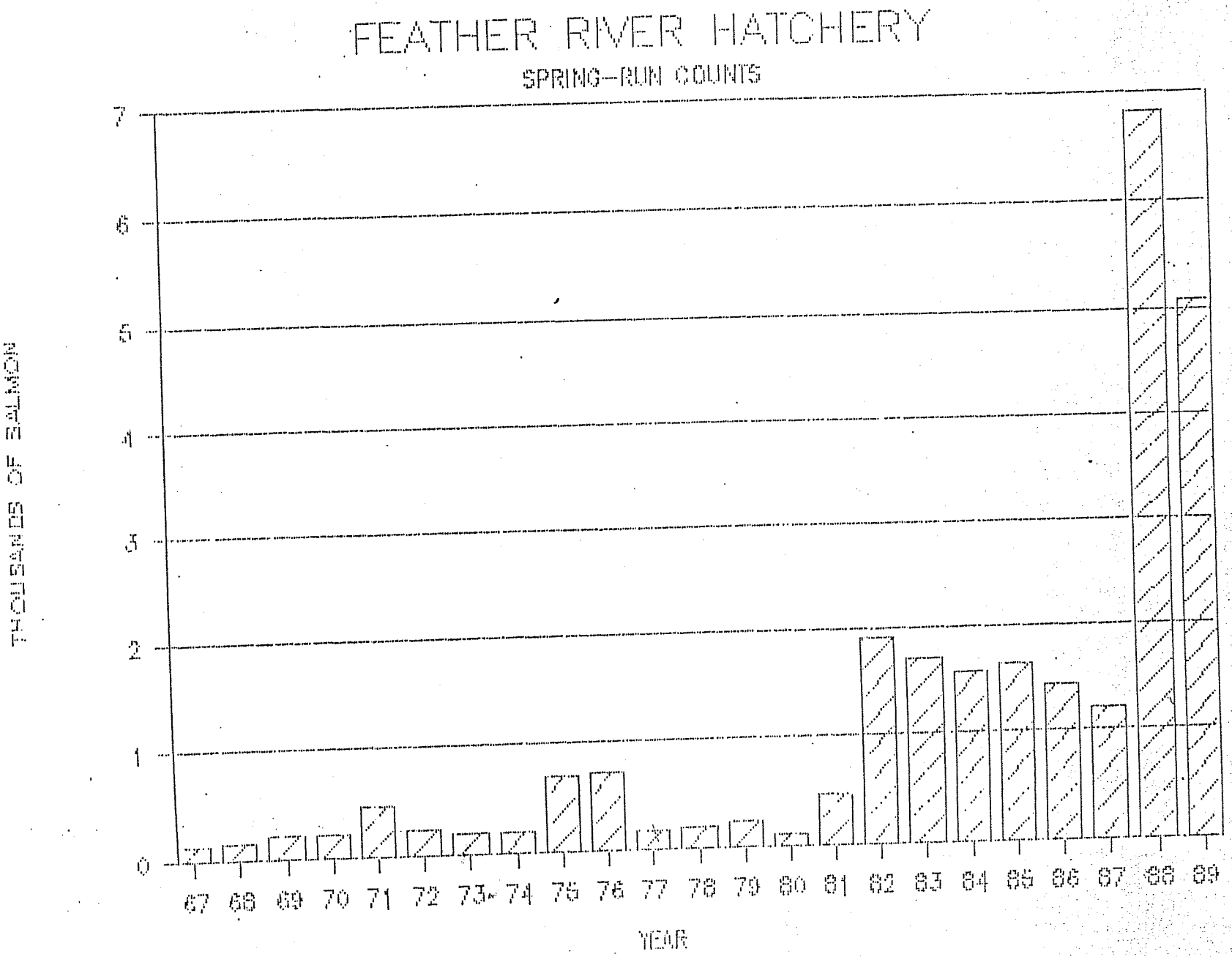


FIGURE 5 Spring-Run Chinook Counts at Red Bluff Division Dam.

