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BRISTOL BAY SALMON AND HERRING FISHERIES

STATUS REPORT THROUGH 1982

By

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April 1983

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PREFACE

This document has been developed to give an overview of fisheries resource management in the Bristol Bay area. It has been designed to acquaint the reader with the vastness and complexity of multispecies management in a presentation stepped from general to complex. The introduction gives a general overview of the area's importance, including summaries of the salmon and herring fisheries. The individual salmon species and herring are then discussed in overview, research, and management sections. Finally a description of the salmon and herring program is given. The reader may choose one, two, or all three segments depending on the complexity of the information desired, or a reader new to the subject can simply start at the beginning. Each segment overlaps and builds on another previous segment to some degree.

This Bristol Bay report is the first of a series of summary reports that will update the status of economic, historic, and biological aspects of many Alaskan fishery resources and their implications to commercial and subsistence fishermen. The reader is referred to other Divisional documents including informational leaflets, annual run forecasts, technical reports, catch and effort reports, and other ad hoc documents of a more detailed nature if further information is required. Major credit for this report goes to the author, Ken Middleton, and the Central Region Bristol Bay management and research staffs. Without their dedicated support, incessant documentation and data summary analysis, this report would not have been possible.

ABSTRACT

Bristol Bay is one of Alaska's most productive fishing areas, featuring major commercial fisheries for five species of Pacific salmon *(Oncorhynchus* sp.) and herring *(Clupea harengus pallasi)*. The salmon fishery has been active for almost 100 years while the herring fishery began in 1967. The ex-vessel value of these combined fisheries has ranged from $3 million to $138 million annually. The seasonality of the salmon fishery is typical for the latitude, running from late May to early September. The herring fishery runs from late April to early June. These fisheries combined utilize the services of over 3,000 commercial fishing and processing vessels and over 1,100 subsistence fishermen. The size and scope of this resource makes the Bristol Bay region one of the most important areas for accurate and timely fisheries management in Alaska.

INTRODUCTION

The Bristol Bay area includes all waters of Alaska and the Bristol Bay drainages east of a line from Cape Newenham on the west to Cape Menshikof to the east (Figure 1). The area hosts valuable Pacific salmon *(Oncorhynchus* sp.*)* and herring *(Clupea harengus pallasi)* fisheries important to both Alaskan and non-Alaskan domestic fishermen and high seas foreign fishermen. A large portion of western Alaska's total annual revenue is generated by the commercial fisheries operating in the Bay area.

Bristol Bay is but one of the areas within the Alaska Department of Fish and Game (ADF&G) Division of Commercial Fisheries Central Region which is one of four management regions within the Division. Five fishing districts have been defined within the Bay area named for their proximity to the mouths of the major salmon producing rivers. These districts are the Ugashik, Egegik, Naknek-Kvichak, Nushagak, and Togiak Districts. Salmon fishing is conducted in all five districts whereas the herring fishery is confined to the Togiak District.

The Bristol Bay fisheries support a large segment of the Alaskan fishing fleet. Over 3,500 limited entry or fishing permits have been issued in the salmon and herring fisheries utilizing a complement of over 7,700 commercial and 1,100 subsistence fishermen. The long-term ex-vessel annual value of the combined salmon and herring fisheries averaged slightly over $57 million (1973-82), although the catch value in 1979 and 1981 was $145 million and $137 million, respectively.

The Bristol Bay salmon fishery provides the State of Alaska and the world with a major portion of all the salmon harvested annually. The commercial fishery developed in the 1880's, largely as a canning industry, and continues today as a canning (15%), fresh (21%), and frozen (61%) industry (1978-1982). The annual catch of salmon since those early days has varied widely, reaching a historic high during the 1980 and 1981 seasons of nearly 28.1 and 27.7 million salmon, respectively. (Figure 2, Appendix Tables 1 and 2). The State's largest sockeye salmon *(O. nerka)* and second largest stock-specific chinook salmon *(O. tshawytscha)* harvests are found here. Shorebased and floating processors provide employment opportunities for over 3,000 workers. Without the salmon fisheries of the Bay region, and the revenue it generates, the Bristol Bay region would be economically depressed.

A newly developed and significant herring fishery has averaged $4.0 million per year to the fishermen for the past 6 years (1977-1982). Herring sac roe for export to Japan is the primary objective, and the herring carcasses are utilized for crab bait and human consumption to a limited extent as a byproduct of the fishery. Seines and set gill nets are employed in the fishery which normally runs from late April to early June. This fishery has not existed long enough to attain any stability, nor is there sufficient data to determine any long range outlook. Sac roe production has steadily increased each year during the past 6 years with the highest yield of 19,556 mt in 1980. This fishery involved 33 processors, 200 units of gill net gear, and 135 purse seines in 1982.

An associated fishery involves the harvest of herring roe-on-kelp. This fishery is conducted largely by local people employing rakes or hand picking the rockweed kelp *(Fucus* sp.*)* at low tide. Approximately 100 to 200 individuals have

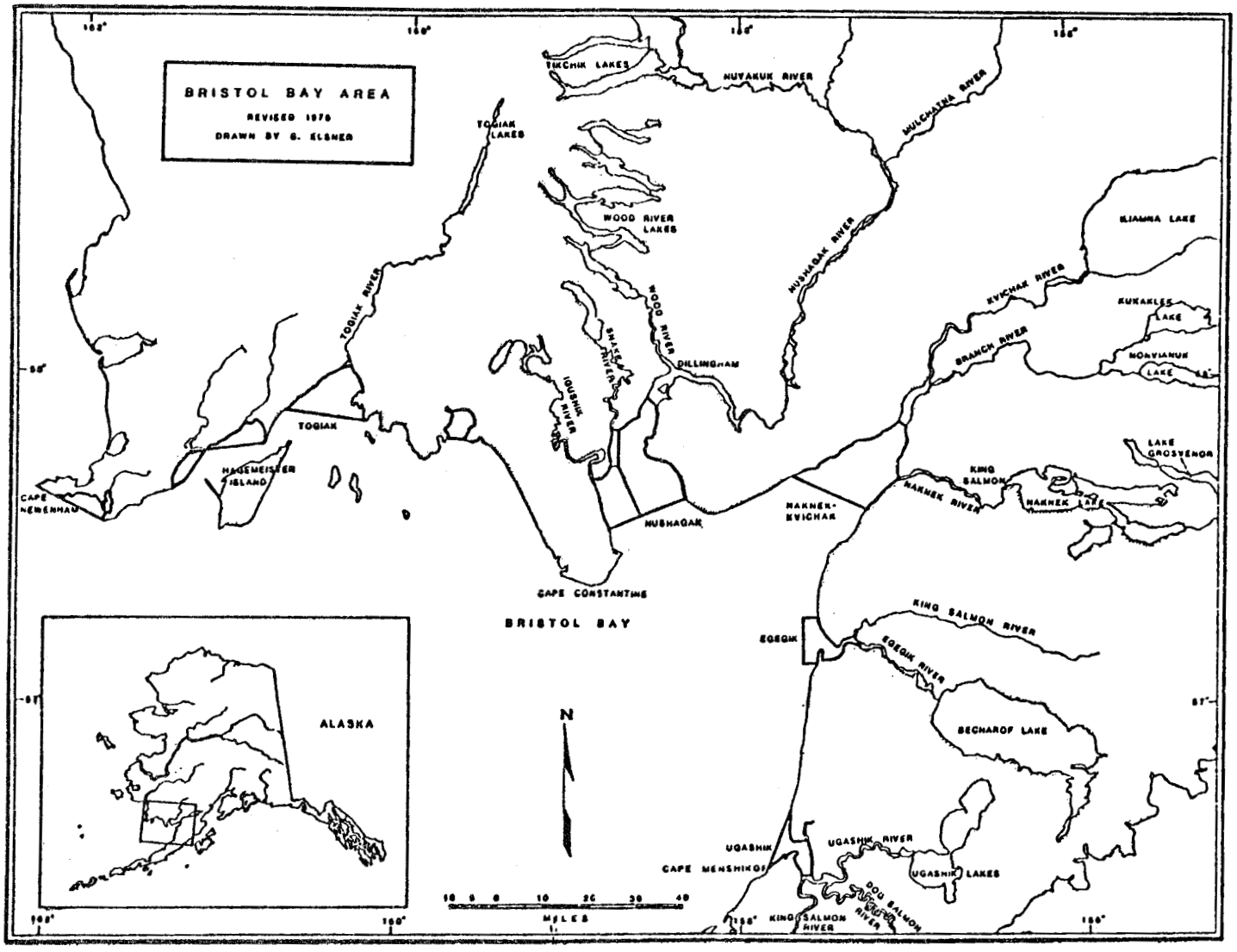


Figure 1. Bristol Bay commercial fishing districts.

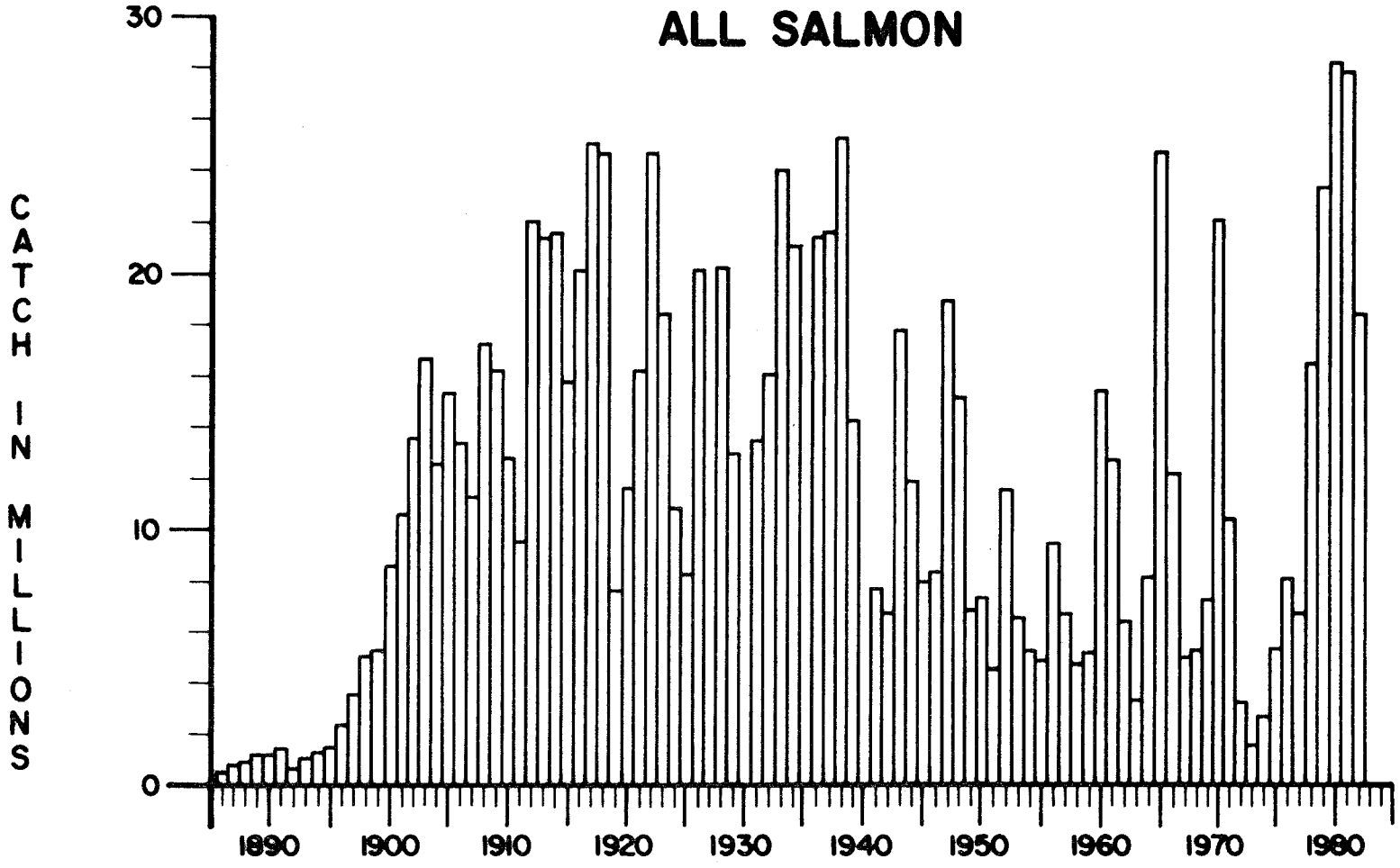


Figure 2. Commercial catch of Bristol Bay salmon in numbers of fish, 1884-1982.

participated annually in this fishery in recent years. Production averaged 149 mt from 1976 to 1979, and dropped off to 200 mt from 1980 to 1982. More stringent regulatory measures have recently been employed to protect the kelp from overharvest.

The importance of the Bay area fisheries cannot be overstressed. Multispecies management in a timely fashion is imperative for effective utilization and continuation of both salmon and herring stocks. By selectively choosing management strategies tailored to the multispecies mixing within the fisheries biomass of the Bristol Bay area, successful harvest and escapement guidelines can be determined and met. In the remainder of this report, a closer inspection of the historical fluctuations in the biology and harvests of the area's fishery resources have forged management strategies balancing all the concerns for exploitation and continuation of these vital fisheries of the Bristol Bay area.

SALMON FISHERY

All five species of Pacific salmon are indigenous to the Bristol Bay area. The sockeye salmon run is the most significant, but there are also significant runs of chinook, chum *(O. keta)*, coho *(O. kisutch)*, and in even-years, pink *(O. gorbuscha)* salmon. Numerically, based on the 1960-1982 data, the average annual catches are as follows: 10.1 million sockeye salmon (Appendix Figure 1); 1.6 million even-year pink salmon (Appendix Figure 2); 775 thousand chum salmon (Appendix Figure 3); 118 thousand chinook salmon (Appendix Figure 4); and 107 thousand coho salmon (Appendix Figure 5).

Run Timing

The seasonality of the fishery is typical for salmon in this latitude. Chinook salmon are the earliest to arrive in the fishing districts, in late May early June, and peak in mid-June, but are still taken in numbers in early July. The sockeye and chum salmon run coincidentally, entering in late June and peaking in early July. Pink salmon follow closely, entering mid-July and peaking in late July. Coho salmon enter the fishery about mid-July and peak in August.

Size of Fishery

The most significant salmon resource in the region is that for sockeye salmon, followed by chinook salmon. Bristol Bay is the largest sockeye salmon producing area in the world, accounting for an average annual catch of 10.1 million sockeye salmon for the past 23 years (1960-1982, Appendix Figure 1). Annual harvests during this period have ranged from 800 thousand to 25.7 million sockeye salmon, demonstrating the extreme cyclic fluctuations characteristic of this fishery. In terms of international and national significance, it accounts for 24% of the entire Pacific rim, 48% of the U.S., and 63% of the Alaska production of sockeye salmon. The Nushagak District in Bristol Bay produces the State's second largest chinook salmon fishery that is stock-specific, nearly matching the Yukon River. This fishery accounts for 19% of Alaska's total chinook salmon production for the past 23 years (Appendix Figure 2). The average annual catch of all salmon species for this same period is 12.7 million fish, or 21% of Alaska's total salmon production.

The sockeye salmon runs to Bristol Bay are characterized by a distinctive 5 year cycle pattern of peak abundance. Presently, the cycle peak occurs on a bi-decade basis, e.g., 1965, 1970, 1975, interspersed by years of decreased production. Historically, this pattern prevailed with three relatively high years and two low years in 5 year period. From the early 1940's through the 1950's, the cycle changed drastically to a 4 year pattern with 1 to 2 years of relatively good production followed by 2 to 3 years of greatly reduced production. The major production system, the Kvichak River system, is the key to the cycle pattern, and returned to a 5 year cycle pattern as a result of the large 1960 brood or parent year. This pattern has been maintained since then, and the objective of maintaining this 5 year cycle is basic to the management strategy for this important sockeye salmon producing system.

History and Regional Importance

The commercial fishery dates from 1884, and remains the basic economic factor in the area. Some 4,600 people make up the resident civilian population of the area, a majority of whom are Alaskan natives. Approximately 67% of the licensed gear holders are Alaska residents, and 70% of these are Bristol Bay residents.

There are 12 shorebased canneries in Bristol Bay that employ in excess of 2,000 cannery workers each season. Not all of these canneries are operational each year. During low production years some plants will consolidate their canning operations with other companies to save on "start-up" and seasonal operation costs. There has been a dramatic shift to freeze processing in recent years, resulting in a large number of "floating" processors that anchor in the larger fishing districts. These newer processing operations employ an additional 500 to 700 workers. Air freighting fresh fish, for processing elsewhere has become a major enterprise, particularly during high production seasons.

Two gear types are utilized in the limited entry commercial salmon fishery, drift and set gill nets. Registration by gear type since 1960 has averaged 1,584 (67%) with a range of 964 to 3,203 drift gill net, and 781 (33%) with a range of 345 to 1,010 set gill net licenses (Table 1). Drift gill net gear accounts for 90% of the annual catch on the average, and set gill nets the remaining 10%. Gear length is limited to 150 and 50 fm (275-92 m), respectively for drift and set gill nets. Vessel size is limited to 32 ft (9.76 m) overall length, and the average number of boats registered for the fishery is 1,740 per year.

The Commercial Fisheries Entry Commission, created in 1973, established maximum numbers of fishing gear permits in certain fisheries. These limits were imposed on the Bristol Bay fishery in 1974. The maximum number allowed are 1,669 drift and 803 set gill net permits.

The economy of the Bristol Bay area is almost entirely dependent upon the commercial fishery. The 23-year (1960-80) average value to fishermen (ex-vessel) for the salmon fishery is $30.7 million. The value has been greatly

Table 1. Registered units of fishing effort by gear type in Bristol Bay, 1960-1982.

	Drift			Set			
Year	Resident	Non-Resident	Subtotal	Resident	Non-Resident	Subtotal	Total
1960	650	364	1,014	345	0	345	1,359
1961	780	638	1,418	496	10	506	1,924
1962	791	400	1,191	619	20	639	1,830
1963	914	545	1,459	773	116	889	2,348
1964	947	689	1,636	793	137	930	2,566
1965	916	677	1,593	868	125	993	2,586
1966	1,019	846	1,865	826	139	965	2,830
1967	965	734	1,699	686	144	830	2,529
1968	973	711	1,684	722	117	839	2,523
1969	1,110	818	1,928	804	166	970	2,898
1970	1,057	824	1,881	747	143	890	2,771
1971	1,034	831	1,865	710	136	846	2,711
1972	993	771	1,764	722	132	854	2,618
1973	2,041	1,162	3,203	902	108	1,010	4,213
1974	634	238	872	475	55	530	1,402
1975	1,216	843	2,059	751	169	920	2,979
1976	987	734	1,721	624	139	763	2,484
1977	999	729	1,728	683	156	839	2,567
1978	1,039	737	1,776	748	161	909	2,685
1979	1,046	754	1,800	763	170	933	2,733
1980	1,060	767	1,827	760	187	947	2,774
1981	1,055	771	1,826	754	202	956	2,782
1982	1,047	775	1,822	735	212	947	2,769

influenced by both increased prices and abundance of sockeye salmon in the late 1970's. For instance, the average ex-vessel value for the years 1978-1982 was $98 million, whereas for the years 1973-1977, the average was $14 million. Depressed market conditions in the 1980 season had a dramatic impact on value. Although the 1980 salmon harvest exceeded 1979 by over 5 million fish, the ex-vessel value dropped $54.1 million (Table 2). However, half of the increased harvest was related to much lower priced pink salmon. Sockeye salmon normally account for about 90% of the annual salmon value.