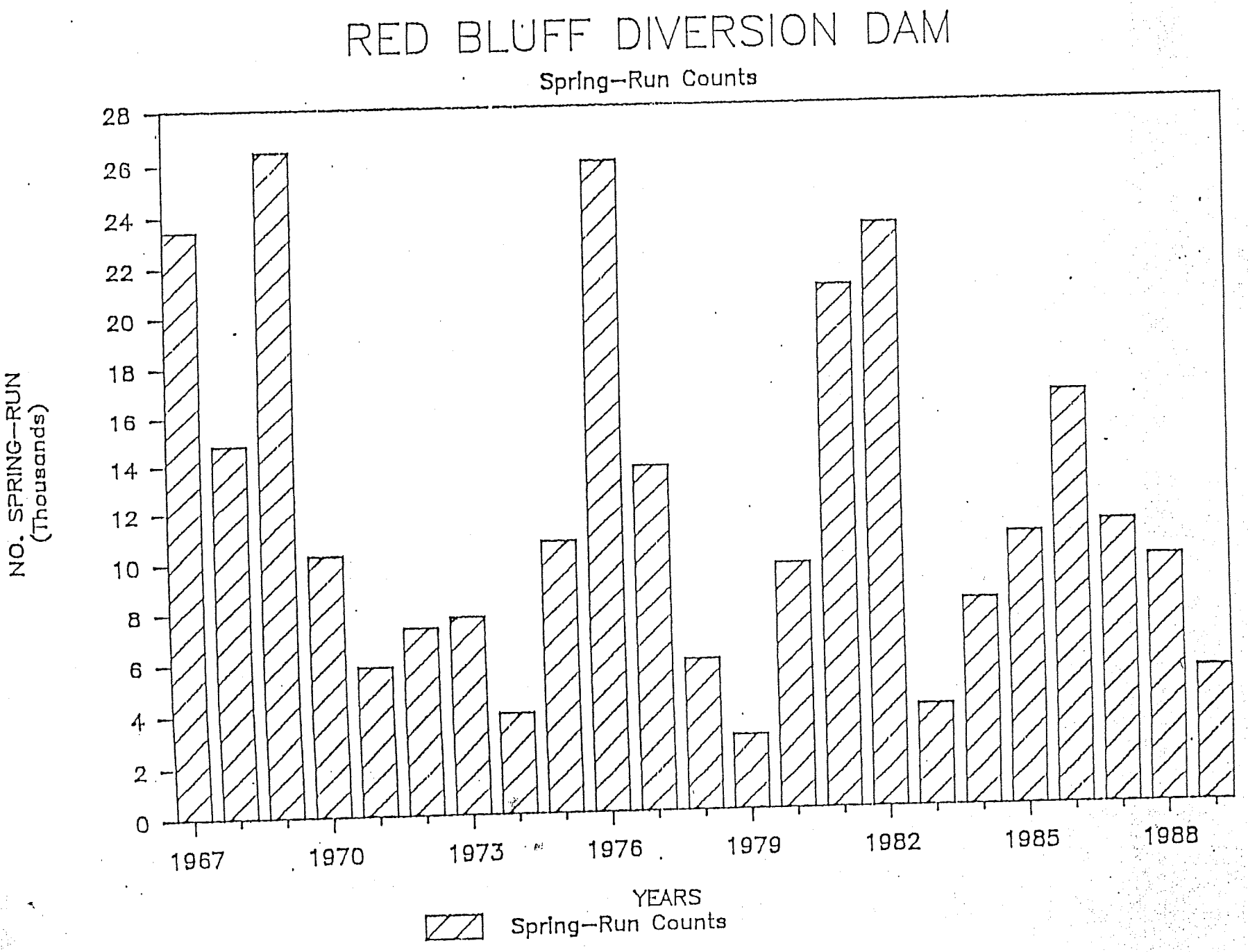
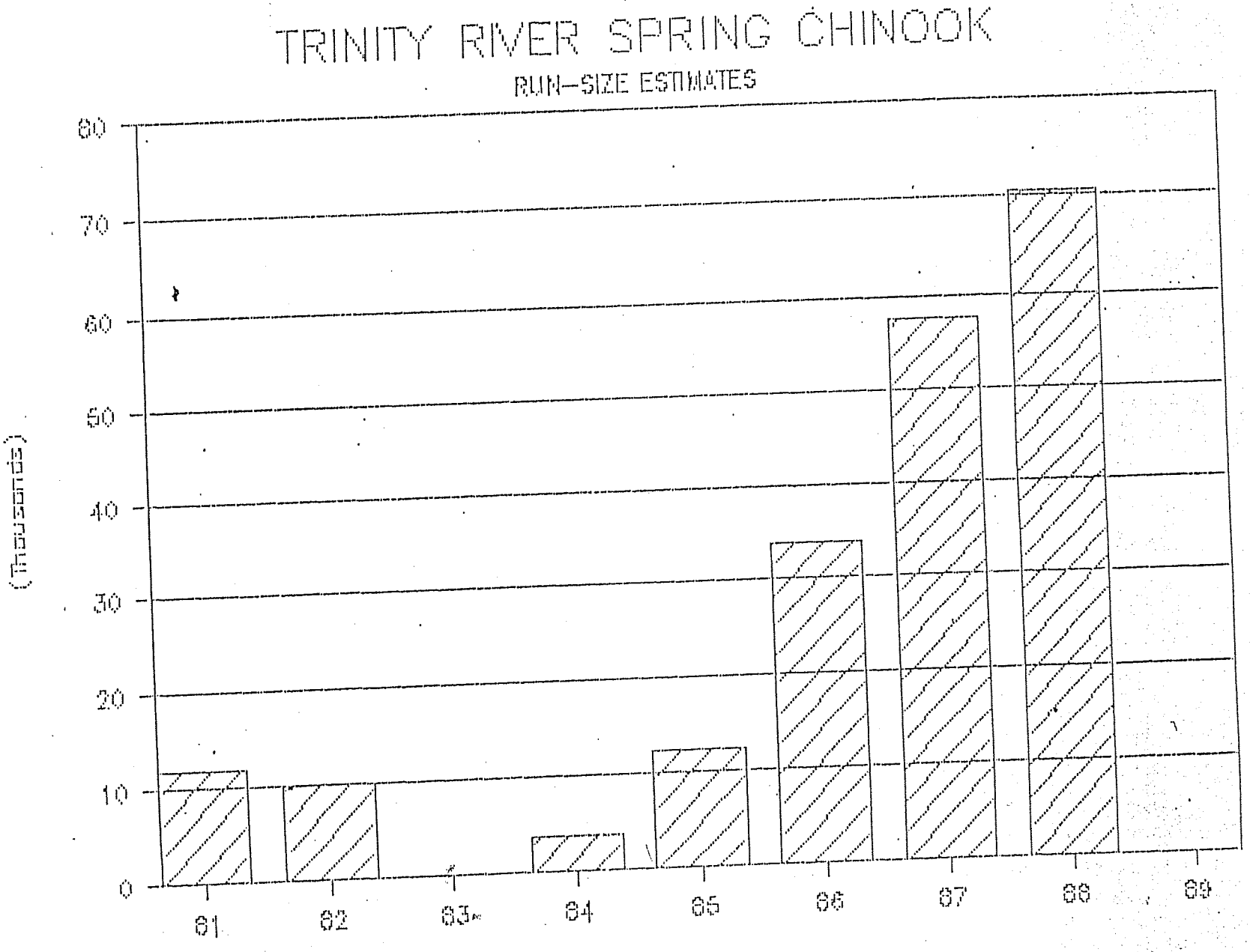


Figure 6. Spring-run chinook salmon run-size estimates for the Trinity River, 1981-1988



FIGUR 7. Spring-Run Chinook Counts at Mill Creek.

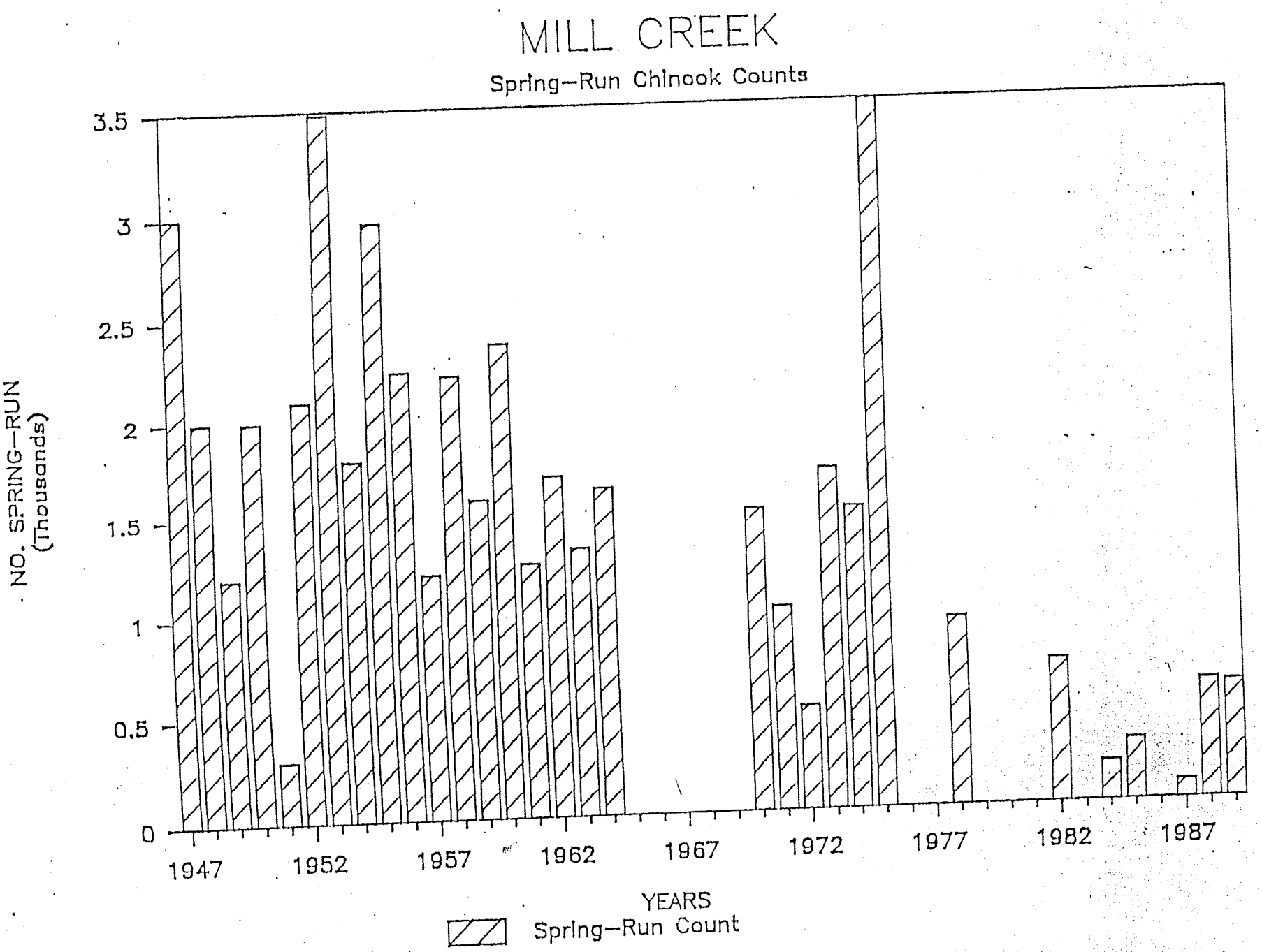


FIGURE 8. Spring-Run Chinook Counts at Deer Creek.