Subsistence Catch

Subsistence salmon fishing is significant in Bristol Bay both in terms of numbers of fish utilized and in importance to watershed residents as a food item. Salmon subsistence catches for personal use and dog food consumption average about 144 thousand (range 93 to 213 thousand) fish per year since 1963 when annual recording commenced (Table 3). There is no apparent trend in the fishery, i.e., the variation in catches both historically and annually are not signficant, indicating a basic use level that is somewhat independent of fish abundance.

Winter subsistence fishing also occurs. The species involved are Arctic char *(Salvelinus alpinus)*, whitefish *(Coregonus* sp.*)*, pike *(Esox lucius)*, smelt *(Osmeridae)*, burbot *(Lota lota)*, and some rainbow trout *(Salmo gairdneri)* and grayling *(Thymallus arcticus)*. Comprehensive documented data does not exist for this fishery.

Fishery Description

Bristol Bay is divided into five major and discrete fishing districts that are related to major river systems entering the Bay. Consequently, they are also the main migratory routes through which salmon must pass to ascent these rivers. The fishing districts are intentionally confined to areas as near as practical to the river mouths in order to minimize the interception of salmon destined for other, adjacent river systems. Specific river stock management is highly desirable and the physical geography of Bristol Bay is advantageous in this regard. Some districts are further divided into sections in order to accommodate local geographical features where several stocks may be involved, and to provide more management flexibility in controlling the exploitation rate on individual river systems stocks.

Although the commercial salmon fishery extends from late May through September, the dominant sockeye salmon fishery is compacted into a relatively short time frame with the bulk of the run passing through the fishing districts in a 2 week period during the first half of July. The fishery is normally quite consistent in timing with peak abundance occurring around 4 July.

With such large numbers of fish passing through rather small fishing areas in such a short period of time, special management techniques are necessary to gauge and control the exploitation rate in order to achieve eascapement goals in the various river systems. One of the more unique features of this fishery is that from mid-June to mid-July the fishing periods are regulated by emergency

Table 2. Ex-vessel value of Bristol Bay commercial salmon harvest in thousands of dollars by species, 1960-1982[1].

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1960	342	13,020	15	88	671	14,136
1961	285	11,914	21	0	393	12,613
1962	276	4,907	41	283	379	5,886
1963	204	3,101	45	0	215	3,565
1964	458	6,100	40	496	465	7,559
1965	371	26,438	9	0	209	27,027
1966	262	10,525	38	823	206	11,854
1967	336	5,110	63	0	286	5,795
1968	357	3,296	110	639	218	4,620
1969	443	8,423	103	0	216	9,185
1970	465	24,368	18	151	466	25,468
1971	652	14,951	16	0	528	16,147
1972	339	3,914	20	47	512	4,832
1973	284	1,892	115	0	829	3,120
1974	460	3,793	142	1,053	567	6,015
1975	214	11,047	151	0	615	12,027
1976	742	17,139	82	1,093	2,892	21,948
1977	1,940	19,434	445	50	4,275	26,145
1978	3,206	40,034	435	5,424	3,173	52,273
1979	4,541	128,992	2,387	5	2,480	138,405
1980	1,881	76,118	1,392	2,173	2,738	84,302
1981	5,599	121,399	1,458	8	4,027	132,490
1982	6,356	68,308	3,423	1,071	2,192	81,350

[1] 1981-1982; preliminary data.

Table 3. Bristol Bay subsistence catches in numbers of fish by species, 1963-1982.

Year	Permits	Chinook	Sockeye	Coho	Pink	Chum	Total
1963	0	4,100	103,200	4,900	0	8,700	120,900
1964	0	3,400	118,000	5,700	5,200	8,700	141,000
1965	0	5,100	119,400	5,700	200	18,500	148,900
1966	0	4,300	99,100	2,800	7,600	6,300	120,100
1967	0	4,200	104,100	5,000	800	14,200	128,300
1968	0	7,100	101,300	2,400	6,100	8,800	125,700
1969	0	7,500	104,100	7,700	100	8,300	127,700
1970	301	7,200	147,800	1,200	1,100	9,500	166,800
1971	310	4,600	109,100	2,500	0	4,200	120,400
1972	353	4,500	76,500	1,400	1,900	8,700	93,000
1973	452	7,200	69,800	3,300	100	8,000	88,400
1974	607	9,900	149,800	7,100	6,200	12,700	185,700
1975	701	8,600	175,400	8,500	1,300	7,500	201,300
1976	716	8,400	120,900	3,500	4,400	9,100	146,300
1977	738	7,000	127,900	6,600	300	9,100	150,900
1978	773	8,100	127,600	4,400	12,700	16,200	169,000
1979	829	10,300	116,500	7,300	500	7,200	141,800
1980	1,243	14,100	168,600	7,300	10,000	13,100	213,100
1981	1,112	13,000	132,100	12,200	2,600	11,500	171,400
1982	806	13,600	110,800	11,500	8,600	12,300	156,800

order. In other words, rather than operating on fixed fishing schedules of so many days or hours per week, the fishery has closures and openings of variable duration, usually 12 or 24 hours, and are announced on a day by day basis, or conversely, no openings may be announced as the individual district and daily situation dictates. Each of the five districts (and perhaps sections within a district) are managed independently to conform to the individual stock characteristics of run timing and strength. Since the fish are very concentrated within the fishing districts, and moving rapidly during the peak of the run (up to 1.6 million fish have been caught in one 12-hour period in a single district), management must be highly flexible and responsive.

There have been two notable exceptions to this basic regulatory scheme since Statehood. Once in 1970 and again in 1980, when forecasted runs to Bristol Bay were so large that virtually all barriers to fishing area and time were lifted in order to maximize harvesting and processing capabilities. During years of very large runs, the basic limiting factor relates to the transport of fish from the fishing grounds to processing facilities, and the capacity of processing plants. Once escapement goals are assured, or in the case of exceptionally strong runs, fishing time is usually continuous from a regulatory standpoint. In this instance, the individual canneries usually resort to catch limits per boat and schedule specific periods when they will accept fish from their fishermen in order to avoid fish spoilage or wasteage as a result of receiving more fish than they can physically store and process in a timely manner.

The Togiak District fishery is an exception to the emergency order management scheme employed in all the other districts. This district is fished by people from Togiak and adjacent villages, and the fishing effort has remained fairly constant for many years. A gradual, but steady increase in fishing effort began in 1974, and by 1980 had increased about 30% over prior years. Additionally, the sockeye runs in this area tend to develop more gradually over a longer period of time. Consequently, the fishery is managed on a fixed schedule of 4 to 5 days per week with necessary adjustments for more or less time on a weekly basis as dictated by run strength as the season progresses.

The species composition is quite specific by district. Sockeye salmon are dominant in all the districts. Chinook salmon are almost exclusively produced by river systems draining into the Nushagak District. Chum salmon are also predominantly produced by Nushagak systems with significant production also occurring in Togiak systems, and occasional catches in the Naknek-Kvichak District matching Togiak catches. Pink salmon are quite specific to the Nushagak District. Recently, however, there has been an unusually strong appearance of pink salmon in the Naknek-Kvichak District. Although the numbers are insignificant compared to the Nushagak production, the recent Naknek-Kvichak pink salmon runs do represent an unusual and unexplained phenomenon. Pink salmon occur in Bristol Bay on even-years only, with only a trace during odd-years. Coho salmon are predominantly produced by Nushagak and Togiak District river systems, with the Nushagak stocks being the larger of the two. Until quite recently, effort has been limited on this species. The Nushagak coho salmon stocks represent the only species in Bristol Bay that may have significant additional harvest potential.

Fishery Economics

There are two basic ways to express fishery values such as first wholesale value of the processed product and ex-vessel value, or the value to the fishermen. There are also several variables associated with each of these values. For the sake of simplicity, and because it is a figure that fishermen and people in general can more readily relate to, this discussion will deal with ex-vessel values. Normally, there are two different prices each season in Bristol Bay, reflecting price agreements by two different marketing associations.

In recent years one marketing association has stipulated in their price agreements that they would receive the same price as the other association should it be higher. Consequently, prices for sockeye salmon have been similar for the two groups in the past few years. Additionally, there may be price differences before and after certain dates within a season, as well as "adjustments" relating to the percentage canned or frozen by a processor. The values listed in Table 2 are estimates based on an average price per fish or pound multiplied by the catch and using average weights by species in the latter instance.

Ex-vessel value is a function of price paid to the fishermen and numbers of salmon caught. From 1960 to 1968, when fish were purchased on a per fish basis, the price for sockeye salmon averaged $1.10 per fish and only varied from 95¢ to $1.18 per fish for independent fishermen. "Company" fishermen, wherein the boat, fishing nets, and fuel were supplied by the processor, were paid less, usually about 62% of the independent price. This class of fishermen phased out of the fishery by 1975. Commencing in 1969, fish were purchased on a price per pound basis. Prices remained fairly stable until 1973 and reached a peak in 1979 of 80¢ per pound for canned sockeye salmon and $1.25 per pound for frozen sockeye salmon. This also marked the first time that a canned/frozen price differential was established. This price coupled with an exceptionally strong sockeye salmon run and resultant catch, plus record chinook and coho salmon catches as well as one of the larger chum salmon catches in history, produced a fishery worth $138 million to the fishermen in 1979, five times the average value.

From 1960-1982, the average annual value was $30.7 million to the fishermen. This has ranged from a low of $3.1 million in 1973 to the 1979 high of $138.4 million. During this period sockeye salmon have accounted for 88% of the value, chum and chinook salmon 4% each, and coho and pink salmon 1%. It is interesting to note how significant coho salmon have become since 1979. They are becoming competitive with all other species, other than sockeye, in terms of value to the fishermen. Unstable market conditions in 1980 led to a sharp reduction in value with a resultant negotiated price of 57¢ per pound being paid for sockeye salmon by most processors without a differential for fish that were frozen.

SOCKEYE SALMON FISHERY

Biological Status

Although the Bristol Bay salmon fishery began in 1884 it was nearly 20 years before catches reached levels that represented the actual potential for sockeye production in the area. This was a reflection of the industry establishing itself in this then remote area of Alaska.

A critical and comprehensive analysis of the historical production is hindered by the passage of time, and the subsequent lack of knowledge of the variables that may have affected production during certain periods of time. Nevertheless, certain patterns are exhibited in the historical catch records. The first most notable pattern is that there was a sustained high catch averaging 13 million salmon for 10 consecutive years (from 1901 through 1910) that varied only 6.2 million at the extreme (Table 4). The pattern after this period was one of continuing high production overall averaging 17.5 million sockeye salmon, but the sustained periods became shorter, finally dropping to 4 year sequences (1921-24, 1926-29, 1931-34, 1936-39) with the intervening years production becoming smaller. The production pattern from 1940 to 1960 changed dramatically. Not only did the overall production decrease 54% during this 20-year period, but the production sequence changed significantly. Peak years shifted to a 4-year rather than a 5-year cycle, related primarily to the Kvichak cycle, and adjacent years production dropped drastically. The lowest period occurred from 1953 through 1959 when production dropped to an average annual catch of only 5.4 million sockeye salmon. Not all river systems have been in similar modes of depression or rebuilding. Since the Naknek-Kvichak District is usually such an overwhelming component of the total Bristol Bay sockeye run, the overall pattern or trend follows the Naknek-Kvichak District rather closely (Figures 3 and 4). Therefore, other river systems tend to be masked somewhat in any general comparisons.

Commencing in 1960, production, especially for the important Kvichak River system, increased significantly. This was due in part to the large 1956 escapement of 9.4 million sockeye salmon to the Kvichak River. The 1960 parent year with a Kvichak River escapement of 14.6 million, reestablished the historic 5-year peak cycle pattern. Production in terms of total run, increased from this point on. However, overall production, particularly for years adjacent to the peak year were still well below historic levels.

In 1969, the Kvichak River forecasted run was large enough to finally attempt to obtain a significant escapement for the cycle year preceding the peak year, which historically had demonstrated a high average rate of return in terms of adults per spawner. Unfortunately, both the 1969 and the 1970 escapements suffered decreased production apparently because of natural mortality as a result of the extremely cold 1970-1971 winters. Consequently, fishing time was severely restricted in both 1974 and 1975 in order to secure escapement goals for these two critical brood years. Catches during the 1972 to 1977 rebuilding period dropped to an all time low of only 3.3 million fish per year.

Table 4. Commercial catch of Bristol Bay sockeye salmon in numbers of fish by district, 1893-1982[1].

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	100,000	0	200,000	640,000	0	940,000
1894	262,550	0	112,850	860,000	0	1,235,400
1895	413,651	54,321	65,219	938,946	0	1,472,137
1896	487,630	20,400	229,020	1,262,690	0	1,999,740
1897	1,410,287	203,458	463,698	1,240,080	0	3,317,523
1898	2,241,113	247,842	548,793	1,890,092	0	4,927,840
1899	1,649,127	284,650	661,524	2,517,436	0	5,112,737
1900	3,208,263	307,574	796,965	4,234,533	0	8,547,335
1901	3,622,638	427,886	769,002	5,401,051	0	10,220,577
1902	6,038,386	403,444	1,640,973	4,725,715	0	12,808,518
1903	7,516,329	781,038	1,703,536	6,319,189	0	16,320,092
1904	5,856,442	136,759	564,492	5,345,659	0	11,903,352
1905	6,773,275	140,000	532,779	7,387,935	0	14,833,989
1906	4,954,905	238,000	203,014	5,427,512	0	10,823,431
1907	6,782,072	481,578	302,402	2,627,351	0	10,193,403
1908	9,088,285	781,131	272,355	6,092,031	0	16,233,802
1909	9,532,722	840,620	218,223	4,906,318	0	15,497,883
1910	6,336,382	619,001	168,471	4,469,755	0	11,593,609
1911	4,587,344	1,158,176	112,521	2,957,073	0	8,815,114
1912	13,821,905	1,455,247	425,763	3,993,428	0	19,696,343
1913	13,691,550	902,728	577,615	5,409,933	0	20,581,826
1914	12,584,809	897,767	254,716	6,457,815	0	20,195,107
1915	7,156,488	1,217,252	509,076	5,904,862	0	14,787,678
1916	11,551,086	1,578,862	647,422	3,744,551	0	17,521,921
1917	15,762,582	1,856,600	1,047,111	5,847,239	0	24,513,532
1918	14,219,536	1,818,218	756,206	6,296,705	0	23,090,665
1919	4,929,761	607,688	146,590	1,477,336	0	7,161,375
1920	5,275,140	498,949	441,770	2,682,056	0	8,897,915
1921	9,690,857	1,136,670	1,135,265	3,717,284	0	15,680,076
1922	15,766,366	2,550,068	1,879,067	3,436,576	0	23,632,077
1923	14,361,488	1,116,057	782,545	1,921,874	0	18,181,964
1924	6,813,083	874,019	446,810	2,168,154	0	10,302,066
1925	3,355,293	212,987	438,103	3,903,125	0	7,909,508
1926	12,717,504	1,522,721	1,151,541	4,022,328	0	19,414,094
1927	8,917,893	1,285,059	211,409	657,467	0	11,071,828
1928	12,200,000	1,300,000	500,000	5,710,000	0	19,710,000
1929	6,711,975	1,107,325	445,673	3,923,675	0	12,188,648
1930	2,334,138	373,250	111,150	1,440,650	0	4,259,188
1931	8,845,850	1,203,063	639,263	2,102,438	0	12,790,614
1932	10,203,563	1,342,913	526,988	2,866,088	0	14,939,552
1933	16,944,386	1,780,344	611,347	4,372,873	0	23,708,950
1934	13,339,666	1,871,974	750,602	4,638,268	0	20,600,510
1935	1,703,568	416,127	0	903,264	0	3,022,959
1936	16,778,943	1,432,588	815,215	1,560,138	0	20,586,884
1937	13,957,327	2,221,161	518,027	4,561,299	0	21,257,814

-Continued-

Table 4. Commercial catch of Bristol Bay sockeye salmon in numbers of fish by district, 1893-1982[1] (continued).

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1938	20,967,834	1,112,759	296,491	2,322,704	0	24,699,788
1939	7,773,909	750,098	639,217	4,169,121	0	13,332,345
1940	2,960,644	210,939	36,022	1,519,082	0	4,726,687
1941	4,966,660	342,900	65,806	1,778,338	0	7,153,704
1942	3,224,192	0	653,392	2,465,779	0	6,343,363
1943	12,874,650	0	1,081,925	3,373,643	0	17,330,218
1944	6,626,906	363,854	1,041,603	3,513,241	0	11,545,604
1945	4,195,431	0	808,797	2,296,019	0	7,300,247
1946	5,077,201	327,208	617,995	2,028,144	0	8,051,206
1947	13,965,201	995,745	913,795	2,767,287	0	18,642,028
1948	9,182,953	1,092,590	1,463,048	2,805,798	0	14,544,389
1949	3,941,568	1,016,115	691,515	800,123	0	6,449,321
1950	4,366,471	791,329	787,384	1,212,091	0	7,157,275
1951	2,926,413	644,551	318,629	436,950	0	4,326,543
1952	9,401,060	886,852	280,146	698,071	0	11,266,129
1953	3,738,839	1,234,600	688,720	449,341	0	6,111,500
1954	1,819,666	1,437,791	1,067,531	315,357	12,280	4,652,625
1955	2,564,341	622,885	240,817	1,054,978	66,085	4,549,106
1956	5,987,750	1,187,099	341,499	1,263,186	101,933	8,881,467
1957	4,578,643	814,459	350,858	491,498	40,044	6,275,502
1958	922,611	500,684	433,813	1,092,156	36,402	2,985,666
1959	1,689,425	662,391	423,414	1,719,687	113,202	4,608,119
1960	9,847,848	1,446,884	752,634	1,517,988	139,648	13,705,002
1961	8,166,983	2,686,076	357,223	511,483	192,161	11,913,926
1962	2,281,284	638,862	243,159	1,461,766	92,945	4,718,016
1963	957,902	695,582	188,695	842,744	186,213	2,871,136
1964	2,243,701	1,103,935	576,768	1,420,941	250,775	5,596,120
1965	19,139,567	3,179,559	925,690	793,323	217,100	24,255,239
1966	5,397,538	2,101,174	445,458	1,170,271	199,799	9,314,240
1967	2,337,226	1,070,942	163,744	657,711	101,107	4,330,730
1968	1,216,858	671,554	82,457	749,281	72,699	2,792,849
1969	4,655,072	889,322	169,845	773,207	134,252	6,621,698
1970	17,803,805	1,403,509	171,541	1,188,534	153,377	20,720,766
1971	5,857,378	1,306,682	954,068	1,256,799	209,060	9,583,987
1972	1,102,365	839,820	17,440	381,347	75,261	2,416,233
1973	168,249	221,337	3,920	272,093	95,723	761,322
1974	538,163	172,253	2,151	510,571	139,341	1,362,479
1975	3,085,416	964,024	14,558	645,902	188,914	4,898,814
1976	2,547,276	1,329,788	174,923	1,265,422	301,883	5,619,292
1977	2,167,214	1,780,567	92,623	619,025	218,451	4,877,880
1978	5,123,668	1,207,294	7,995	3,137,166	452,016	9,928,139
1979	14,991,826	2,257,332	391,118	3,327,346	460,984	21,428,606
1980	15,120,457	2,623,066	885,875	4,497,787	634,561	23,761,746
1981	10,948,744	4,480,710	1,949,531	7,713,416	620,811	25,713,212
1982	4,987,922	2,413,935	1,161,117	5,998,830	583,701	15,145,505