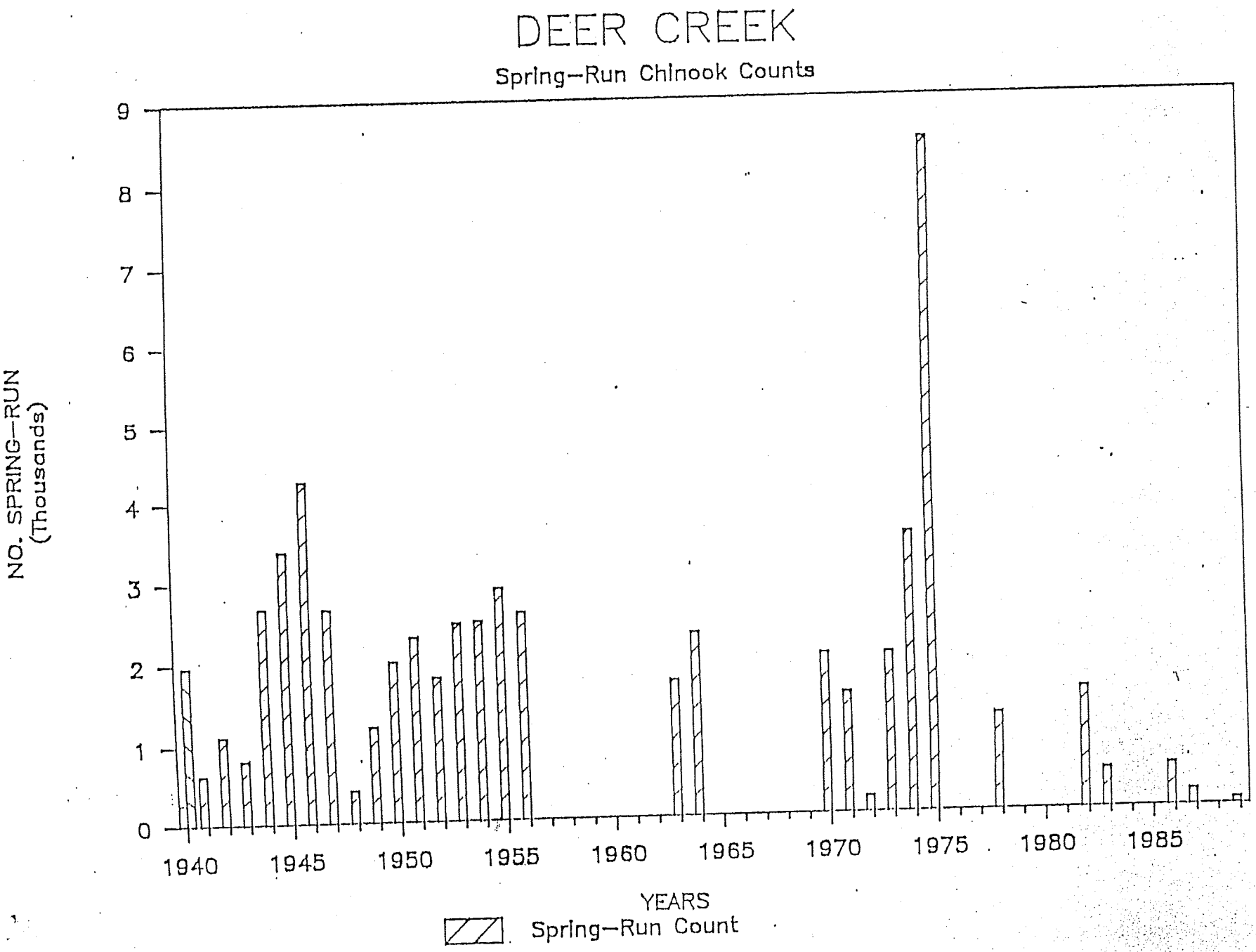


Figure 9. Spring-run chinook salmon index area counts for the Salmon River, 1981-1989