[1] Sources: 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

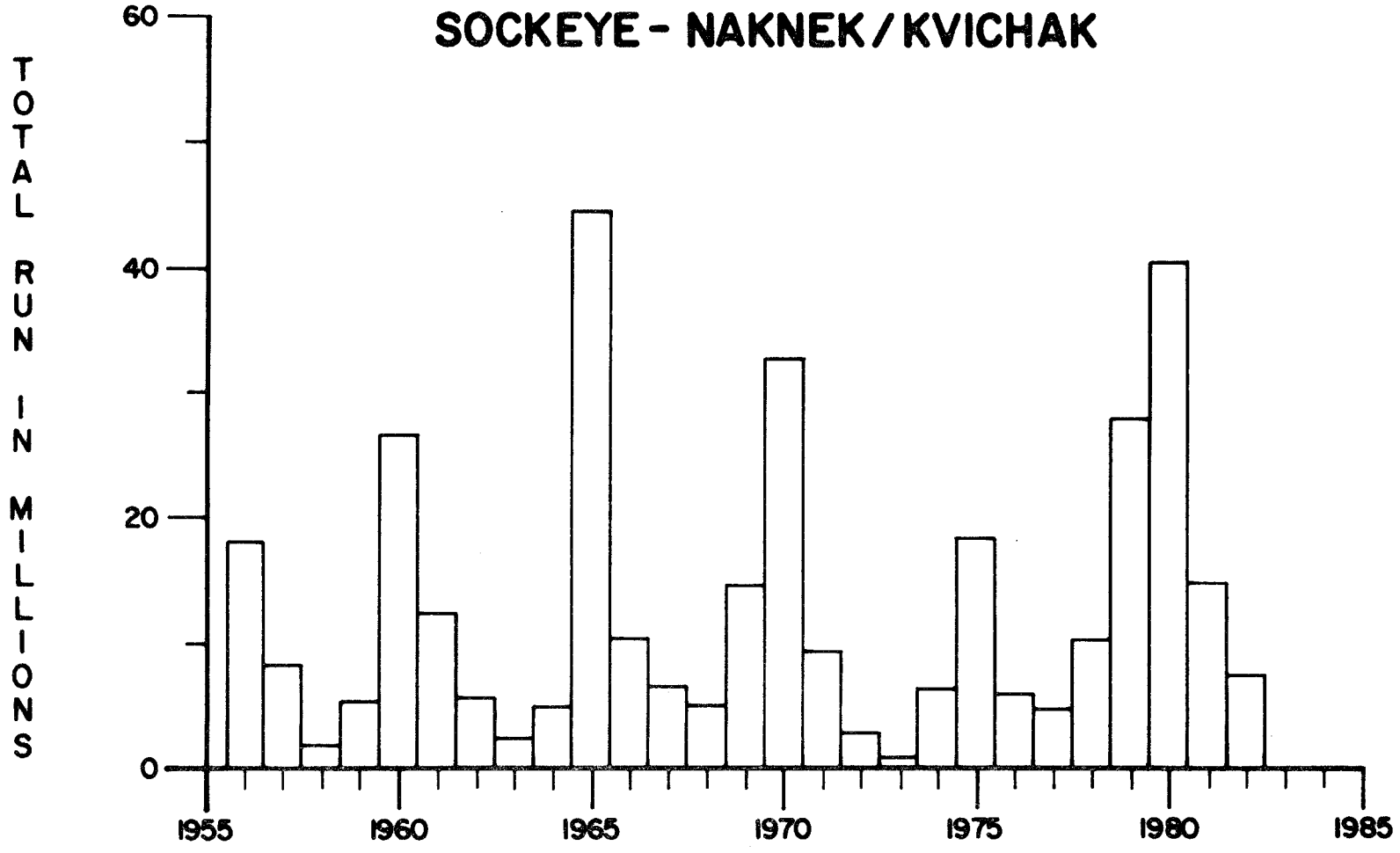


Figure 3. Total run of sockeye salmon to Naknek-Kvichak District in numbers of fish, 1956-1982.

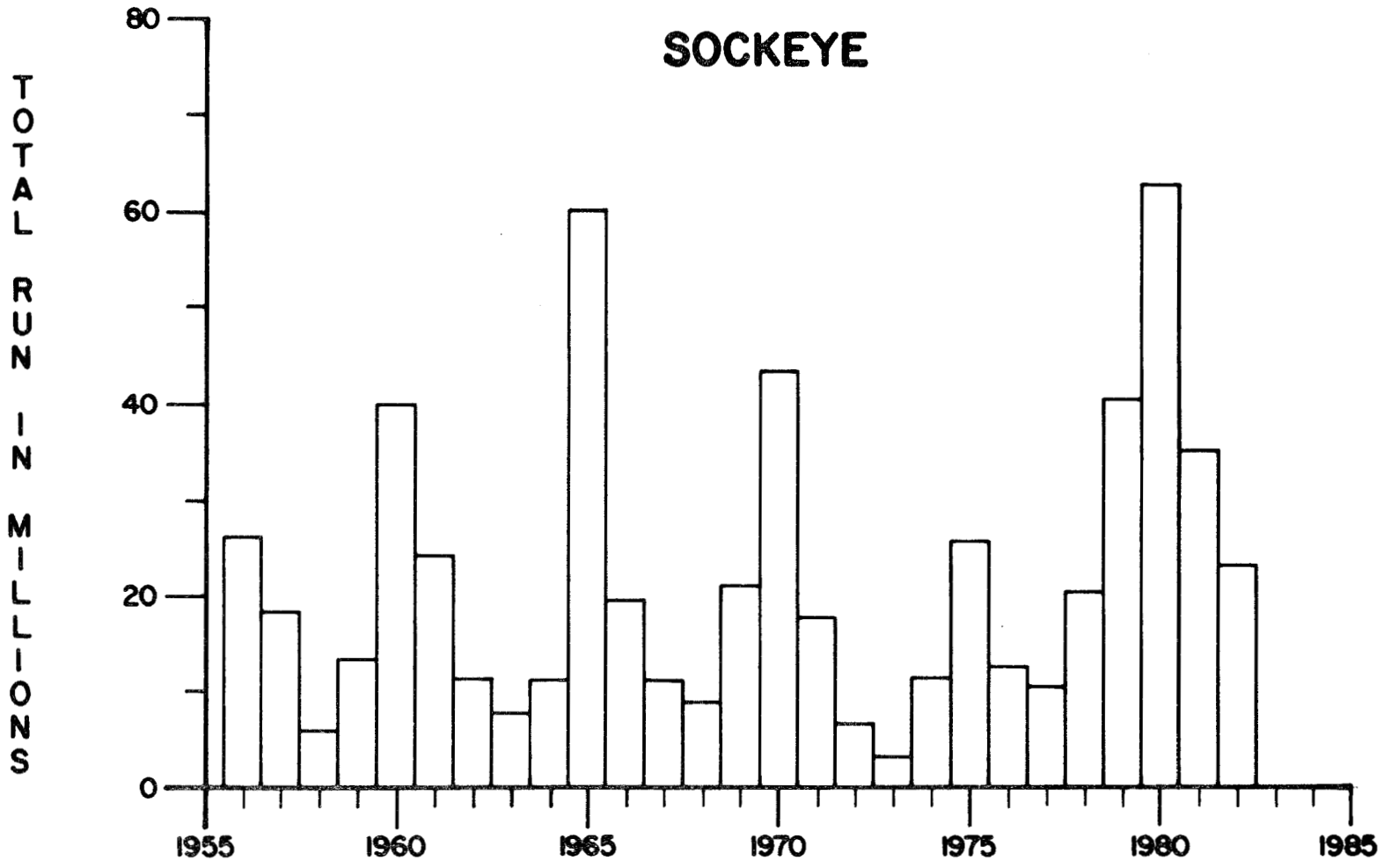


Figure 4. Total run of sockeye salmon to Bristol Bay including estimates of high seas catch in numbers of fish, 1956-1982.

The restraints imposed on the fishery during 1974 and 1975, and the sacrifices borne by the fishermen and industry, began to pay off handsomely in 1978 and are expected to continue. Unusually good survival rates also aided in boosting production throughout Bristol Bay. The 1980 sockeye salmon catch could easily have broken the record year of 1938 had there not been a price dispute. Escapement totals in 1980 were the highest on record. The strong sockeye salmon run in 1981 which was not burdened by a price dispute, saw a record harvest of 25.7 million sockeye salmon that broke the prior record set in 1938 (Table 4). The most significant factors, however, have been the 1978 to 1982 production, plus the outlook for 1983-85. The overlapping production from these adjacent strong years is and will be highly significant to future production. If the 1983 projected run and harvest materializes as expected, the average production in terms of catch for the 5 years, 1978-1983, will be 19.6 million sockeye salmon per year, or as high as any 6-year period in the history of the fishery.

Historically, the Nushagak District was the second most productive system in Bristol Bay, averaging a 5 million sockeye salmon catch for 20 years (1899 to 1918), nearly 2.8 million for the following 30 years, and finally dropping to an 882 thousand average in the 29 years from 1949 to 1977. Only in the past 5 years during recent times has the Nushagak District catch reached the historical sustained level (Figure 5, Table 4). In terms of total run, the Nushagak District has been very close to or exceeded the average run of 3 million sockeye salmon in 6 of the last 7 years (Table 5). The 1980 and 1981 production of 12.8 and 10.6 million sockeye salmon, respectively for this district is truly outstanding and exceptional. Proportionately, based on total run performances since 1956, this was the largest increase in production for any area in Bristol Bay during 1980 and 1981.

The Egegik District has demonstrated relatively stable production through its history, except for a period related to World War II when fishing effort was down. The drastic decline of 1973 and 1974 was reflected throughout Bristol Bay. Historical high catches for Egegik are relatively recent, occurring in 1965 and 1980 of 3.2 and 10.9 million fish, respectively (Table 4). The average total run to the Egegik District is 2.3 million for the 27 years from 1956 to 1982. The District has produced runs matching or exceeding this average for the last 4 years (Figure 6). Overall, the Egegik system seems to be in healthy condition and fairly stable.

The Ugashik District represents a different pattern, and one more difficult to characterize or explain, even in recent years (Figure 7 and Table 5). The total run figures need to be examined to relate to this district since there have been several seasonal closures, nearly total closures and limited fishing effort in recent years. As can be seen on Table 5, production has been especially depressed from 1972 through 1978 when 4 out of 7 years total runs (catch plus escapement) were less than 100 thousand sockeye salmon. In spite of such depressed conditions, the 1975 and 1976 escapements of 429,336 and 356,308 fish, respectively, produced excellent runs in 1979 and 1980 of 2.1 and 4.2 million, respectively (Table 5). However, even with periods of fairly high sustained levels of escapement, from 1946 to 1954 (Table 6), catches in subsequent years were quite low. This erratic behavior for the Ugashik District also poses particular difficulties in forecasting runs based on parent year escapements. Although production has rebounded significantly in the Ugashik system during 1979-1982, and the immediate outlook may be encouraging, the long-term prospects for this system are uncertain.

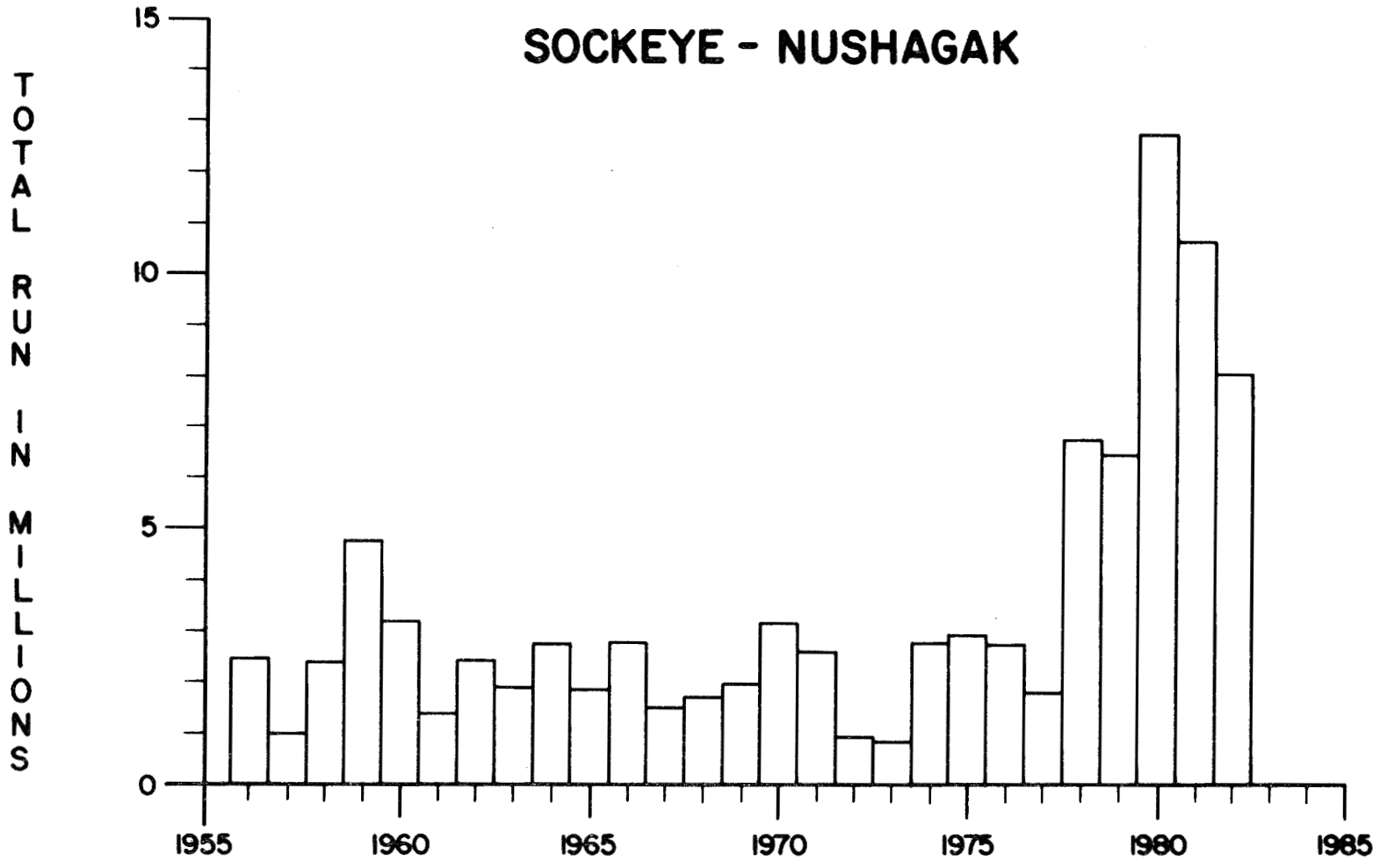


Figure 5. Total run of sockeye salmon to Nushagak District in numbers of fish, 1956-1982.

Table 5. Total run of Bristol Bay sockeye salmon by district[1], including estimates of high seas interceptions[2], 1956-1982.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Subtotal	High seas[2] catch est.	Total
1956	17,987,663	2,291,367	766,794	2,435,287	326,933	23,808,044	2,431,000	26,239,044
1957	8,182,693	1,205,666	565,660	990,225	65,044	11,009,288	7,349,000	18,358,288
1958	1,830,164	747,038	713,359	2,370,089	108,402	5,769,052	377,000	6,146,052
1959	5,426,663	1,734,850	642,642	4,761,572	322,842	12,888,569	598,000	13,486,569
1960	26,546,759	3,245,648	3,094,034	3,191,246	331,658	36,409,345	3,727,000	40,136,345
1961	12,313,946	3,387,614	723,662	1,371,116	319,615	18,115,953	6,129,000	24,244,953
1962	5,675,864	1,666,344	517,185	2,399,464	164,497	10,423,354	960,000	11,383,354
1963	2,405,324	1,693,184	585,699	1,906,600	313,809	6,904,616	1,001,000	7,905,616
1964	4,799,125	1,953,511	1,059,538	2,759,945	365,449	10,937,568	314,000	11,251,568
1965	44,358,311	4,624,167	1,923,552	1,892,589	329,886	53,128,505	6,943,000	60,071,505
1966	10,363,503	2,905,420	1,160,294	2,800,997	332,797	17,553,011	1,935,000	19,488,011
1967	6,511,700	1,707,806	407,674	1,533,163	192,437	10,352,780	922,000	11,274,780
1968	4,991,392	1,010,208	153,353	1,725,945	129,117	8,010,015	885,000	8,895,015
1969	14,562,968	1,904,876	330,225	1,985,793	259,318	19,043,180	2,031,000	21,074,180
1970	32,648,673	2,323,243	906,565	3,154,690	366,273	39,399,444	3,968,000	43,367,444
1971	9,367,826	1,940,696	1,483,820	2,610,181	422,302	15,824,825	2,049,000	17,873,825
1972	2,850,033	1,386,222	96,868	909,997	157,231	5,400,351	1,302,000	6,702,351
1973	786,759	550,179	42,908	853,400	210,653	2,443,899	839,000	3,282,899
1974	6,427,913	1,447,883	64,005	2,778,039	247,833	10,960,673	510,000	11,470,673
1975	18,353,032	2,137,864	443,894	2,918,940	378,076	24,231,806	1,353,000	25,584,806
1976	5,915,130	1,838,948	531,231	2,751,698	502,473	11,539,480	1,001,000	12,540,480
1977	4,694,214	2,473,081	294,143	1,839,081	421,085	9,721,604	768,000	10,489,604
1978	10,315,734	2,102,992	90,429	6,622,698	792,092	9,923,945	452,000	20,375,945
1979	27,429,822	3,289,374	2,098,022	6,400,917	685,227	39,903,957	304,000	40,207,957
1980	40,568,323	3,683,926	4,221,159	12,808,225	1,207,011	62,488,644	590,000	63,078,644
1981	14,581,532	5,175,390	3,277,230	10,564,053	986,741	34,584,926	818,000	35,402,926
1982	7,517,614	3,448,563	2,346,668	8,011,932	925,125	22,249,902	443,000	22,692,902

[1] 1981-1982; preliminary data.

[2] Based on maturing fish caught in year of inshore run plus immature catch in preceding year.

Table 6. Escapement of eastside Bristol Bay sockeye salmon in numbers of fish by river system, 1940-1982[1].