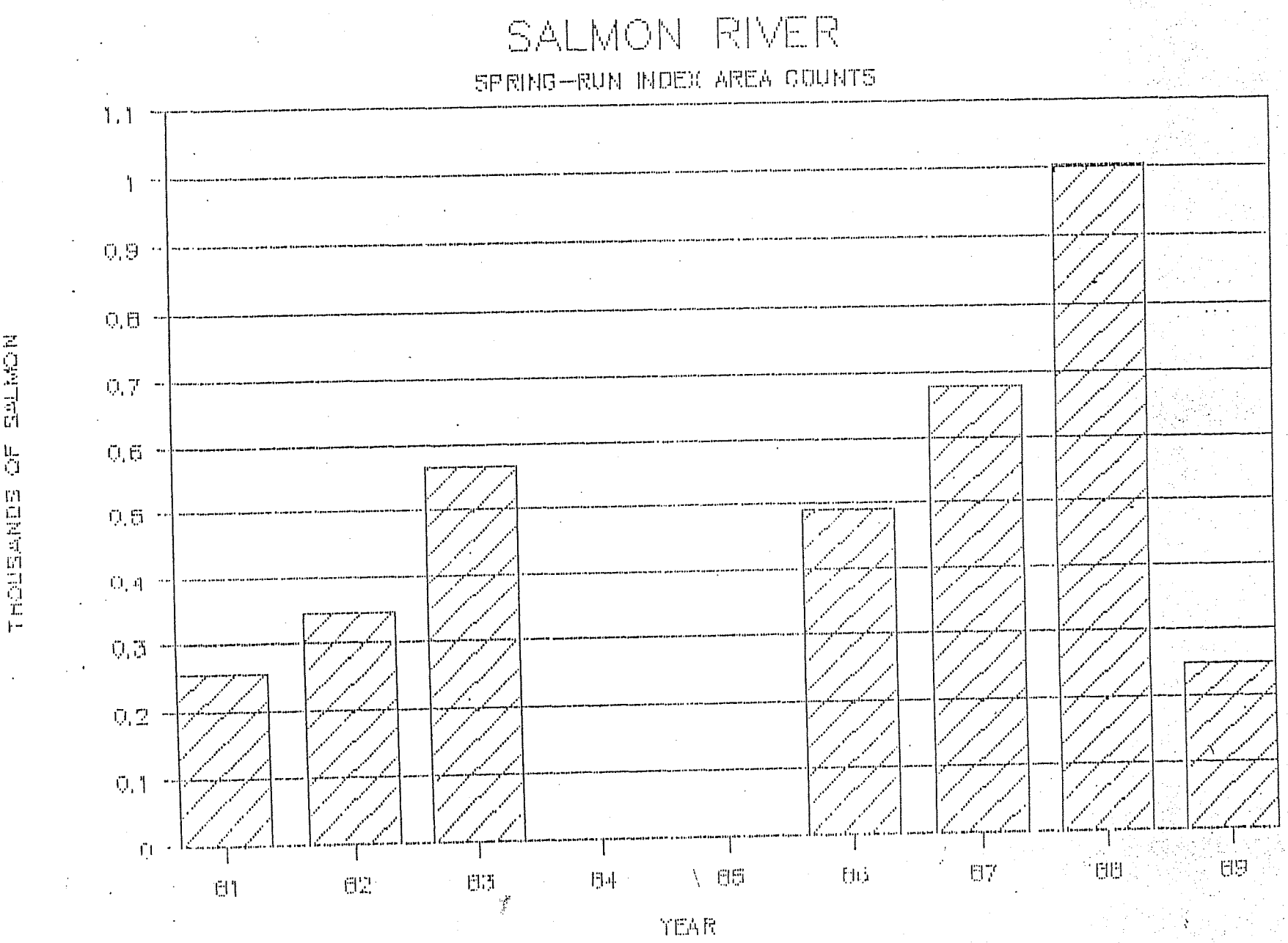
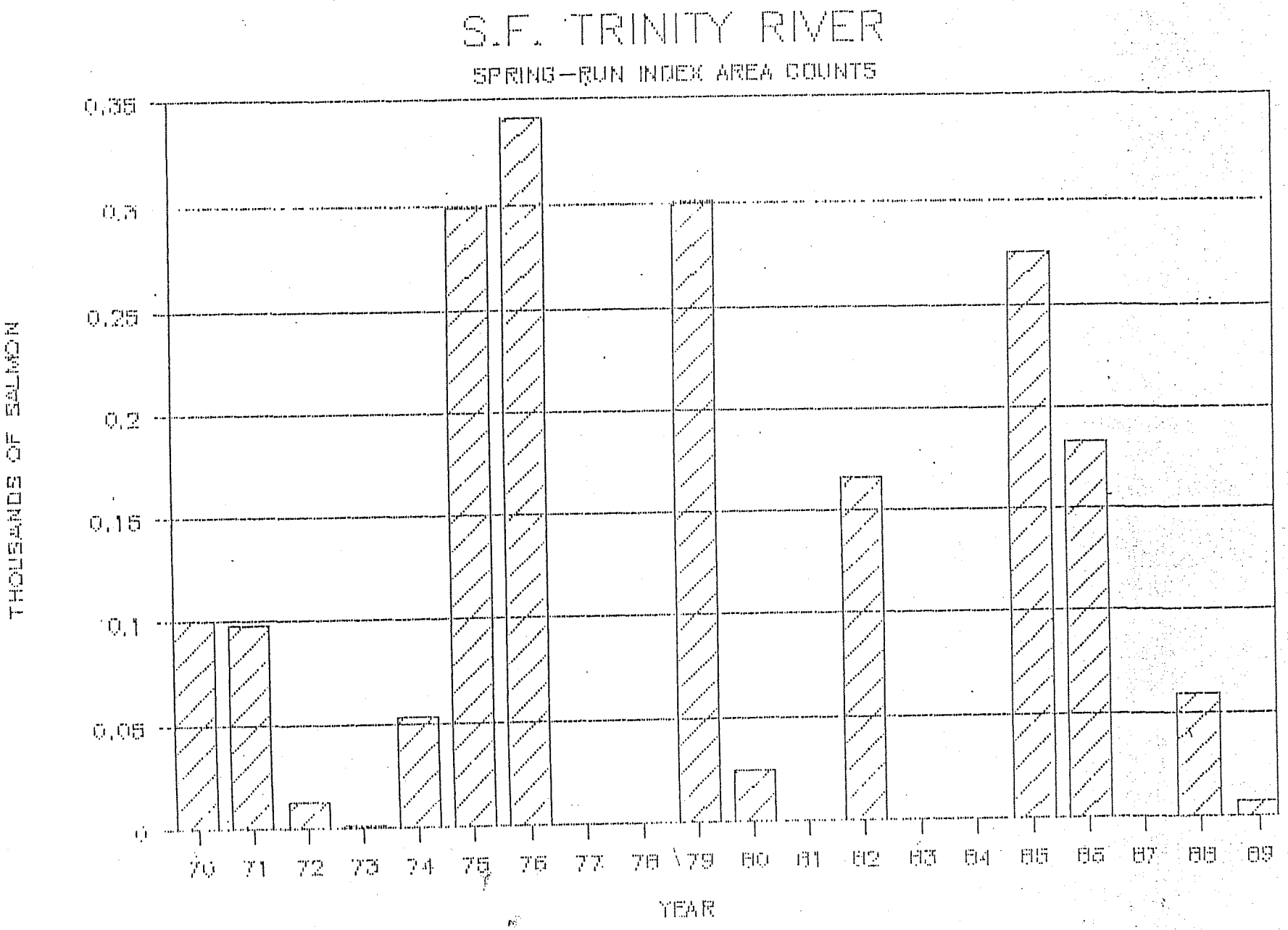