Year	Kvichak	Branch	Naknek	Egegik	Ugashik	Total
1940	0	0	422,000	0	0	0
1941	0	0	483,000	0	0	0
1942	0	0	1,000,000	0	0	0
1943	0	0	600,000	0	0	0
1944	0	0	444,000	0	0	0
1945	0	0	484,000	0	0	0
1946	0	0	510,000	0	587,000	0
1947	0	0	304,000	0	309,000	0
1948	0	0	455,000	0	1,018,000	0
1949	0	0	270,000	0	742,024	0
1950	0	0	468,000	0	998,149	0
1951	0	0	700,000	0	205,881	0
1952	0	0	486,000	0	651,209	0
1953	0	0	519,000	0	1,056,361	0
1954	0	0	804,000	0	458,635	0
1955	0	0	279,000	0	76,982	0
1956	9,443,318	784,000	1,772,595	1,104,268	425,295	13,529,476
1957	2,842,810	126,595	634,645	391,207	214,802	4,210,059
1958	534,785	94,650	278,118	246,354	279,546	1,433,453
1959	680,000	825,431	2,231,807	1,072,459	219,228	5,028,925
1960	14,630,000	1,240,530	828,381	1,798,764	2,341,400	20,839,075
1961	3,705,849	90,036	351,078	701,538	366,439	5,214,940
1962	2,580,884	90,630	723,066	1,027,482	274,026	4,696,088
1963	338,760	203,304	905,358	997,602	397,004	2,842,028
1964	957,120	248,700	1,349,604	849,576	482,770	3,887,770
1965	24,325,926	175,020	717,798	1,444,608	997,862	27,661,214
1966	3,775,184	174,336	1,016,445	804,246	714,836	6,485,047
1967	3,216,208	202,626	755,640	636,864	243,930	5,055,268
1968	2,557,440	193,872	1,023,222	338,654	70,896	4,184,084
1969	8,394,204	182,490	1,331,202	1,015,554	160,380	11,083,830
1970	13,935,306	117,060	732,502	919,734	735,024	16,499,626
1971	2,387,392	187,302	935,754	634,014	529,752	4,674,214
1972	1,009,962	151,188	586,518	546,402	79,428	2,373,498
1973	226,554	35,280	356,676	328,842	38,988	986,340
1974	4,433,844	214,848	1,241,058	1,275,630	61,854	7,227,234
1975	13,140,450	100,480	2,026,686	1,173,840	429,336	16,870,792
1976	1,965,282	81,822	1,320,750	509,160	356,308	4,233,322
1977	1,341,144	100,000	1,085,856	692,514	201,520	3,421,034
1978	4,149,288	229,400	813,378	895,698	82,434	6,170,198
1979	11,218,434	294,200	925,362	1,032,042	1,706,904	15,176,942
1980	22,505,268	297,900	2,644,698	1,060,860	3,335,284	29,844,010
1981	1,754,358	82,210	1,796,220	694,680	1,327,699	5,655,167
1982	1,134,840	239,300	1,155,552	1,034,628	1,185,551	4,749,871

[1] Sources: 1940-1945; AEIDC, 1978. 1946-1956; AEIDC, 1978 and Mathisen et al. 1963. 1956-1982; ADF&G Bristol Bay Data File.

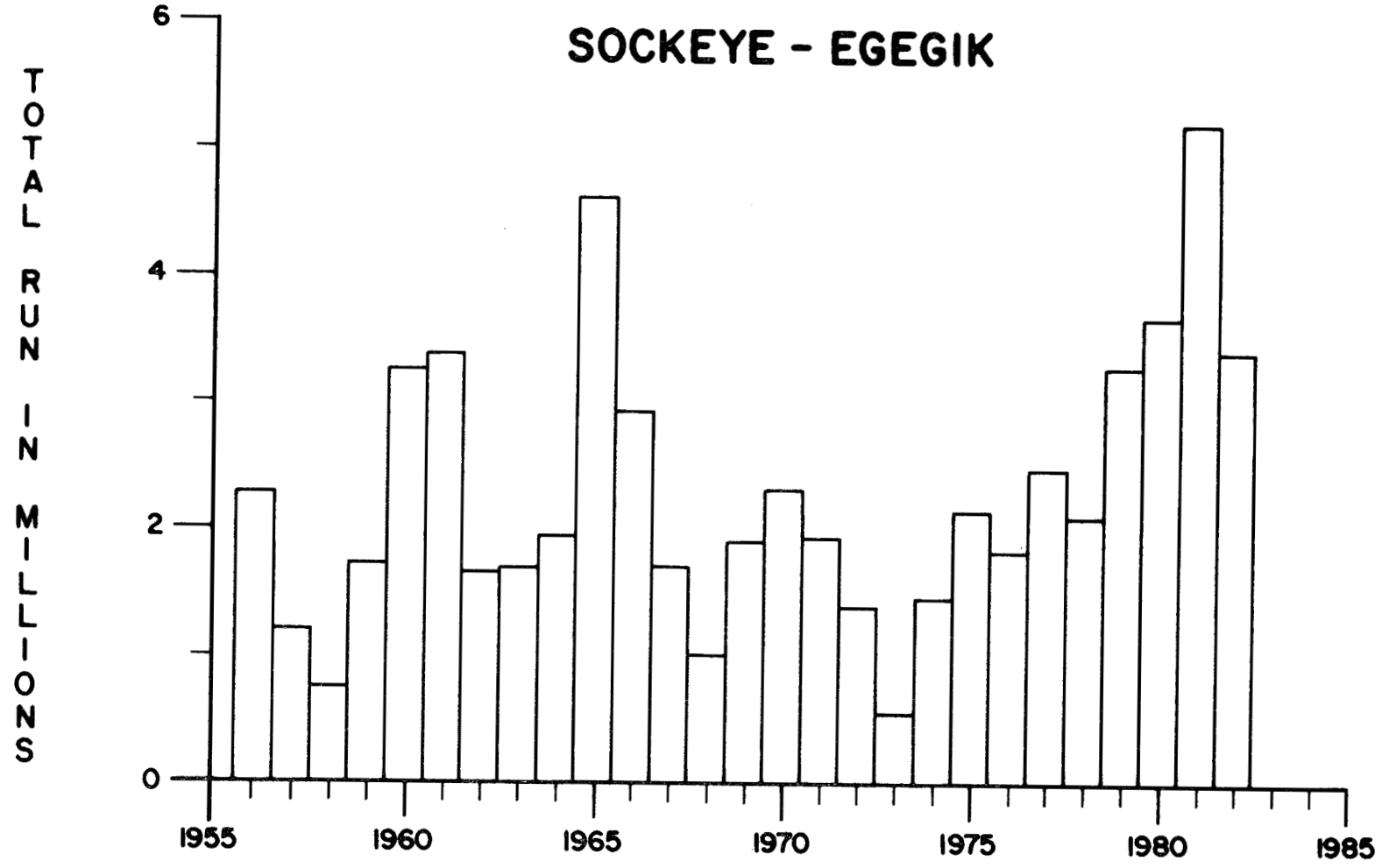


Figure 6. Total run of sockeye salmon to Egegik District in numbers of fish, 1956-1982.

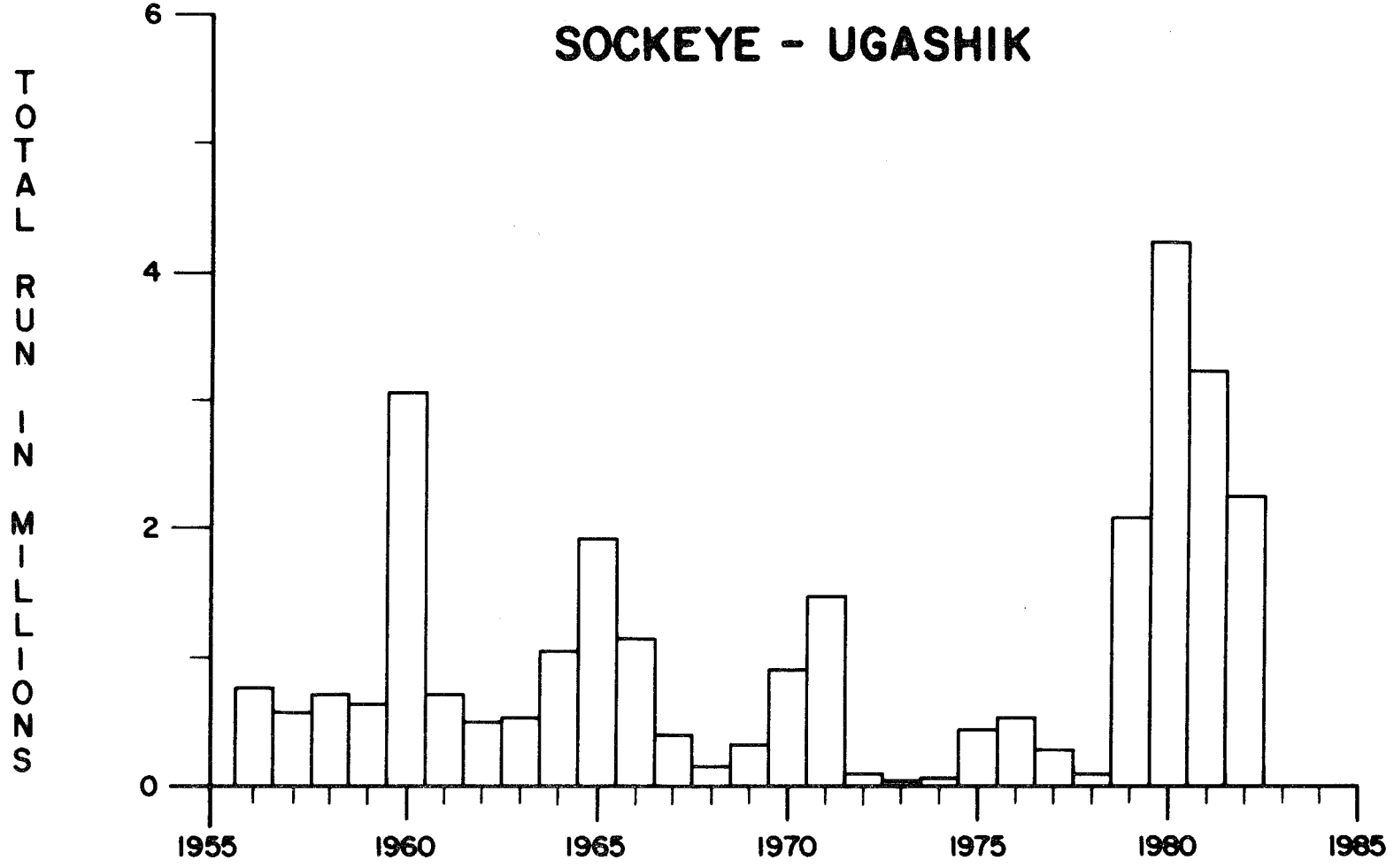


Figure 7. Total run of sockeye salmon to Ugashik District in numbers of fish, 1956-1982.

The Togiak District fishery is the most recent in Bristol Bay, dating from 1954. Based on the average total run of 402 thousand sockeye salmon, this system is producing at a sustained high rate with no indications of problems. Production has exceeded the average for the last 7 consecutive years (Figure 8).

In summary, the overall outlook for Bristol Bay sockeye salmon production is most encouraging. Although it is apparent that exceptional survival conditions have greatly aided in boosting production in the last 2 to 3 years, the variable cycle year escapement strategy for the Kvichak River system has paid off in terms of greater production spread over more years. Increased and consistent escapements to major contributing Nushagak District river systems appear to be essential to increased and sustained production for this important fishery.

Barring any severe natural setbacks, as experienced in the early 1970's, the decade of the 1980's should be a highly productive and significant period for the Bristol Bay sockeye salmon fishery.

Commercial Harvest

The Bristol Bay sockeye salmon catch has averaged 11.3 million fish per year from 1893 through 1982. The highest sustained catch period covered 40 years, from 1900 to 1940 (Table 4 and Appendix Tables 1 and 2), and averaged 14.7 million sockeye salmon per year. From 1941 to 1959 production decreased to an average of 8.3 million per year for this 19-year period. It was during this period that the important Kvichak River stock switched from a 5 to a 4-year cycle pattern for reasons still not understood. Production from 1960 on started to increase, coincidental with the Kvichak River stock reverting to the historical 5-year cycle. While production on peak years during this period was at or near historical levels, production for the intervening years was well below historical levels. Additionally, a short term setback during the mid-1970's, believed to be a result of harsh environmental conditions, greatly reduced catches as the fisheries were severely restricted to obtain escapement goals. Consequently, the harvest during this last 21-year period has averaged only 10.1 million sockeye salmon to the domestic inshore fishery. However, since 1956 a Japanese high seas gill net fishery has been harvesting Bristol Bay sockeye salmon. Adding the average catch of 1.9 million sockeye salmon per year from the Japanese fishery (see Table 5 for high seas catch) boosts the actual yield to 12 million per year, or the same as the long-term historical level.

The impact of this foreign fishery has been greatly reduced in recent years as a result of the 1976 Magnuson Fishery Conservation and Management Act (MFCMA) which established a Fisheries Conservation Zone from 3 to 200 miles (4.8 to 322 km) offshore from the U.S. coastline. This act has enabled the U.S. to exercise area and time prohibitions against foreign fishing fleets to minimize the interception of Bristol Bay sockeye salmon. The real significance of this act can be appreciated by comparing four "sets" of years when Bristol Bay sockeye salmon were most abundant (1956-57, 1960-61, 1965-66, 1970-71) and the high seas fishery averaged 4.1 million Bristol Bay sockeye salmon during these periods compared to the 1978-80 period of record runs and a high seas interception that averaged only 521 thousand sockeye salmon for each of these 5 years (Table 5).

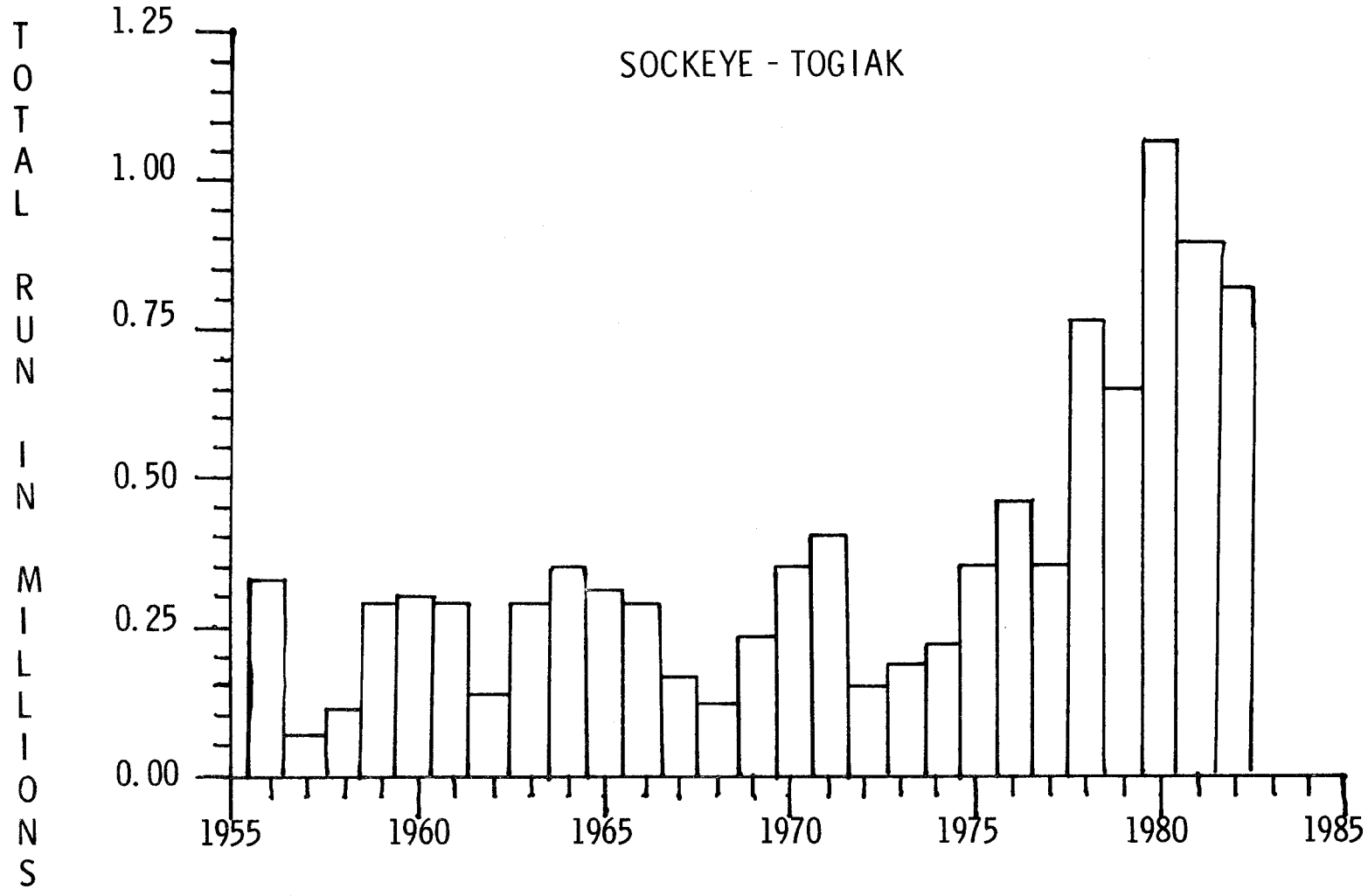


Figure 8. Total run of sockeye salmon to the Togiak District in numbers of fish, 1956-1982.

Sockeye salmon production rebounded dramatically during the late 1970's, and barring any environmental setbacks, such as the winters of 1970-71, should continue at historical high levels into the early and mid-1980's. Of particular note is the strength recently demonstrated by "off-cycle" years, a feature that had not been prevalent in this fishery for the past 40 years.

In summary, Bristol Bay sockeye salmon status at present is strong and it closely approximates the largest levels observed during peak periods in this 97-year-old fishery. There are not many, if any, salmon fisheries in the world that could make a similar claim.

Escapement

The single most important element in managing the sockeye salmon fishery is the number of fish allowed through the fishing districts to reach the spawning grounds. The escapement is the pre-determined number which is intended to yield the highest sustained rate of return per spawner and is referred to as the escapement goal.

The large, clear water river systems, and the fact that sockeye salmon migrate right along the banks of these rivers, aids greatly in obtaining accurate escapement counts for each of the nine rivers where visual counting stations are maintained along the river banks. Some rivers have continuous records of escapement going back 35 to 40 years, but the best records for nearly all major systems date from 1955 (Tables 6 and 7). On river systems where counting towers are not maintained escapements are estimated from aerial surveys of spawning areas.

Escapement goals are relatively new to Bristol Bay, having evolved largely over the last 20 years on a scientific and sufficient data basis. They have also changed in several instances as the data base expanded to enable better analyses. A great deal of debate has ensured over the years concerning escapement goal levels, particularly in the 1960's when total run size data from known escapements was limited. Long-term data is essential, or at least very helpful, in establishing basic escapement-return relationships to determine what escapement level will yield the greatest rate of return on the average. Large controlling factors, over which we have no control, are the environmental conditions affecting survival rates, both freshwater and marine. Therefore, long-term averages are important in order that these short-term, but sometimes significant changes do not overly influence the analyses of the escapement-return relationships.

Escapement goals differ from river system to river system since each has its own characteristic escapement-return relationship from which an escapement goal is determined (Appendix Figures 6-13). However, escapement goals generally remain fixed from year to year for each of the river systems except for the Kvichak. Systems other than the Kvichak do not exhibit the extreme cyclic patterns inherent to the Kvichak. Fairly large fluctuations in run size do occur periodically in the other river systems, but these probably are a result of varying survival rates or other unknown variables affecting production other than a definite cycle pattern of production. The Kvichak system has three different escapement goals, depending upon the cycle year. Escapement

Table 7. Escapement of westside Bristol Bay sockeye salmon in numbers of fish by river system, 1908-1919 and 1946-1982[1].

Year	Wood	Igushik	Snake	Nuyakuk	Nushagak	Togiak	Total
1908	2,603,655	0	0	0	0	0	0
1909	893,244	0	0	0	0	0	0
1910	670,104	0	0	0	0	0	0
1911	354,299	0	0	0	0	0	0
1912	325,264	0	0	0	0	0	0
1913	753,109	0	0	0	0	0	0
1914	0	0	0	0	0	0	0
1915	259,341	0	0	0	0	0	0
1916	551,959	0	0	0	0	0	0
1917	1,081,508	0	0	0	0	0	0
1918	943,202	0	0	0	0	0	0
1919	145,114	0	0	0	0	0	0
1946	3,717,000	500,000	70,000	432,000	0	0	0
1947	1,782,000	350,000	50,000	325,000	0	0	0
1948	1,483,250	300,000	5,000	303,000	0	0	0
1949	101,025	20,000	3,000	14,000	0	0	0
1950	451,600	75,000	4,000	42,000	0	0	0
1951	457,600	40,000	3,000	39,000	0	0	0
1952	226,800	150,000	4,000	38,000	15,000	0	0
1953	515,542	100,000	4,000	189,000	20,000	0	0
1954	570,624	80,000	4,000	29,000	8,000	0	0
1955	1,382,755	500,000	30,000	16,000	5,000	0	0
1956	773,101	400,000	4,000	30,000	5,000	225,000	1,437,101
1957	288,727	130,000	3,000	67,000	10,000	25,000	523,727
1958	960,455	107,478	9,000	196,000	5,000	72,000	1,349,933
1959	2,209,266	643,808	139,950	48,861	0	209,640	3,251,525
1960	1,016,073	495,087	16,598	145,500	0	192,010	1,865,268
1961	460,737	294,252	4,856	79,788	20,000	127,454	987,087
1962	873,888	15,660	1,760	37,890	8,500	71,552	1,009,250
1963	721,404	92,184	37,960	166,608	45,700	127,596	1,191,452
1964	1,076,112	128,532	12,436	103,224	18,700	114,674	1,453,678
1965	675,156	180,840	12,000	203,070	28,200	112,786	1,212,052
1966	1,208,682	206,360	4,500	161,010	50,174	122,998	1,753,724
1967	515,772	281,772	11,000	20,250	46,658	91,330	966,782
1968	649,344	194,508	4,100	96,642	32,070	56,418	1,033,082
1969	604,338	512,328	9,300	69,828	16,792	125,066	1,337,652
1970	1,161,964	370,920	23,800	364,648	44,824	212,896	2,179,052
1971	851,202	210,960	8,500	224,382	58,338	213,242	1,566,624
1972	430,602	60,018	2,000	28,596	7,434	81,970	610,620
1973	330,474	59,508	915	110,016	80,394	114,930	696,237
1974	1,708,836	358,752	15,266	154,614	30,000	108,492	2,375,960
1975	1,270,116	241,086	9,518	669,918	82,400	180,162	2,462,200
1976	817,008	186,120	12,728	425,220	45,200	200,590	1,686,866
1977	561,828	95,970	9,304	232,554	320,400	202,634	1,422,690
1978	2,267,238	536,154	18,074	576,666	87,400	340,076	3,825,608
1979	1,706,352	859,560	8,439	360,120	139,100	224,838	3,298,409
1980	2,969,040	1,987,530	36,500	3,026,568	290,800	572,450	8,882,888
1981	1,233,318	591,144	14,571	834,204	177,400	365,930	3,216,567
1982	976,470	423,768	12,000	537,864	63,000	341,424	2,354,526

[1] Sources: 1908-1919; Mathisen, 1971. 1946-1959; Mathisen et al. 1963. 1960-1982; ADF&G Bristol Bay.

goals for the peak year since 1975 is 14 million fish; peak year minus one (pre-peak), 6 million fish and the "off cycle" years, 2 million fish (Appendix Figure 6). Since the historic production, and apparently natural pattern for Kvichak system sockeye was a 5-year cycle characterized by two to three highly productive years in the 5 years, the objective of cycle escapement management became a primary goal in rebuilding the Bristol Bay sockeye salmon fishery.

Under normal circumstances the level of escapement can usually be controlled within a fairly tight "range" around the escapement goal figure. Variables such as delayed fishing because of price disputes, catches exceeding the processing and transport capacities, unusual variations in run timing, runs that greatly exceed or are much smaller than forecasted, and even fish behavior within the bays relating to fish "holding" or rapidly moving through an area, all affect the ability of the manager to achieve escapement goals. Weather, at certain times, can also be a major contributing factor.

Some systems are much more "manageable" than others. If a single, major river system is associated with a particular fishing district, then management is generally easier and more exact. Examples of such systems in Bristol Bay are the Ugashik, Egegik, and Togiak Rivers. Although the Kvichak and Naknek Rivers enter a common bay quite close to each other, they can be managed independently fairly successfully by dividing the fishing district into two sections and managing separately if need be. The Branch River, which is a tributary to the Kvichak River, cannot be managed as a separate entity and it's escapement is strictly incidental to that of the Kvichak system. The Nushagak District is a much more complex area to manage because several major river systems are involved, namely the Wood, Nuyakuk, and Nushagak Rivers entering the upper end of Nushagak Bay. Furthermore, the Nuyakuk is a tributary to the Nushagak River. Another significant system, the Igushik River, also enters Nushagak Bay, but is somewhat separated from the other systems. Its manageability though is somewhat limited by physical characteristics of the immediate area. Actual escapements achieved for each river system are compared with escapement goals for the years 1962 through 1982 in Appendix Tables 3-6.

Escapement is both the starting and end point for fisheries management. Up to this point in this report the high seas foreign catch, the inshore domestic catch, and finally the escapement have been discussed. Since all of these parts are affected by a broad array of variables, the truest picture of performance is examination of the combined sum, or total run. Unfortunately, the complete data base for this purpose covers only 25 years, dating from 1956. Examination of Table 4 clearly demonstrates the significance of recent production. The combined 1978 through 1982 runs total 181.8 million sockeye salmon. Assuming that the 1983 forecast of 27.1 million is accurate, these 6 years will have produced more than 208 million total sockeye salmon. This would be a 27% increase over any other 6 year period since 1956.

Management Strategies and Problem Identification

The basic management strategies for sockeye salmon in this fishery are rather simple in concept, yet somewhat complicated in execution. Essentially, the mechanism is to periodically open specific fishing areas for a limited time to allow catches on a certain stock or stocks of fish. Each catch period

represents a large "sample" that is measured in various ways to assess its significance or meaning at that time. Each catch period is followed by a closed period which allows some "escapement." While the catch is a rather straightforward numerical value, and is usually available within several hours of a particular fishing period, the escapement value for a specific closure on a real time basis is much more difficult to ascertain in most instances. Although accurate visual counting stations are maintained on all the major river systems, this capability is too far removed in space and time from the fishing districts, except in two instances, to be of immediate use in determining subsequent open or closed periods. Therefore, an elaborate system of supportive and indirect measuring methods have been developed to assess the continuous balancing of open and closed fishing periods in terms of achieving escapement goals and harvesting fish in excess of those needs.

Fundamental to this basic strategy is the concept of stock management, in that as much as possible, each major river system is managed as an individual entity. The accurate assessment of these individual stocks' performance relative to escapement goals is the cornerstone of meaningful management strategies. To assess and improve this capability requires dedicated and farsighted research application.

In order to insure the viability of the numerous spawning populations within a given stock or stocks, and to develop sufficient data on a given run to insure attainment of a particular goal, it is desirable to spread both the catch and escapement throughout the run. However, conservative management is necessary during the first half of a run since there are so many variables at work that may not be readily apparent early on.

Management capability, flexibility, and quick response are essential to carrying out these strategies. Strategies may vary under extraordinary circumstances, such as when regulatory restraints were virtually removed during the 1970 and 1980 seasons.

In-season management involves a multitude of simultaneous analyses covering five individual fishing districts. Although in itself not a reliable indicator of the strength of the Bristol Bay sockeye salmon run, the Shumagin Island - Unimak sockeye salmon fisheries in the Alaska Peninsula area in June is watched very closely since Bristol Bay sockeye salmon pass these areas on their migratory movement from the Gulf of Alaska. The first check point beyond there, where only Bristol Bay sockeye are involved, occurs at Port Moller on the north side of the Alaska Peninsula, some 200 mi (322 km) from Bristol Bay. At this point, the sockeye salmon travel within an 80 mi (129 km) band from the coastline. The Department conducts a test fishing program in this area that continuously samples along a line that intercepts the sockeye salmon run to Bristol Bay. This sampling yields information concerning run timing, age composition (that is compared to forecasted age composition), and estimates of probable run size some 7 days before becoming available to the fishery.

The next step occurs with actual commercial catches. This is a basic and valuable comparative statistic and is subjected to careful analysis since catches themselves do not necessarily reflect total run strength.

Additionally, commercial fishing boats are chartered to conduct test fishing during closed fishing periods in the Nushagak, Naknek-Kvichak, and Egegik Districts. This endeavor attempts to assess the relative buildup of run strength in these important districts during periods when the commercial fleet is inactive. This sampling may involve from one to four boats per district.

In some rivers (Ugashik, Egegik, Kvichak, and Igushik) test gill net sampling is conducted on each tide just above the commercial fishing areas to develop estimates of daily escapement rates into the rivers.

A further check point is established by conducting aerial surveys on those rivers where feasible. The bays are usually quite turbid because of the tidal action on the mud and silt substrate. This condition extends variable distances upstream in all the rivers. Once above this influence however, sockeye salmon can readily be observed (under proper weather conditions) migrating in tight bands along the river banks. Experienced observers can also make reasonable estimates of numbers, and daily or even twice daily observations can provide valuable data on escapement rates in this rapidly changing fishery. Finally, tower counts are analyzed daily to verify river test fishing, aerial surveys and particularly escapement rate. In two instances, the Wood and Naknek Rivers, tower counts occur close enough in time to the commercial fishery to be useful for immediate application on management decisions.

All of this, and much more, information is constantly being transmitted, sorted, and analyzed on a hourly basis throughout the salmon run. In this era of data processing and computers, this vast array of information is put through rapid and sophisticated analysis to aid management decisions.

In the final analysis however, a good deal of personal judgment, based on solid experience is essential in determining just when and how long the very efficient fishing fleets should be allowed to harvest, or not to harvest these valuable fish.

Program objectives continue to be imperfectly met annually because of a variety of environmental and social effects alluded to earlier. To minimize the effects of the weather, more all purpose sampling methods, such as sonar will be continually developed. In addition, advances in fishing gear technology will be incorporated into test fish operations.

PINK SALMON FISHERY

Biological Status

The current status of pink salmon in Bristol Bay is at an all time high. However, their abundance has characteristically been erratic historically and any long-term projections would be mere speculation. It is probably realistic to assume that production will decline in the immediate future to levels more in line with past performances and total runs in the 2 to 3 million fish range.

Commercial Harvest

Pink salmon is the second most abundant species in Bristol Bay considering only even-years since odd-year production is almost nonexistent (Table 8 and Appendix Table 1). Although pink salmon is the second most abundant species in Bristol Bay, they are the least valuable on a per fish or per pound basis. Consequently, they only represent 2% of the total ex-vessel value, and average $1.1 million for the past 23 years with a range of $0 to $5.4 million (Table 2). In terms of ex-vessel value they match coho salmon but are in fourth place overall. Although the earliest years catch data reflects odd-year pink production in fair numbers, these figures are suspect since no similar occurrence has been recorded since 1913. The historical catch data actually has to be viewed in three time frames because of significant changes in gear use. The catches prior to 1923 were largely from traps in the Nushagak District. The average catch during this 24-year period (omitting 1919 and 1921) was 490 thousand fish. From 1923 to 1956 (even-years only) pink salmon, or small mesh gear was prohibited as were traps and the average pink salmon catch was 140 thousand for this 16-year period (even years only). Small size mesh, or pink salmon gear, was allowed by regulation in 1958. The even-year average catch from 1958 to 1982 is 1.5 million fish. Pink salmon catch data prior to 1958 cannot realistically be used as any gauge of pink salmon production because of the gear restraints mentioned, and the fact that the fishery normally closed at about the time that pink salmon runs were just getting well underway.

The 1978 run was unparalleled in history to our knowledge. The record 5.2 million catch was three and a half times greater than the 1958 to 1982 average and twice the previous high. The recorded escapement for 1978 was a staggering 11.5 million. The 1980 return from this enormous 1978 run was not nearly as large, but still produced a catch of nearly 2.7 million, slightly exceeding 1966 for the second highest catch on record, and resulted in the third largest escapement of 3.4 million fish (Table 9).

The vast majority of pink salmon are produced from river systems entering the Nushagak District, and the bulk of this production comes from the Nuyakuk River, tributary to the Nushagak River. The Nushagak District has accounted for 86% of the Bristol Bay pink salmon catches since 1958. Pink salmon runs to other districts tend to be small and most catches are taken incidentally in sockeye salmon gill net gear.

Because tower and aerial enumeration on the primary Nuyakuk River has only been operational since 1958, total run data for the Nushagak District is limited and total run comparisons can only be made for the past 13 even-years.

Escapement

The primary pink salmon system in Bristol Bay is the Nuyakuk River, tributary to the Nushagak River. In most years, the bulk of the spawners concentrate in a 30 mi (48 km) stretch of the river from the Department counting towers upstream to the rapids at the outlet of Tikchik Lake. Therefore, the counting station designed mainly for sockeye salmon, also serves to count the pink salmon spawning population in this river.

Table 8. Commercial catch of Bristol Bay pink salmon in numbers of fish by district, 1893-1982[1].

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	0	0	0
1894	0	0	0	0	0	0
1895	0	0	0	0	0	0
1896	0	0	0	0	0	0
1897	0	0	0	35,348	0	35,348
1898	0	0	0	59,786	0	59,786
1899	0	0	0	16,758	0	16,758
1900	0	0	0	7,803	0	7,803
1901	13,000	0	0	218,188	0	231,188
1902	46,752	0	8,080	447,433	0	502,265
1903	0	2,700	0	238,804	0	241,504
1904	35,593	2,691	19,723	340,139	0	398,146
1905	32,200	49,000	26,662	183,153	0	291,015
1906	319,563	14,000	22,797	1,545,585	0	1,901,945
1907	0	0	0	344,148	0	344,148
1908	2,570	0	3,890	392,797	0	399,257
1909	28	7,132	0	94,119	0	101,279
1910	219,330	2,430	0	430,369	0	652,129
1911	12,000	0	0	79,764	0	91,764
1912	145,536	4,900	14,167	1,516,039	0	1,680,652
1913	4,524	2,954	0	418,015	0	425,493
1914	167,423	6,717	82	390,776	0	564,998
1915	124,385	10,413	0	0	0	134,798
1916	45,164	0	0	638,607	0	683,771
1917	37,082	0	0	0	0	37,082
1918	35,322	0	0	583,981	0	619,303
1919	439	0	0	13	0	452
1920	950,098	21	0	1,095,318	0	2,045,437
1921	924	0	0	15	0	939
1922	38,766	28,929	0	222,100	0	289,795
1923	3	0	0	0	0	3
1924	2,025	0	0	101,031	0	103,056
1925	0	0	0	18	0	18
1926	4,165	0	0	283,876	0	288,041
1927	0	0	0	3	0	3
1928	933	0	0	45,732	0	46,665
1929	0	0	0	0	0	0
1930	1,741	0	0	246,986	0	248,727
1931	0	0	0	0	0	0
1932	900	0	0	171,496	0	172,396
1933	0	0	0	150	0	150
1934	0	0	0	33,303	0	33,303
1935	0	0	0	0	0	0
1936	12,699	952	0	510,190	0	523,841
1937	0	0	0	0	0	0
1938	0	0	0	0	0	0

-Continued-

Table 8. Commercial catch of Bristol Bay pink salmon in numbers of fish by district, 1893-1982[1] (continued).

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1939	0	0	0	48	0	48
1940	14,618	30	0	243,694	0	258,342
1941	0	0	0	0	0	0
1942	6,640	0	0	165,273	0	171,913
1943	0	0	0	0	0	0
1944	3,435	0	0	51,829	0	55,264
1945	0	0	0	23	0	23
1946	5,183	1	0	36,066	0	41,250
1947	0	0	0	421	0	421
1948	253	0	1	52,982	0	53,236
1949	0	0	1	37	0	38
1950	330	0	0	31,841	0	32,171
1951	11	0	0	23	0	34
1952	6,277	0	1,000	6,852	0	14,129
1953	7	2	0	3	0	12
1954	1,925	0	0	99,207	1,850	102,982
1955	0	0	0	9	0	9
1956	511	4	0	91,457	0	91,972
1957	2	24	0	3	0	29
1958	19,666	492	0	1,113,794	1,590	1,135,542
1959	25	6	78	137	55	301
1960	10,582	0	0	289,781	1,669	302,032
1961	42	3	0	248	245	538
1962	32,436	43	1	880,424	1,030	913,934
1963	56	1	2	226	176	461
1964	49,127	606	18	1,497,817	2,001	1,549,569
1965	514	0	0	95	91	700
1966	142,221	8	11	2,337,066	13,545	2,492,851
1967	20	0	0	265	829	1,114
1968	218,732	211	0	1,705,150	11,743	1,935,836
1969	205	5	1	263	1,396	1,870
1970	28,301	41	0	417,834	10,735	456,911
1971	2	0	0	37	173	212
1972	57,074	12	0	67,953	1,984	127,023
1973	109	0	1	61	216	387
1974	508,534	4,405	340	413,613	13,086	939,978
1975	6	9	2	126	279	422
1976	264,631	4,121	116	739,590	28,085	1,036,543
1977	19	0	5	3,017	1,476	4,517
1978	734,880	11,430	530	4,348,336	57,524	5,152,700
1979	134	6	9	1,787	1,913	3,849
1980	288,363	2,476	51	2,202,545	70,033	2,563,468
1981	177	262	29	338	6,722	7,528
1982	125,869	1,973	14	1,285,947	23,660	1,437,463

[1] Sources: 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

Table 9. Inshore catch, escapement, and total run of Bristol Bay pink salmon in thousands of fish during even-years, 1958-1982[1].

Year	Catch	Escapement Estimates[2]	Total Run
1958	1,114[4]	4,000[3]	5,114
1960	302	146	448
1962	914	543	1,457
1964	1,550	911	2,461
1966	2,493	1,442	3,935
1968	1,936	2,161	4,097
1970	457	153	610
1972	127	59	186
1974	940	986	1,926
1976	1,037	1,040	2,077
1978	5,153	11,492	16,645
1980	2,563	3,317	5,880
1982	1,437	1,806	3,243

[1] 1982; Preliminary data.

[2] 1960-1972; Nushagak District estimates only. 1974; Nushagak and Naknek-Kvichak estimates. 1976-1982; Nushagak, Naknek-Kvichak, and Togiak estimates; 1980-1982 Ugashik; 1982 Egegik.

[3] Aerial estimates, Nuyakuk River.

[4] Nushagak District catch only.

Over 90% of the observable pink salmon in this area are found in the Nuyakuk River. Smaller populations also exist in Wood, Igushik, Nushagak, and Mulchatna Rivers. These populations are estimated by aerial surveys as are spawners located below the Nuyakuk counting towers. Since the counting towers are located some 100 mi (160 km) from the fishing district, these counts cannot be used for in-season management purposes.

Since 1958, the catch plus escapement, or total run of pink salmon to the Nushagak District has averaged 3.2 million fish. This includes one very depressed cycle year (1972), which produced a total run of only 126 thousand pink salmon. Presumably, this was a result of the severe winters of 1970-71 that also affected sockeye salmon production during this same period. However, the 1976 cycle year escapement of 863 thousand to Nushagak District produced the enormous run of 13.7 million in 1978, for a 16 to 1 return per spawner.