Figure 10. Spring-run chinook salmon index area counts for the South Fork Trinity River, 1970-1989



CHINOOK MANAGEMENT AREAS (PFMC)

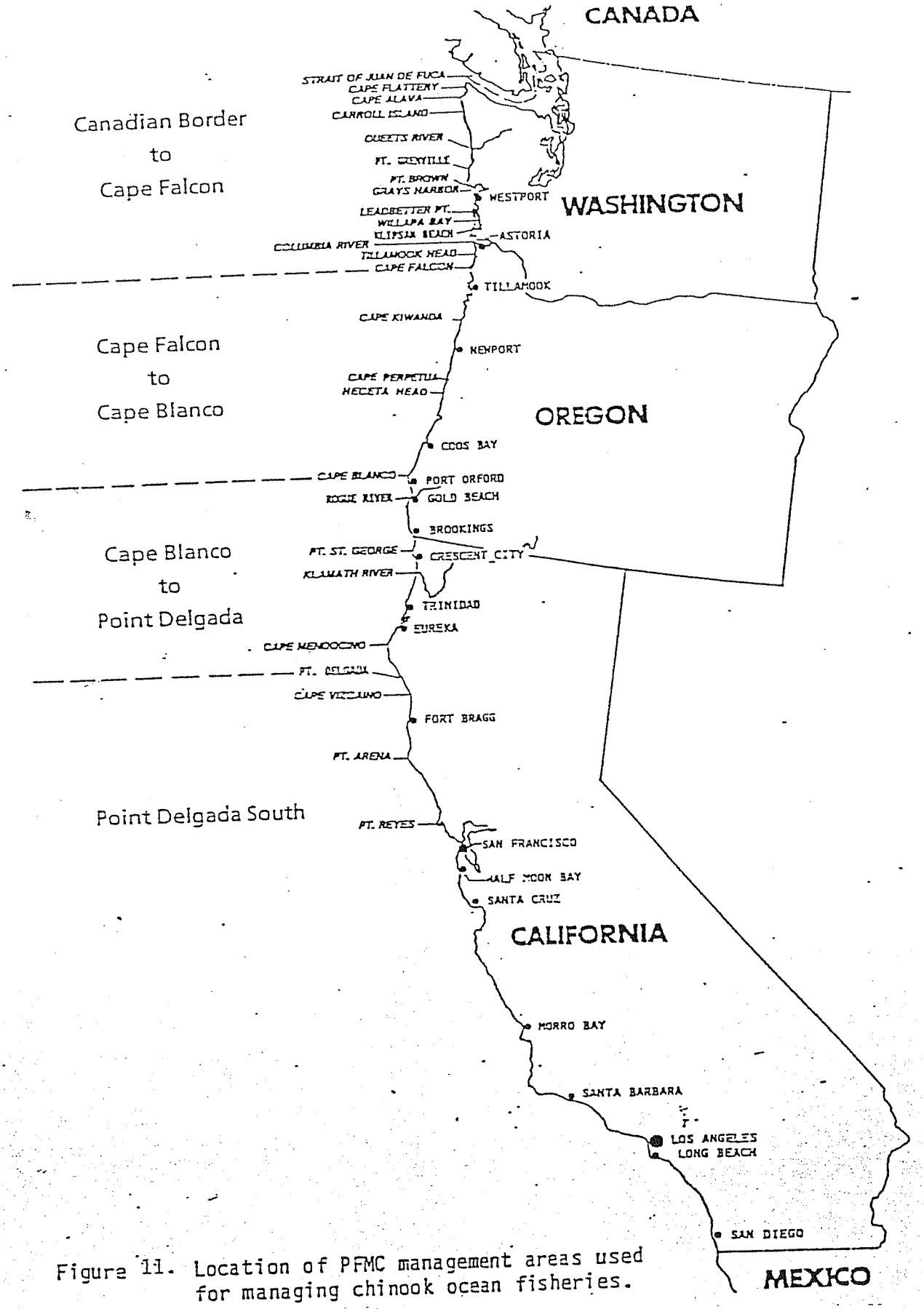


Figure 11. Location of PFMC management areas used for managing chinook ocean fisheries.