An escapement goal of 1 million pink salmon has been established for the Nushagak District. This is a somewhat subjective figure based on general performance of escapements and resultant returns since 1958.

Management Strategies and Problem Identification

Pink salmon cannot readily be managed on the basis of real-time escapement, although aerial surveys can sometimes be helpful. A new Nushagak River sonar counting project shows much promise as a reliable in-season escapement estimate to aid in managing this fishery. Fishing effort can vary greatly from year to year for pink salmon, thus, fishing effort is an important component in assessing catch data and trends. Fishing time generally tends to be more liberal during the early portion of the run than for sockeye salmon since progressive catch data has been the basic management tool used to assess the strength of the run.

Fishing time is adjusted as the run develops and indications from the fishing fleet, upriver subsistence catches, aerial surveys, and since 1980, sonar escapement trends provide sufficient information to modify the exploitation rate.

It is not uncommon in this fishery to encounter the situation where there is not enough fishing effort or interest from buyers to harvest the available surplus. Our inability to forecast probable run size with any degree of confidence may tend to detract from serious or certain planning by both fishermen and processors.

The basic problem with pink salmon is our nearly total lack of knowledge concerning the species in this area. Other than routine sampling of the Nushagak District commercial catch and Nuyakuk River escapement, biological studies have not been conducted on pink salmon in Bristol Bay. This lack of knowledge hinders the ability to realistically forecast runs with any degree of confidence. New funding was acquired in 1981 to assess the total pink salmon smolt migration from the Nuyakuk-Nushagak River systems. Future data collections will show whether this program will be a successful method of forecasting run size.

The inability to assess escapement on a real time basis is a serious deficiency. This, in combination with having to use catch as a primary management technique, greatly enhances the possibility of over or under exploitation. Once the new sonar enumeration program in lower Nushagak River is fully operational, escapement estimates and trends will be available to the fishery manager on

a timely basis and this will negate the need to rely on the less reliable catch per unit effort (CPUE) and aerial survey run strength indicators. A great deal of personal experience with the fishery has been necessary under these circumstances in order to conduct a reasonably managed fishery.

CHUM SALMON FISHERY

Biological Status

The current status of Bristol Bay chum salmon is well above average, in terms of catch, escapement, and total estimated runs. In terms of total run, which is the only real indicator of production, the last 7 (1976-82) years have been extraordinary relative to the prior years of 1966-1975 for the Nushagak and Togiak Districts, where such data is available. Overall production, catch plus escapement for the 7 years, 1976 to 1982, have averaged 1.7 million chum salmon for these two districts compared to the previous 9 year average of 742 thousand fish.

The recent years trend cannot logically be expected to continue on a long-term basis, but it is evident that chum salmon are experiencing exceptional survival rates along with other species and recent years escapement levels should produce above-average production of the next few years. Chum salmon can generally be expected to perform somewhat synchronous to sockeye salmon, although they do not exhibit the dramatic ups and downs of sockeye salmon and tend to be more stable overall.

Since chum salmon stocks cannot presently be managed independently of the far more numerous sockeye salmon runs, it is not possible to project long-term possibilities for this species, except to say that they have held up relatively well through the history of this fishery. More precise management capability for sockeye salmon may likely result in biological benefits for chum salmon.

Commercial Harvest

Chum salmon is the third most abundant species in Bristol Bay and match pink salmon with an average annual value of 1.2 million dollars to the fishermen, and also 4% of the total value for all species.

Although chum salmon occur simultaneously with the sockeye, their pattern of catches are quite stable throughout the history of the fishery, far more so than any other species, and have averaged about 497 thousand fish annually with a range of 146.5 thousand in 1950 to 1.6 million in 1977 (Table 10). Their value on a per pound basis is generally intermediate between pink and sockeye salmon. Recent high catches and increased prices over the past 7 years (1976-1982) have raised the average value for these years up to $3.1 million.

Chum salmon in Bristol Bay are produced largely in the Nushagak District which has accounted for 52% of the total production since 1960. The Togiak and Naknek-Kvichak Districts rank second, producing 20%. The remaining 8% are somewhat evenly divided between the Egegik and Ugashik Districts. Catches have increased rather significantly in the past 7 years since 1976, averaging 1.2 million or

Table 10. Commercial catch of Bristol Bay chum salmon in numbers of fish by district, 1893-1982[1].

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	0	0	0
1894	0	0	0	0	0	0
1895	0	0	0	0	0	0
1896	0	0	0	0	0	0
1897	0	0	0	0	0	0
1898	0	0	0	0	0	0
1899	0	0	0	0	0	0
1900	0	0	0	0	0	0
1901	0	0	0	0	0	0
1902	0	0	0	0	0	0
1903	0	0	0	0	0	0
1904	1,138	0	1,600	34,570	0	37,308
1905	4,946	0	19,105	34,933	0	58,984
1906	24,000	0	60,000	169,541	0	253,541
1907	45,458	20,925	26,972	415,372	0	508,727
1908	5,024	29,197	10,309	415,369	0	459,899
1909	1,872	8,917	10,728	356,621	0	378,138
1910	93,840	3,002	7,156	206,220	0	310,218
1911	89,688	3,416	8,967	245,795	0	347,866
1912	11,149	2,419	0	341,059	0	354,627
1913	5,830	0	13,704	265,184	0	284,718
1914	9,662	1,064	14,531	541,690	0	566,947
1915	129,130	1,591	18,212	444,146	0	593,079
1916	259,013	7,500	49,196	1,173,914	0	1,489,623
1917	45,997	5,726	879	303,620	0	356,222
1918	94,036	6,663	6,588	638,537	0	745,824
1919	25,251	2,627	6,095	170,501	0	204,474
1920	188,469	5,503	31,765	208,601	0	434,338
1921	102,157	8,634	8,777	235,763	0	355,331
1922	57,367	27,659	4,888	426,001	0	515,915
1923	17,319	7,169	8,253	152,161	0	184,902
1924	113,731	6,042	13,455	152,235	0	285,463
1925	110,396	9,321	15,825	96,266	0	231,808
1926	130,644	1,017	19,062	175,295	0	326,018
1927	44,489	5,413	8,376	137,525	0	195,803
1928	109,060	12,294	15,070	260,157	0	396,581
1929	170,927	19,268	23,619	407,740	0	621,554
1930	95,991	16,339	18,835	95,765	0	226,930
1931	315,956	20,343	9,536	289,891	0	635,726
1932	337,062	11,810	11,811	547,839	0	908,522
1933	53,235	4,903	11,824	185,696	0	255,658
1934	149,676	9,723	16,089	156,581	0	332,069
1935	30,549	360	0	41,140	0	72,049
1936	83,069	10,630	5,346	159,919	0	258,964
1937	133,002	17,829	10,939	140,461	0	302,231

-Continued-

Table 10. Commercial catch of Bristol Bay chum salmon in numbers of fish by district, 1893-1982[1] (continued).

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1938	319,420	52,390	38,460	135,110	0	545,380
1939	386,789	41,616	52,491	453,786	0	934,682
1940	145,101	18,594	0	129,455	0	293,150
1941	213,906	25,166	524	284,684	0	524,280
1942	22,240	0	14,363	132,360	0	168,963
1943	136,743	0	9,320	230,740	0	376,803
1944	113,800	26,260	10,489	164,920	0	315,469
1945	198,348	0	33,400	403,545	0	635,293
1946	86,629	26,560	22,652	100,199	0	236,040
1947	110,009	31,175	17,307	57,224	0	215,715
1948	187,881	40,142	30,654	237,980	0	496,657
1949	60,748	16,422	36,400	155,568	0	269,138
1950	19,622	4,240	14,699	107,888	0	146,449
1951	38,844	15,439	16,843	85,624	0	156,750
1952	93,835	18,060	19,651	117,875	0	249,421
1953	212,112	26,724	21,027	127,483	0	387,346
1954	138,016	62,040	39,384	159,852	1,352	400,644
1955	39,405	23,238	51,280	97,521	735	212,179
1956	93,841	16,713	6,934	172,546	25,483	315,517
1957	45,620	12,849	13,226	143,461	44,186	259,342
1958	119,324	12,089	12,714	193,688	20,277	358,092
1959	200,458	29,407	20,185	186,891	44,575	481,516
1960	304,286	62,837	51,415	642,099	255,320	1,315,957
1961	182,398	57,429	30,928	267,176	190,001	727,932
1962	176,712	23,053	22,040	290,633	165,107	677,545
1963	100,408	14,807	10,554	167,161	77,167	370,097
1964	153,644	23,496	30,688	463,309	131,371	802,508
1965	45,430	11,188	14,971	177,434	111,521	360,544
1966	57,273	32,085	29,100	129,344	95,410	343,212
1967	49,606	11,039	14,104	338,286	63,322	476,357
1968	43,187	16,193	17,624	178,786	108,001	363,791
1969	42,535	7,835	1,995	214,235	66,389	332,989
1970	120,279	43,854	17,969	435,033	100,711	717,846
1971	151,465	27,073	14,506	360,015	123,847	676,906
1972	115,737	42,172	9,689	310,126	178,885	656,609
1973	123,610	23,034	6,092	336,331	195,431	684,498
1974	41,347	4,022	2,334	157,941	80,710	286,354
1975	79,740	4,094	1,634	152,891	87,058	325,417
1976	317,550	46,955	9,924	801,064	153,559	1,329,052
1977	340,228	83,121	4,465	899,701	270,649	1,598,164
1978	185,451	44,480	1,449	651,743	274,967	1,158,090
1979	196,398	38,004	12,174	440,279	219,942	906,797
1980	204,515	78,556	36,343	681,930	299,682	1,301,026
1981	345,955	87,452	32,624	772,869	236,407	1,475,307
1982	194,256	82,040	50,283	456,441	159,136	942,156

[1] Sources: 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

nearly three times the historical average. The largest catch in history occurred in 1977, and record or near record catches, have occurred for 5 out of the last 7 years. Some of this may be attributed to more fishing time directed at harvesting recent large sockeye salmon runs, but there is little doubt that chum salmon have been more abundant in recent years.

Escapement

Efforts to determine chum salmon escapements have been centered in the Nushagak and Togiak Districts of Bristol Bay where 73% of the commercial catch has been produced since 1960. Chum salmon escapement estimates are based upon extensive aerial survey methods begun in the mid 1960's. With the exception of the newly established sonar counting site on the Nushagak River in 1979, existing sockeye salmon counting tower projects are located in areas where chum salmon are not found.

A comprehensive aerial survey data base has been established for chum salmon escapement estimates in the Togiak District since 1967. Nushagak District escapements have been monitored by aerial surveys since 1966, but the quality of these surveys have not been as good as in the Togiak District because of the sheer size of the drainage and the number of spawning streams involved.

Escapement estimates in the Nushagak District have averaged 268 thousand since 1966, with a range of 80 thousand in 1966 and 1975 to 969 thousand in 1980, and 256 thousand in the Togiak District with a range of 85 thousand in 1969 to 496 thousand in 1977 (Table 11). Since escapement estimates are based on aerial survey methods, it is probable that these estimates are minimal, but are reflective of the relative magnitude of escapement levels.

It appears that chum salmon runs to the Nushagak and Togiak Districts combined, have been commercially exploited at about 50%. If this exploitation rate is applied to other Bristol Bay districts, the probable escapement for chum salmon overall in Bristol Bay averages approximately 750 thousand fish since 1960.

Escapement goals have not been formalized for chum salmon, but minimum escapement levels of 200 thousand for the Nushagak District and approximately 200 thousand for the Togiak District are believed to be necessary to maintain the chum salmon stocks at a sustained production level in line with historical performance.

Management Strategies and Problem Identification

Since chum and sockeye salmon runs are coincidental in timing, management of chum salmon specifically is generally not possible. When chum salmon runs are very strong, and additional sockeye closures will not materially affect sockeye escapements (even though more sockeye salmon escapement may be desirable), additional fishing time has been allowed in the Nushagak District to harvest chum salmon that are apparently in excess of escapement needs. This event only occurs in rare instances.

Fishing effort is not directed specifically at chum salmon except in the outlying sections of the Togiak District.

Table 11. Commercial catch, escapement, and total run of chum salmon in Nushagak and Togiak Districts in thousands of fish, 1966-1982[1].

	NUSHAGAK DISTRICT			TOGIAK DISTRICT		
Year	Catch[2]	Escapement	Total	Catch[2]	Escapement	Total
1966	129	80	209	95	0	0
1967	338	200	538	63	179	242
1968	179	100	279	108	348	456
1969	214	130	344	66	85	151
1970	435	273	708	101	241	342
1971	360	226	586	124	229	353
1972	310	195	505	179	170	349
1973	336	200	536	195	163	358
1974	158	100	258	81	161	242
1975	153	80	233	87	114	201
1976	801	500	1,301	154	392	546
1977	900	609	1,509	271	496	767
1978	652	293	945	275	396	671
1979	440	166	606	220	293	513
1980	682	969	1,651	300	415	715
1981	773	177	950	236	331	567
1982	456	256	712	159	86	245

[1] 1966-1982 escapement estimates are from comprehensive aerial surveys. Zero escapements indicate lack of aerial surveys. Nushagak escapement estimate from aerial surveys and sonar counts, 1979-1982.

[2] 1981-1982, preliminary data.

Like pink salmon, there is very little knowledge concerning chum salmon in Bristol Bay. The present level of knowledge is limited to annual estimates of spawning populations in the Nushagak and Togiak Districts, plus sampling the commercial catch to determine the age classes comprising each years run.

Since run timing is coincidental with sockeye salmon, any attempts to develop in-season run strength indicators would probably be frustrated because of the numerical superiority of sockeye salmon in most areas. There is always the hazard of overexploiting a weak chum salmon run during a strong sockeye salmon run. Similarly, real-time escapement enumeration would be useful information but the application toward actual management manipulation specific to chum salmon would be limited.

Specific biological data concerning average freshwater and marine survival rates would be useful in terms of developing long range forecasts which are not possible at present.

The Offshore Test Fishing project at Port Moller has provided a data base that indicates the general chum salmon run size shortly before entering the fishery and has been used to modify fishing time in the Nushagak District when the sockeye salmon run timing and other circumstances allow.

CHINOOK SALMON FISHERY

Biological Status

The 5 year period (1978-1982) for chinook salmon have all been above average total runs to the Nushagak District, averaging 280 thousand compared to the 16 year (1966-1982) average of 169 thousand fish. The 2 years (1981-1982) have been especially strong, averaging 346 thousand chinook salmon. Recent years have also been above average for the Togiak District with a peak year run of 97 thousand in 1978 (Table 12). The Togiak chinook salmon run has averaged 41 thousand since 1967.

Overall, chinook salmon production in Bristol Bay has definitely been up over the past few years. The outlook for the next several years is promising because of the very good escapements in recent years, and a reduction in the high seas foreign fisheries interception of western Alaska chinook salmon.

Commercial Harvest

Chinook salmon is the fourth most abundant species in Bristol Bay, and represents 4% of the total value from 1960 to 1982 (Table 2), averaging $1.3 million in ex-vessel value for this period. The historical average catch (1893-1982) is 82 thousand fish. For the past 23 years, 1960-1982, the average is 118 thousand. The historical commercial catch by river system for chinook salmon is shown in Table 13. Chinook salmon are the largest species and average about 22 lb (10 kg) per fish. Until 1969, chinook salmon, as well as other salmon species in Bristol Bay were purchased on a per fish basis. Beginning in 1969 a price per pound buying basis was established, and since then chinook salmon have ranked

Table 12. Commercial catch, escapement, and total run of chinook salmon in Nushagak and Togiak Districts in thousands of fish, 1966-1982[1].

	NUSHAGAK DISTRICT			TOGIAK DISTRICT		
Year	Catch[2]	Escapement	Total	Catch[2]	Escapement	Total
1966	58	40	98	10	0	0
1967	96	65	161	13	10	23
1968	78	70	148	13	16	29
1969	81	35	116	20	8	28
1970	88	50	138	29	15	44
1971	83	0	0	27	20	47
1972	46	25	71	20	14	34
1973	30	35	65	11	11	22
1974	32	70	102	11	15	26
1975	21	70	91	7	11	18
1976	61	100	161	30	14	44
1977	85	65	150	35	20	55
1978	119	130	249	57	40	97
1979	157	95	252	30	20	50
1980	65	141	206	13	12	25
1981	195	150	345	24	27	51
1982	200	147	347	40	17	57

[1] 1966-1982 escapement estimates are from comprehensive aerial surveys. Zero escapements indicate lack of aerial surveys.

[2] 1981-1982, preliminary data.

Table 13. Commercial catch of Bristol Bay chinook salmon in numbers of fish by district, 1893-1982[1].

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	44,000	0	44,000
1894	0	0	0	10,500	0	10,500
1895	1,452	0	0	18,473	0	19,925
1896	2,524	0	0	14,777	0	17,301
1897	1,247	257	259	18,134	0	19,897
1898	1,845	537	142	16,736	0	19,260
1899	1,248	0	0	37,011	0	38,259
1900	2,342	41	778	55,146	0	58,307
1901	15,245	616	3,755	86,431	0	106,047
1902	6,755	0	4,118	98,216	0	109,089
1903	3,032	264	1,570	81,640	0	86,506
1904	11,406	0	760	85,787	0	97,953
1905	17,470	0	2,456	96,929	0	116,855
1906	33,574	400	4,162	105,058	0	143,194
1907	28,495	1,410	3,615	104,157	0	137,677
1908	17,565	1,213	2,056	69,175	0	90,009
1909	17,084	2,891	2,203	108,311	0	130,489
1910	13,629	801	892	86,433	0	101,755
1911	7,951	460	946	103,806	0	113,163
1912	9,570	202	467	87,489	0	97,728
1913	5,648	254	691	67,656	0	74,249
1914	10,657	405	1,209	88,693	0	100,964
1915	29,392	510	1,739	116,387	0	148,028
1916	20,934	365	1,904	81,921	0	105,124
1917	16,155	143	531	74,316	0	91,145
1918	39,540	427	695	46,386	0	87,048
1919	106,705	198	1,273	93,778	0	201,954
1920	27,791	441	1,181	97,937	0	127,350
1921	19,540	566	828	71,048	0	91,982
1922	11,272	940	626	61,182	0	74,020
1923	9,681	394	541	56,397	0	67,013
1924	17,715	126	290	53,532	0	71,663
1925	26,149	833	1,870	68,596	0	97,448
1926	18,933	331	484	54,856	0	74,604
1927	14,298	735	769	68,044	0	83,846
1928	13,876	462	661	51,076	0	66,075
1929	21,995	302	753	127,613	0	150,663
1930	16,131	316	949	88,032	0	105,428
1931	2,029	236	47	44,863	0	47,175
1932	10,091	271	203	57,721	0	68,286
1933	2,646	522	581	45,559	0	49,308
1934	8,130	364	576	36,875	0	45,945
1935	1,892	46	0	1,635	0	3,573
1936	7,699	362	217	13,425	0	21,703
1937	10,628	704	1,034	24,263	0	36,629

-Continued-

Table 13. Commercial catch of Bristol Bay chinook salmon in numbers of fish by district, 1893-1982[1] (continued).

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1938	13,120	1,731	1,352	29,731	0	45,934
1939	14,289	936	923	17,260	0	33,408
1940	7,596	772	0	6,899	0	15,267
1941	6,592	460	0	23,609	0	30,661
1942	3,736	0	695	14,575	0	19,006
1943	11,167	0	389	29,590	0	41,146
1944	7,925	20	258	8,170	0	16,373
1945	10,396	0	595	15,618	0	26,609
1946	7,889	699	693	18,120	0	27,401
1947	11,552	500	49	29,540	0	41,641
1948	8,408	303	188	40,217	0	49,116
1949	8,343	341	460	41,608	0	50,752
1950	6,472	333	10,768	27,688	0	45,261
1951	5,009	342	606	34,226	0	40,183
1952	11,404	972	632	39,848	0	52,856
1953	13,848	743	463	27,502	0	42,556
1954	7,101	9,777	1,093	38,045	0	56,016
1955	11,448	3,079	3,160	56,463	1,279	75,429
1956	6,006	1,448	616	57,441	866	66,377
1957	5,524	4,139	883	79,122	1,752	91,420
1958	8,391	3,155	2,368	87,245	2,048	103,207
1959	15,298	3,282	5,493	54,299	5,917	84,289
1960	17,778	2,991	2,209	81,416	7,309	111,703
1961	10,206	3,266	3,483	60,953	10,748	88,656
1962	8,816	2,070	2,929	61,283	8,949	84,047
1963	4,713	2,355	3,030	45,979	6,192	62,269
1964	12,902	3,618	3,694	108,606	10,716	139,536
1965	9,793	2,313	4,042	85,910	10,909	112,967
1966	5,456	1,949	1,916	58,184	9,967	77,472
1967	3,705	2,285	1,582	96,240	13,381	117,193
1968	6,398	3,472	2,153	78,201	13,499	103,723
1969	19,016	2,801	2,107	80,803	20,181	124,908
1970	19,037	3,765	1,498	87,547	28,664	140,511
1971	10,254	2,187	779	82,769	27,026	123,015
1972	2,262	1,097	166	46,045	19,976	69,546
1973	951	1,475	292	30,470	10,856	44,044
1974	480	1,133	1,200	32,051	10,797	45,662
1975	964	237	111	21,454	7,226	29,992
1976	4,064	1,138	338	60,684	29,744	95,968
1977	4,373	3,694	2,167	85,074	35,218	130,526
1978	6,930	3,126	5,935	118,548	57,000	191,539
1979	10,415	5,547	9,568	157,321	30,022	212,873
1980	7,517	5,610	4,900	64,958	12,543	95,528
1981	10,378	5,834	3,636	194,869	24,348	239,065
1982	12,503	4,984	7,078	200,057	39,997	264,619

[1] 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

well above pink and chum salmon in value and very close to sockeye and coho salmon, particularly in recent years with the advent of a more vigorous frozen fish market.

The majority of Bristol Bay chinook salmon are produced in the Nushagak District which accounts for 72% of the production for the 1960 to 1982 period. Another 16% are produced in the Togiak District, and the remainder are rather evenly divided between the Ugashik, Egegik, and Naknek-Kvichak Districts. Although there is a regulatory 6-3/4 in (17 cm) minimum mesh size, virtually all gear in use is either 8 or 8-1/2 in (20.3 or 21.6 cm) stretch mesh.

Chinook salmon catches have been particularly good over the past 23 years, even with the early 1970's decline suffered by all species. The 1960 to 1982 production represents a 44% increase over the historical average. The 1982 catch of 265 thousand matched the record catch in 1919 of 201 thousand fish. For a species that is the most long-lived of Pacific salmon, consequently exposed to mortality inducing elements longer, the Bristol Bay chinook salmon stocks have exhibited a stable and long-term productivity.

Even though chinook salmon are far less abundant than either pink or chum salmon, their large size and relatively high value make them a highly desirable species from the fisherman's viewpoint. This can best be exemplified by examining the ex-vessel value by species in Table 2. The average ex-vessel value for chinook salmon from 1977 to 1982 was 3.9 million dollars, chum salmon 3.1 million, and pink salmon 2.9 million (using only 3 years to average the pink value), even though chum salmon were 8 times and pink salmon 25 times more abundant than chinook salmon. This is a valid economic comparison since all three species have experienced exceptional production during this period.

Escapement

The primary chinook salmon producing rivers in Bristol Bay are those draining into the Nushagak and Togiak Districts where over 88% of the Bristol Bay production has occurred since 1982. Other than minimal aerial survey coverage of the Branch and Naknek Rivers, the majority of escapement studies have centered in the Nushagak and Togiak Districts where an extensive aerial survey data base has been developed. Aerial survey assessment of chinook salmon spawning populations began in the Nushagak area in 1966 and in the Togiak area in 1967. Presently, the aerial survey project forms the basis for escapement estimates in both districts.

Escapements in Nushagak District have averaged 81 thousand fish since 1966 with a range of 25 to 150 thousand (Table 12), and in recent years (1976-1982) have increased to 118 thousand. Togiak District chinook salmon escapements have shown a more stable trend, averaging 17 thousand fish with a range of 8 to 40 thousand from 1967 through 1982 (Table 12). The Togiak District escapements represent data for some 12 streams throughout the district with the Togiak and Kulukak Rivers being the major producers. The Nushagak surveys involve 21 streams, and six of these are the key index streams or major producers.

Although escapement estimates are not available for the smaller chinook salmon producing districts in Bristol Bay, it is reasonable to project that total runs

have averaged about 300 thousand chinook salmon in recent years (1976-1982) throughout Bristol Bay.

Escapement goals have not been determined for chinook salmon, but minimal escapement levels have been set at 50 thousand and 10 thousand for the Nushagak and Togiak Districts, respectively.

Management Strategies and Problem Identification

The early run timing of chinook salmon allows them to be managed separately from other salmon species. Nushagak District is the only area in Bristol Bay with a major directed commercial effort on chinook salmon. Some directed effort on chinook salmon has evolved in recent years in the Togiak and Ugashik Districts, but these are still not significant fishery ventures. A large proportion of the Togiak District chinook salmon catch is taken incidentally to the sockeye salmon fishery with smaller mesh gill nets (5-3/8 in or 13.5 cm).

The Nushagak District management strategy in the 1960's was to limit the harvest to a range of 60 thousand to 80 thousand salmon unless catch trends indicated that a significantly larger than average run was in progress. As local fishery managers became more experienced, the local subsistence fishery was found to be a reasonable indicator of general escapement trends. As chinook salmon became more valuable in the mid 1970's, fishing effort began to increase dramatically. This increased fishing pressure was countered by additional closures in-season to obtain escapement needs. Since escapement assessment occur well after the fishery, catch per unit of effort (CPUE) analysis is a basic management tool in this fishery at present.

As commercial and recreational pressure continued to build on the Nushagak chinook salmon stocks on the late 1970's, the need to develop and refine real-time escapement enumeration techniques became more apparent. It does not appear that the new Nushagak River sonar counting systems will work very well for chinook salmon because of their migrational characteristics, i.e., they do not tend to migrate close to shore.

A pilot project was started in 1980 to statistically evaluate subsistence catches just upriver from the commercial fishery in order to estimate daily escapement rates and project escapement trends. This project shows considerable promise as a management tool.

Conflicts between user groups has begun to develop in recent years, and they can be expected to continue and probably increase as the sport fishery continues to grow on Nushagak District chinook salmon stocks. Very little effort has been directed toward sport fishing harvest trends and related use patterns. A Department project to address this issue will be necessary in the near future.

COHO SALMON FISHERY

Biological Status

Beginning in 1979 and 1980, catches of coho salmon rose dramatically to over 300 thousand fish per year, peaking in 1982 at 663 thousand fish which broke all

previous catch records (Table 14). Escapement enumeration is too recent to fully assess the current and any long term biological status. However, it is reasonable to conclude that the current status is probably high, and this species is in a mode of good production at present, as are other salmon species in Bristol Bay.

Past performance, or catch data, is difficult to evaluate since coho salmon have not really been targeted upon until quite recently. It is believed that the recent high catches in the Togiak District probably cannot be sustained, but that Nushagak District stocks probably have the potential for a significantly higher sustained production comparable to the 1980-1981 levels.

Commercial Harvest

Coho salmon is the least abundant species in Bristol Bay in terms of commercial catch production and represents 2% of the average total value from 1960 to 1982. The average ex-vessel value for this period has been $460 thousand, although as mentioned above, the catches in the 1980-1982 period have been record catch seasons. This is also reflected in the ex-vessel values for 1980 through 1982 ($1.4, $1.5, and $3.4 million) which were from three to seven times greater than the average, respectively (Table 2).

The $3.4 million average catch for coho salmon is 76 thousand fish for Bristol Bay. Historically, virtually the entire catch has come from the Nushagak District. Larger catches in other districts in recent years reflect increased interest and effort for coho salmon and possibly the beginning of a new catch trend for this species. Since the start of the Togiak District fishery in 1954, a significant coho salmon fishery has developed over the past 17 years which has matched the Nushagak production in recent years (Table 14). Overall, the Nushagak District has accounted for 77% of the total coho salmon production. Over the past 17 years, Nushagak and Togiak Districts have accounted for 52% and 32% of the total production, respectively. Although catches for these two areas are similar in recent years, the Nushagak District watershed supports a far larger coho salmon population, as the 1982 commercial catch of 388 thousand shows.

Coho salmon is a rather notorious species for unpredictable production. Their life history of extended juvenile stream life (in Bristol Bay mainly two or more years) makes them particularly susceptible to environmental mortalities during the freshwater phase of their existence. Their production pattern in Bristol Bay tends to be somewhat erratic, but there are other factors that have contributed to this pattern other than basic production. Generally speaking, coho salmon have not been of great interest to processors until recently. Relatively low numbers and their lateness in the season have detracted from the larger canneries operating for coho salmon once the sockeye salmon season is over. Fishing effort also tends to drop off significantly after July. Recent higher interest in the frozen fish market and the advent of more freezer-processor vessels in Bristol Bay has stimulated more interest in coho salmon.

Barring a decrease in natural production, it is anticipated that catches will continue to be somewhat above average in the future.

Table 14. Commercial catch of Bristol Bay coho salmon in numbers of fish by district, 1893-1982[1].

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	74,000	0	74,000
1894	0	0	0	47,000	0	47,000
1895	0	0	0	28,050	0	28,050
1896	127,538	0	0	117,530	0	245,068
1897	0	0	0	150,000	0	150,000
1898	0	0	0	55,744	0	55,744
1899	0	0	0	100,396	0	100,396
1900	0	0	0	0	0	0
1901	1,286	0	0	2,893	0	4,179
1902	0	0	0	193,838	0	193,838
1903	0	0	0	60,073	0	60,073
1904	5,250	0	558	123,661	0	129,469
1905	7,000	0	5,733	65,568	0	78,301
1906	0	0	0	207,257	0	207,257
1907	0	0	0	129,065	0	129,065
1908	0	0	0	103,013	0	103,013
1909	0	0	0	80,513	0	80,513
1910	0	0	0	139,200	0	139,200
1911	0	0	0	129,971	0	129,971
1912	10	0	0	195,083	0	195,093
1913	2	165	0	66,640	0	66,807
1914	17,508	0	0	81,434	0	98,942
1915	13,271	0	0	117,172	0	130,443
1916	288	0	0	293,210	0	293,498
1917	3	0	0	62,260	0	62,263
1918	0	0	0	108,576	0	108,576
1919	0	0	0	46,687	0	46,687
1920	3,900	264	3,630	145,510	0	153,304
1921	0	0	0	84,564	0	84,564
1922	180	21	0	159,783	0	159,984
1923	0	0	0	9,274	0	9,274
1924	152	440	0	39,787	0	40,379
1925	5	0	0	16,591	0	16,596
1926	350	0	0	12,947	0	13,297
1927	8	1	0	137	0	146
1928	10	5	0	4,825	0	4,840
1929	117	59	0	58,444	0	58,620
1930	0	0	0	34,150	0	34,150
1931	0	0	0	920	0	920
1932	0	0	0	4,630	0	4,630
1933	0	0	0	15,800	0	15,800
1934	0	0	0	12,190	0	12,190
1935	0	0	0	2,230	0	2,230
1936	0	3,523	1,680	19,107	0	24,310
1937	320	0	0	1,380	0	1,700
1938	0	340	0	4,485	0	4,825

-Continued-

Table 14. Commercial catch of Bristol Bay coho salmon in numbers of fish by district, 1893-1982[1] (continued).

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1939	0	297	0	26	0	323
1940	1,130	12,074	700	11,131	0	25,035
1941	2,273	241	1,168	30,958	0	34,640
1942	224	0	300	28,733	0	29,257
1943	0	0	310	1,360	0	1,670
1944	0	240	620	23,660	0	24,520
1945	57	0	7,424	8,954	0	16,435
1946	0	5,758	14,124	31,126	0	51,008
1947	0	7,218	1,330	1,015	0	9,563
1948	481	9,061	7	2,269	0	11,818
1949	0	5,305	0	21,014	0	26,319
1950	3,720	2,644	585	21,788	0	28,737
1951	1,404	2,520	35,683	2,856	0	42,463
1952	11	0	2,936	2,067	0	5,014
1953	660	1,761	0	2,195	0	4,616
1954	111	2,932	70	20,423	0	23,536
1955	123	4,208	2,777	13,920	0	21,028
1956	887	8,573	0	53,999	0	63,459
1957	1,619	4,056	0	61,454	1,616	68,745
1958	3,624	4,370	746	127,088	0	135,828
1959	40	1,388	1,397	12,779	1,731	17,335
1960	197	2,421	0	13,457	65	16,140
1961	426	3,533	16	16,653	5	20,633
1962	2,474	3,828	4,553	28,418	11	39,284
1963	6,823	910	2,743	29,648	1,138	41,262
1964	3,133	775	380	26,416	5,859	36,563
1965	3,053	945	713	2,851	521	8,083
1966	4,096	1,932	533	11,517	15,864	33,942
1967	1,175	1,044	1,901	31,517	18,159	53,796
1968	7,357	6,507	5,771	48,867	24,872	93,374
1969	17	5,548	9,292	37,799	28,720	81,376
1970	53	7,027	1,695	3,688	2,027	14,490
1971	89	923	469	8,036	3,192	12,709
1972	402	1,249	0	3,654	8,652	13,957
1973	255	2,701	2,307	28,709	23,070	57,042
1974	916	1,156	4,055	12,569	25,049	43,745
1975	43	951	4,595	7,342	33,350	46,281
1976	1,195	2,321	3,561	6,778	12,791	26,646
1977	2,883	2,685	3,884	52,562	45,201	107,215
1978	913	2,256	2,024	44,740	44,338	94,271
1979	12,355	15,148	17,886	129,607	119,403	294,399
1980	7,802	22,537	19,419	147,726	151,000	348,484
1981	785	30,602	26,817	225,409	29,554	313,167
1982	9,111	72,105	51,176	387,801	142,952	663,145

[1] Sources: 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

Escapement

Very little escapement data is available for Nushagak and Togiak Districts where 87% of the Bristol Bay coho salmon catch has been produced since 1966. Because of the relatively low interest in this species until quite recently, no special effort has been directed toward developing escapement assessment techniques.

The Nushagak River sonar enumeration program started in 1979 shows considerable promise for assessing coho salmon escapements. In 1980, 102 thousand coho salmon were counted into the Nushagak River through 6 August and was the first escapement estimate ever made for coho salmon into the Nushagak River. The actual 1980 escapement into the Nushagak River was significantly higher than the 102 thousand fish recorded since the sonar project was terminated 10 days before the coho salmon commercial fishery peaked. The project objective was to count pink salmon, and the coho counting capability was not fully realized until after the fact. Coho salmon were not enumerated in 1981 because of inadequate funding, but in 1982 the sonar coho salmon escapement estimate was 227 thousand fish. Future plans entail expanding the project duration for complete assessment of the coho salmon escapement.

Togiak District coho salmon escapement studies were started in 1980 using aerial survey techniques and this first year effort indicates an escapement of 50 to 80 thousand coho salmon to the Togiak River, its tributaries, and the Kulukak River system. Aerial surveys were continued in 1981 and 1982 with 41 and 54 thousand coho salmon enumerated by this method, respectively. These aerial survey derived coho salmon escapements are considered minimal total estimates.

Management Strategies and Problems

Due to limited interest in coho salmon and minimal fishing pressure until recently, there has not been a need for any special management strategies in the past. The Department has successfully resisted efforts to move inner fishing boundaries into upriver areas and has also supported a liberal 5 day per week basic fishing schedule to encourage use of this resource.

The basic management strategy to date has been to evaluate in-season catches relative to fishing effort, or CPUE, as a general measure of whether the runs are strong or weak.

Future strategies will have to be developed commensurate with any continued increased pressure on coho salmon. The Nushagak River sonar project will certainly become an important component of coho management in the Nushagak District. Aerial surveys of the Togiak and Kulukak River systems will provide an important data base for this area in terms of measuring the exploitation rate on these stocks and adequacy of escapement levels.

Recent increases in both commercial and recreational fishing pressure dictate that more refined techniques be developed to measure current and long-term production trends. Basic biological information such as age composition and sex ratios is needed from coho salmon escapements to evaluate whether the present mesh size is appropriate for the highest production.

Coho salmon in Bristol Bay is also a prized sport fish, and considerable fishing effort is directed at certain stocks. Problems on the Togiak River in recent years have developed where illegal commercial fishing activities have come into direct confrontation with sport fishing interests. Adequate enforcement effort

can and has solved those problems, but as both commercial and recreational interests grow in the future, more and continued attention will need to be focused in this direction.

BRISTOL BAY SALMON MANAGEMENT PROGRAM

Because Bristol Bay has been a long established and highly productive fishery for nearly 100 years, it has received special and rather intense treatment by a lot of people and agencies over the years. Throughout the years it has probably received more attention, funding, and research than any salmon fishery in Alaska. Although even these efforts were somewhat meager and limited for many years, the fact that many pioneering efforts were initiated in Bristol Bay established an invaluable data base and some important precedents in fisheries research and management. This section summary is intended to give a general idea of the scope and type of projects and activities being conducted in Bristol Bay on an annual basis.

The ADF&G presently has eight permanent staff biologists assigned to management and research activities in the Bristol Bay salmon fisheries. There are from 50 to 60 seasonal positions hired each summer to man the many support projects. Funding for these positions represent 4% of the average ex-vessel value from 1960 to 1982.

There are some 11 "classes" or types of annual salmon projects in Bristol Bay, and more than 30 individual projects are involved, aside from Program Administration which covers fixed supportive costs such as utilities, rent, etc, and aside from periodic research and management activities that are not conducted on an annual basis.

The following material is a brief description and statement of objectives for each project.

General Salmon Management

Aerial surveys are used to determine lower river escapement rates and fishing effort during open fishing periods. This information is needed to adjust in-season fishing time and area. Daily contact with processors concerning catch estimates provides needed information to determine harvest rates. Costs of these vitally important activities along with cost of subsistence fishery monitoring activities are all included in this catch-all project. Project objectives are to provide in-season estimates of the following: (1) catch by species by district by fishing period, (2) fishing effort by district by fishing period, and (3) in-season sockeye salmon escapement counts downriver from tower sites.

Escapement Enumeration

This project includes cost of post-season spawning area aerial surveys used to enumerate sockeye, pink, chum, chinook, and coho salmon spawning in the Branch, Togiak, and Nushagak River systems and includes expenses related to eight field camps where migrating sockeye and pink salmon are enumerated from towers as they migrate upstream to tributary lakes and streams. These towers are placed on both banks of the river for each of the eight major sockeye producing river systems of Bristol Bay (Ugashik, Egegik, Naknek, Kvichak, Nuyakuk, Wood, Igushik, Togiak). Salmon are captured by beach seine and sampled for age, length, weight, and sex statistics. The basic escapement and biological sampling data provides the information needed to evaluate long-term management strategies and to implement periodic

adjustments in fishing time and area in the Bay's five fishing districts. Project objective is to obtain accurate escapement counts by river system need to evaluate both short and long term management strategies.