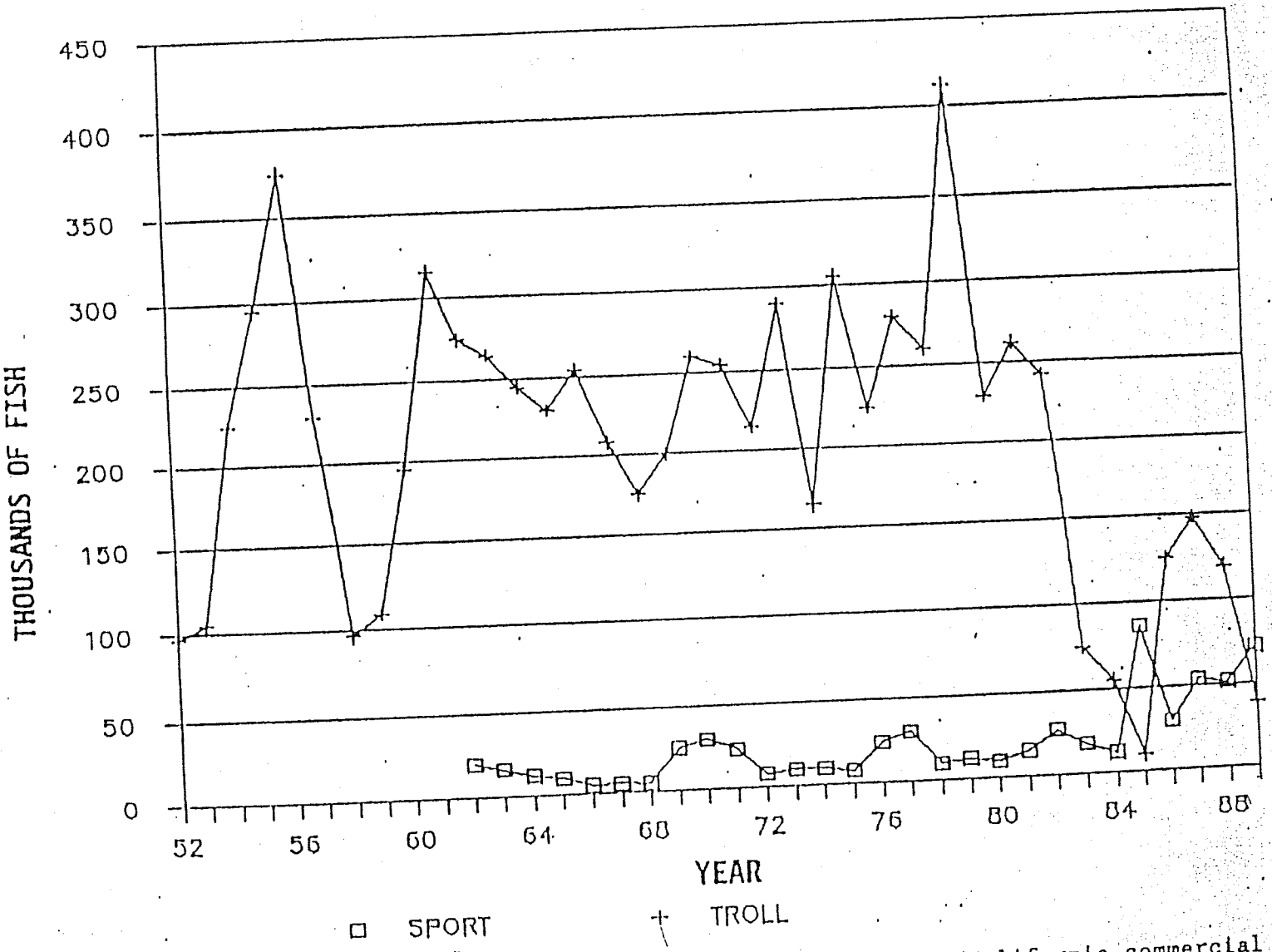


Figure 12. Ocean chinook harvest from the KMZ, 1952-1989. (California commercial harvest for 1952-1985 and Oregon commercial harvest for 1952-1979 are by port of landing while the California commercial harvest for 1986-1989 and the Oregon harvest for 1980-1989 is for the area of catch.)

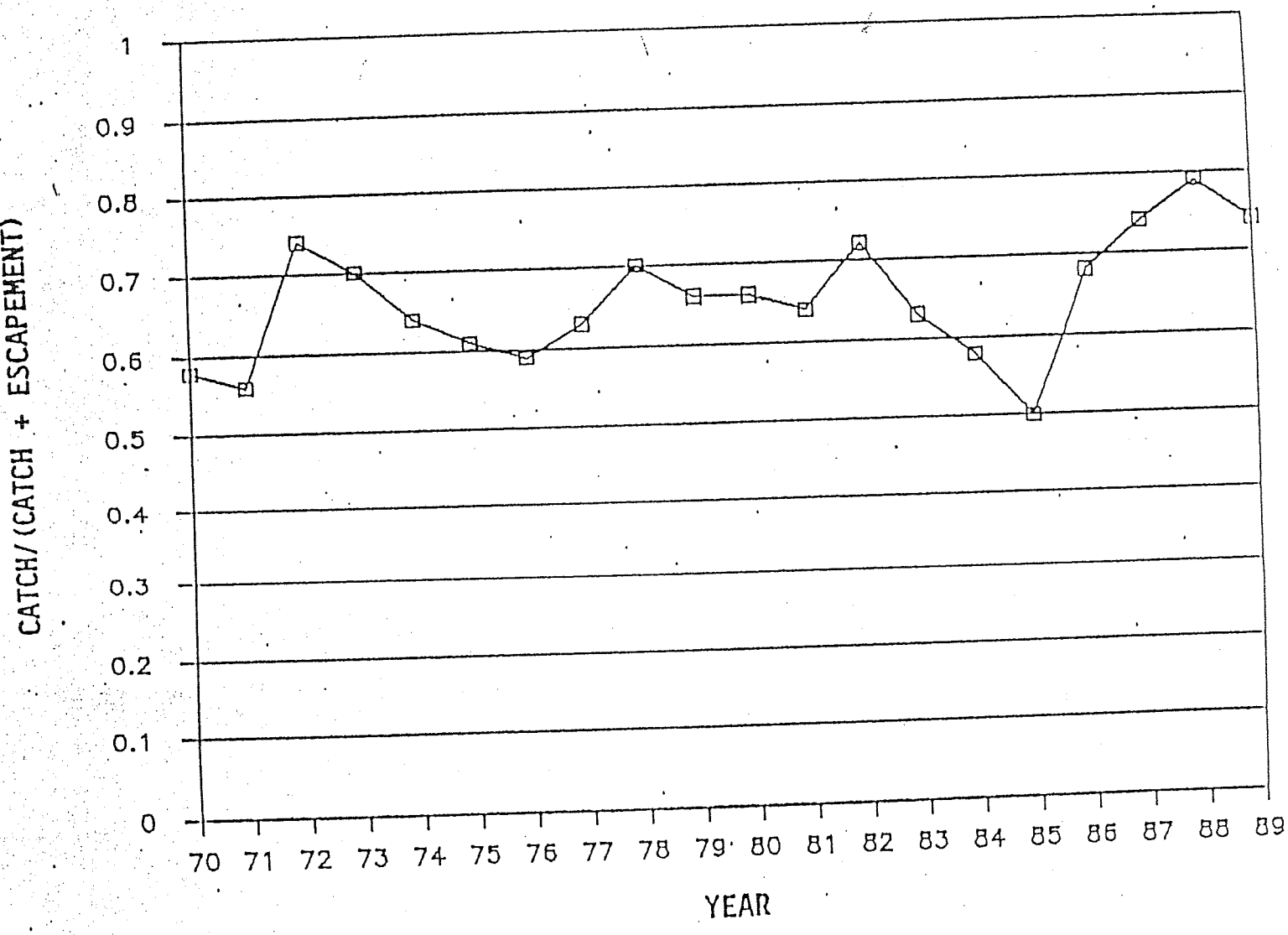


Figure 13. Central Valley chinook salmon harvest rate index, 1970-1989.

APPENDIX TABLE 1. Adult Spring-Run Chinook Counts and Population Estimates. a*

Year	SACRAMENTO RIVER River	RBDD	Mill Creek	Deer Creek	Big Chico Creek	Butte Creek	FEATHER RIVER River	Hatchery	Yuba River	San Joaquin River
1940	b*		b*	268						
1941	b*		b*	635						
1942	b*		b*	1,108						35,000
1943	b*		b*	812	b*	b*	b*			5,000
1944	10,000		b*	2,692	b*	b*	b*			56,000
1945	3,000		b*	3,363	b*	b*	b*			30,000
1946	26,000		b*	4,272	b*	b*	b*			6,000
1947	25,000		3,000	2,669	b*	b*	b*			2,000
1948	9,000		2,000	419	b*	b*	b*			
1949	7,000		1,200	1,200	b*	b*	b*			b
1950	18,000		2,000	2,000	b*	b*	b*			0
1951	5,000		300	2,300	b*	b*	b*			0
1952	7,000		2,100	1,800	b*	b*	b*			0
1953	8,000		3,485	2,475	b*	b*	b*			0
1954	9,000		1,789	2,500	b*	b*	3,000			0
1955	17,000		2,967	2,900	b*	b*	1,000			0
1956	7,000		2,233	2,600	b*	3,000	2,000			0
1957	b*		1,203	b*	b*	2,192	1,000			0
1958	b*		2,212	b*	1,000	1,100	3,000			0
1959	b*		1,580	b*	200	500	4,000			
1960			2,368			6,700				
1961			1,245			3,100				
1962			1,692		200	1,750				
1963			1,315	1,702	500	4,600	600			
1964			1,628	2,290	100	600	3,362			
1965					50	1,000	1,189			
1966					50	80	305			
1967		23,441			150	180		146		
1968		14,817			175	280		171		
1969		26,471			200	830		233		
1970		10,264	1,500	2,000		285		235		
1971		5,830	1,000	1,500	0	470		484		
1972		7,346	500	200		150		256		
1973		7,762	1,700	2,000	50	300		205		
1974		3,933	1,500	3,500	100	150		198		
1975		10,703	3,500	8,500		650		691		
1976		25,983				46		713		
1977		13,730	0		0	100		194		
1978		5,903	925	1,200		128		202		
1979		2,900				10		250		
1980		9,696				119		122	200	
1981		21,025				250		469	200	
1982		23,438	700	1,500		534		1,910		
1983		3,931		500		50		1,712		
1984		8,147	191		0	23		1,562		

(continued on next page)

APPENDIX TABLE 1. Adult Spring-Run Chinook Counts At Selected Locations. a*
(continued)

Year	SACRAMENTO RIVER River	RBDD	Mill Creek	Deer Creek	Big Chico Creek	Butte Creek	FEATHER RIVER River	Hatchery	Yuba River	San Joaquin River
1985		10,747	291		0	254		1,632		
1986		16,691		543		1,371		1,433		
1987		11,204	90	200		14		1,213		
1988		9,781	572		0	1,300		6,833		
1989		5,255	563	77	30	1,300		5,078		

a* From Fry (1962) and AFB Administrative Reports.
b* Less than 500 fish.