Catch Sampling

Salmon are sampled from commercial catches made in all commercial fishing districts within Bristol Bay (Naknek/Kvichak, Egegik, Ugashik, Nushagak, and Togiak). Sampling includes measuring fish for length and weight, determining sex, and removing a scale for aging purposes. Sampling is conducted throughout the duration of the commercial fishery, most frequently at the larger shore-based processing facilities. Project objective is to provide species, age, weight, length, and sex data for those salmon commercially harvested in order to monitor and assess the long-term affects of the commercial fishery.

Nushagak Sonar

Two side-scanning sonar units are installed in the lower portion of the Nushagak River near Portage Creek. Salmon migrating upstream are counted as they swim over the units. Salmon are sampled with gillnets and beach seines to obtain age, weight, length, and sex data and to obtain species composition information. The sonar counts are adjusted for species composition, resulting in an estimate of the total salmon escapement by species to the Nushagak River system. Project objective is to obtain accurate and timely (in-season) escapement estimates of salmon returning to the Nushagak River system to assist in providing data to establish fishing schedules in the Nushagak District. The estimates derived from this project not only serve to facilitate better in-season management decisions, but will provide an estimate of total salmon escapement levels in the entire Nushagak River system, and hence provide an evaluation of long-term management strategy.

Inside Test Fishing

Test fishing is conducted immediately above commercial fishing districts to estimate the number of sockeye salmon which have escaped the fishery. Since about 80% of the run occurs within a 2-week period, and the delay in counting at upriver towers ranges from 2 to 15 days, early test fish estimates of escapement are used in making management decisions. Fishing is accomplished by gillnet. The project objective is to provide in-season estimates of escapement of sockeye salmon to the Kvichak, Egegik, Ugashik, and Igushik Rivers before such data is available from respective tower counts in order to assist in determining appropriate fishing periods and harvest rates.

Port Moller Offshore Test Fishing

A gillnet test fishery is conducted along a transect line extending from 30 to 80 mi (48 to 129 km) off Port Moller toward Cape Newenham. Fishing is conducted from a 70 ft (21.4 m) vessel, 7 days per week, fishing five or six stations each day. Sockeye and chum salmon total return estimates are calculated daily based on CPUE statistics. These estimates are used throughout the season to provide managers, fishermen, and processors updated information on run strength. The project objective is to provide an in-season estimate for the sockeye and chum salmon run size and timing approximately 7 days before becoming available in Bristol Bay fishing districts.

Sockeye Forecast

This project provides a forecast of the sockeye salmon run to Bristol Bay 1 year in advance of the fishery with periodic updates through the season. The forecast is derived from commercial catch, escapement, age composition, smolt outmigration, and fry index data. In-season forecast adjustments utilize data from test fisheries (offshore, inside, outside), commercial catches, and escapements into Bristol Bay rivers. Forecasts are used: (1) to establish selected quotas for the Alaska Peninsula fishery; (2) for pre-season planning by processors, fishermen, and the Department; and (3) for INPFC activities. The project objective is to forecast the annual strength of the sockeye salmon runs to Bristol Bay.

Smolt Studies

Estimates are made of the total smolt outmigration from the Kvichak, Naknek, Egegik, Ugashik, Nuyakuk, and Wood River systems by use of sonar biomass counters. Smolt are sampled at each location to provide age, length, and weight data. Data provided by these projects are used to forecast sockeye salmon returns and refine optimum escapement levels. Kvichak River smolt data provide the very best forecast tool for that system. Other smolt projects are too new to evaluate, but should prove equally as valuable. Project objectives are to estimate sockeye salmon smolt production from six Bristol Bay river systems (Kvichak, Naknek, Ugashik, Wood, Egegik, and Nuyakuk); to refine escapement goals; provide survival data for the parent year spawners; and forecast adult returns.

Buoys and Markers

Buoys and markers are used in all fishing districts to clearly define legal fishing areas. Shore markers consist of either strobe lights, stand up markers, or vinyl panels. Buoys must be anchored on location each spring and retrieved each fall. Annual maintenance for both buoys and markers consists of scraping, painting, and repairing missing or damaged parts. The project objective is to accurately mark all fishing districts and sections for commercial salmon fishing in order to provide stock-specific management and harvest

Outside Test Fishing

Commercial fishing boats are chartered with the use of a reimbursable test fish fund to fish in the Nushagak, Naknek-Kvichchak, Egegik, and Ugashik Districts when the commercial fishing season is closed. Gillnet sets are made along predetermined routes to sample stock strength of the run in the district. An onboard Department employee records catch and effort data and radios this information to the King Salmon and Dillingham offices. The project objective is to monitor stock strength of salmon runs in fishing districts during closed fishing periods.

Nushagak River Pink and Chum Salmon Index

This project is a fry indexing program to improve pre-season forecasts. During the spring, the outmigrating Nushagak River pink and chum salmon fry population is indexed. Fry are captured with inclined plane traps as they migrate past Portage Creek. Fry population indices, average condition factors, and climatological factors are statistically related to total returns to provide the basis for

improved pre-season forecasts. The project objective is to index pink and chum salmon fry stock abundance.

Catch and Escapement Leaflet

Activities include collecting, reading, and tabulating approximately 20 to 30 thousand salmon scales from the catch and escapements for all Bristol Bay rivers. These data are used to allocate the entire Bristol Bay sockeye salmon catch into component stocks and age classes. A technical data report is prepared annually entitled "Bristol Bay Sockeye Salmon - A Compilation of Catch and Escapement Data." Project objectives include the documentation of Bristol Bay salmon catch and escapement statistics and to allocate the entire Bristol Bay sockeye salmon catch into component age classes and stocks.

HERRING FISHERY

General Description

The history of commercial herring and herring roe-on-kelp fisheries in Bristol Bay is quite recent, only dating from 1967. During this period there were two years that the herring sac roe fishery did no operate (1971 and 1976) because of lack of buyers (Table 15). From 1967 through 1975 the fishery remained quite small with one to three processors and averaging 24 gill net operators. Only an occasional seiner entered the fishery during this period.

Due to a decline in world herring stocks and increasing markets, a growing interest in Alaska herring resulted in the first significant growth in the fishery in 1977. Subsequent years witnessed a greatly expanding effort and harvest, reaching 19.6 metric tons (43.1 million lb) in 1982 (Table 15).

Herring are concentrated in the Togiak District, and this is the only area where commercial fishing has been conducted to date in Bristol Bay. Purse seines are restricted to 150 fm (274.5 m) in length and 850 meshes in depth in this shallow water fishery. Gill nets are also restricted to 150 fm (275 m) in length and no more than 300 fm (549 m) can be operated from a single vessel.

Due to resource concerns as evaluated from the 1980 season, significant regulatory changes were adopted by the Alaska Board of Fisheries for the 1981 season. The most important changes related to deferring fishing until a minimum population level is estimated inshore, and a graduated harvest rate based on observed abundance levels and age class representation is obtained.

The herring roe-on-kelp fishery has grown steadily over the years. Harvesting of the intertidal rockweed kelp is restricted to hand picking and hand operated rakes. The intensity and effectiveness of this fishery has resulted in specific and localized harvest quotas being imposed in-season after biomass estimates are made each spring and spawning success is evaluated in terms of egg deposition density.

Table 15. Commercial harvest of Bristol Bay herring and herring roe-on-kelp, 1967-1982[1].

Herring Sac Roe and Bait-Food

Year	Number of Processors	Units of Gear		Catch in Pounds			Metric Tons
		Gill Net	Purse Seine	Gill Net	Purse Seine	Total	
1967	1	27	0	268,902	0	268,902	122
1968	2	35	2	136,900	44,865	181,765	82
1969	2	22	1	36,231	58,250	94,481	43
1970	3	16	1	37,195	18,000	55,195	25
1971	0	0	0	0	0	0	0
1972	1	18	1	64,929	97,505	162,434	74
1973	2	26	1	102,147	0	102,147	46
1974	3	10	1	38,256	208,000	246,256	112
1975	2	39	0	111,185	0	111,185	50
1976	0	0	0	0	0	0	0
1977	6	43	6	614,839	4,974,610	5,589,449	2,535
1978	16	40	25	1,240,158	14,261,821	15,501,979	7,030
1979	33	350	175	8,939,528	13,364,102	22,303,630	10,115
1980	27	363	140	6,190,000	33,002,000	39,192,000	17,774
1981	28	106	83	4,536,000	20,540,000	25,076,000	11,372
1982	33	200	135	13,348,000	29,772,000	43,120,000	19,556

Herring Roe-on-Kelp

Year	Number of Processors	Number of Fishermen	Harvest	
			Pounds	Metric Tons
1968	1	1	54,600	25
1969	1	3	10,125	5
1970	1	5	38,855	18
1971	1	12	51,795	24
1972	1	12	64,165	29
1973	1	10	11,596	5
1974	3	26	125,646	57
1975	2	44	111,087	50
1976	5	49	295,780	134
1977	5	75	275,774	125
1978	11	160	329,858	150
1979	16	100	414,727	188
1980	21	78	189,662	86
1981	7	108	378,207	172
1982	8	214	234,924	107

[1]1977-1982; Preliminary data.

Biological Status

The biological status of the Bristol Bay herring stocks has generated a great deal of interest recently because of the rapidly expanding nature of the fishery and inherent uncertainties concerning any new fishery. Historically, both the U.S.S.R. and Japan have operated high seas herring fisheries in the Bering Sea, on stocks believed to be derived primarily from populations spawning along the coastline of western Alaska. The Soviet fishery started in 1959 and the Japanese fishery in 1963. By 1970, the combined foreign fleet catches peaked at 146,000 metric tons (321.9 million lb) and declined steadily to a low of 16,000 metric tons (35.3 million lb) in 1976. Bilateral agreements between the U.S., U.S.S.R., and Japan commenced in 1973 to establish quotas in an attempt to halt the decline of herring stocks. The Fisheries Conservation and Management Act of 1976 enabled the U.S. to impose more restrictive quotas and area closures on the foreign fisheries in order to rebuild these herring stocks and to enhance the domestic, inshore fishery needs on specific, manageable populations. A court order in 1980 deferred any foreign allocation and made herring a prohibited species.

Since the inshore fishery is quite new, and the foreign fishery statistics are somewhat irregular and probably involve a multitude of stocks, it is difficult to categorize the Bristol Bay stocks except that the Bering Sea herring as a broad group were in a severely depressed state during the early and mid 1970's. Inshore data on coastal spawning populations indicate increased abundance of herring in the Bristol Bay area during the late 1970's. However, the estimated 1980 abundance was one-third of that estimated in 1979. This decline plus a weakness of some age classes resulted in much more restrictive management strategy being imposed for the 1981 season.

Although considerable effort is currently being directed toward determining the biological status of the Bristol Bay herring stocks, it is too soon to accurately define the biological status of this new fishery.

Commercial Harvest

The herring harvest in Bristol Bay is directed toward the production of sac roe for export to Japan. Incidental production for bait and food markets results from catches of spawned-out herring or those below economic sac roe recovery rates. The roe-on-kelp (rockweed) fishery is also directed toward the Japanese market. These increasing demands, fishing pressures, and catches propelled the Bristol Bay herring and roe-on-kelp fishery into the most productive and valuable herring fishery in Alaska almost overnight.

From a fishery averaging only 27 thousand (range $4-$43 thousand) for 10 years (1967-1976), the average for the last six years (1978-1982) jumped to $4 million with a high of almost $7 million in 1979 (Table 16). The value dropped significantly in 1980 because of market conditions, as did salmon. Although the herring sac roe fishery production increased 76% in 1980 over 1979, the ex-vessel value decreased 48%. Overall, the value of both fisheries increased 52% from 1979 to 1980.

Table 16. Ex-vessel value of Bristol Bay commercial herring and roe-on-kelp harvest in thousands of dollars, 1967-1982[1].

Year	Herring	Roe-on-Kelp	Total
1967	11	0	11
1968	7	8	15
1969	4	1	5
1970	2	6	8
1971	0	8	8
1972	4	9	13
1973	2	2	4
1974	24	19	43
1975	9	22	31
1976	0	127	127
1977	447	116	563
1978	2,635	120	2,755
1979	6,741	249	6,990
1980	3,205	95	3,300
1981	3,989	250	4,239
1982	6,174	176	6,350

[1] 1977-1982; Preliminary data.

The herring sac roe and bait and food fishery production (Table 15) ranged from 25 to 122 metric tons (55.2 to 269.0 thousand lb) and averaged 69 metric tons (152.1 thousand lb) from 1967 to 1975. No fishery occurred in 1971 and 1976. In 1977, 6 processors, 6 seiners, and 43 gill netters produced the first significant catch of 2,535 metric tons (5.6 million lb) with the seiners accounting for 88% of the catch. Fishing effort peaked in 1980 with 363 gillnet vessels and in 1979 with 175 purse seine vessels. The highest catch to date occurred in 1982 with a yield of 19,556 metric tons or 43.1 million lb (Table 15).

The roe-on-kelp fishery commenced in 1968, one year after the herring fishing started. This fishery was relatively small and stable for the first six years, averaging 17.5 metric tons (38,500 lb) of product, and seven fishermen. Since 1974, both the level of participation and production rose dramatically. Fishing effort peaked in 1982 with 214 participants, and production peaked in 1979 with a harvest of 188 metric tons or 414.7 thousand lb (Table 15).

Management Strategies and Problem Identification

Since herring had been fairly abundant during the late 1970's and fishing effort relatively low, at least until 1979, management operations were directed at such basics as developing coordinated and timely catch reports on a daily basis, standardizing aerial survey estimate methodology, developing sampling techniques, etc. Because of the importance of aerial surveys in assessing available herring during the course of the commercial fishing season, particular emphasis has been placed upon this component of the program. A basic strategy common to herring fisheries in Alaska has been to contain the exploitation rate between 10%-20% of available fish, depending upon the relative strength of a given annual population and age class representation.

The sharp decline in total estimated biomass and concern for younger age classes during the 1980 season prompted a more conservative strategy to insure the biological viability of this important herring resource. The basic strategy adopted by the Board of Fisheries in December 1980 for the 1981 season is as follows:

1) when the total observed biomass of early season older age class herring exceeds 20,000 metric tons (44.1 million lb), the season will open and the harvest rate will be 10% of the observed biomass; the harvest rate may be allowed to increase to 20% if the observed biomass exceeds 40,000 metric tons (88.2 million lb) and sufficient spawning has occurred;

2) when the total observed biomass of later season younger age class herring exceeds 20,000 metric tons (44.1 million lb), a harvest rate of no more than 10% will be allowed; and

3) the number of openings allowed in the herring roe-on-kelp fishery will be based on the fishing time in the herring fishery.

Extra care during this early phase of the fishery is necessary to minimize the impact of a commercial fishery while building an adequate data base in order to develop a comprehensive management plan.

Since herring stocks that spawn along the western Alaska coastline are also subject to foreign fisheries activities in the Fishery Conservation Zone, the North Pacific Fishery Management Council is required to prepare a Fishery Management Plan for this species. The management and research needs listed below are drawn from the 7 November 1980 Draft Fishery Management Plan for Bering-Chukchi Sea herring.

In summary form, the key areas of investigation are as follows: (1) find means of improving the accuracy of foreign catch statistics; (2) develop means of reducing the incidental catch of herring in other fisheries; (3) refine estimates of abundance and biological characteristics of stocks through research resource surveys; (4) improve the capability for predicting changes in resource abundance, composition, and availability; and (5) identify the origin and distribution of stocks in offshore waters. Under item (3) above which concerns vital biological information requirements on the near-shore populations, such methods as aerial surveys, hydroacoustic surveys, and spawn deposition surveys are ongoing or under consideration. Item (4) above emphasizes the need for predicting changes in abundance and could involve monitoring oceanographic and climatological conditions, annual pre-recruit surveys to measure the availability of young fish and their probable contribution to future population strength, and such basic information as mortality rates, growth rates, and recruitment rates. Item (5) above concerns identifying the specific eastern Bering Sea herring stocks, their distribution and occurrence in the coastal fisheries.

BRISTOL BAY HERRING MANAGEMENT PROGRAM

The Bristol Bay herring program is a component of the overall ADF&G Bering Sea Herring Program which involves project operations extending from Bristol Bay to Kotzebue. The Bering Sea herring permanent staff of two biologists are responsible for overall planning and coordinating of herring operations in both the Central and Northern management regions. They in turn are supported by local area staff personnel in terms of field and management operations during the herring season in Bristol Bay and along the western Alaska coastline to the north. Funding to support these programs represents 2% to 4% of the ex-vessel value of the fishery. The Bristol Bay herring program involves four project categories aside from program administration which were fixed supportive costs such as utilities, rent, etc.

The following material is a brief description and statement of objectives for each project.

Togiak Aerial Surveys

Abundance of herring on the Togiak herring grounds is monitored by aerial surveys. Flights are scheduled, weather permitting, to determine daily biomass estimates, beginning at the time the ice leaves the fishing area in the spring. Flights continue throughout the fishing season until herring schools are no longer present. Daily biomass estimates are used in conjunction with daily catch reports to provide in-season information needed for periodic adjustments in fishing time to meet the Board of Fisheries guidelines of a 10%-20% exploitation rate for statewide herring fisheries. The project objectives are to assess roe herring abundance in the Togiak District of Bristol Bay, develop desired harvest levels, and provide a data base with which to adjust fishing time and area when needed.

Togiak Test Fishing

Herring are caught in variable mesh gillnets set in spawning areas. The samples are used to determine age, sex, and size characteristics and gonad condition of the run throughout the season, including closed periods when commercial catch samples are not available. These data are used in conjunction with the commercial catch samples to develop year class abundance estimates. Test fish catches are also used as an index of overall abundance throughout the duration of the fishery. This index is especially valuable during closed fishing periods or when inclement weather conditions prevent aerial surveys and commercial fishing efforts. The project objectives are to assess age, sex, and size characteristics of the Togiak herring spawning populations and to index abundance of that population.

Togiak Fisheries Monitoring

The Togiak fishery for sac roe and food/bait herring occurs during late April and the month of May. The fishery takes place along an extensive coastline and the catch is monitored by daily radio contact with processors followed up with fish ticket collection and compilation. Commercial catches are sampled to determine in-season age, size, and sex characteristics of the harvest. Post-season fish ticket analysis provides final estimates of catch and effort during the fishery. Catch data is used in conjunction with biomass estimates to provide the rationale for in-season adjustments of fishing area and time to meet the Board of Fisheries guideline of a 10%-20% exploitation rate for herring fisheries. Project objectives are to provide in-season estimates of catch by district by fishing district by fishing period; to provide in-season estimates of fishing effort; to provide post-season estimates of catch and effort; and to develop age, sex, and size characteristics of the commercial harvest.

Kelp Fishery Assessment

In 1977, 1978, and 1979, beaches were sampled along the Togiak coastline to estimate the kelp biomass in the intertidal area. Beaches are periodically surveyed to update these estimates. The roe-on-kelp fishery is closely monitored to insure wastage does not occur and to develop estimates of the effect of the harvest on both the herring and kelp resources. Daily reports of the number of pounds of kelp harvested by area is applied to the biomass estimate of kelp in each area to maintain a 10%-20% harvest rate. The University of Alaska is under contract to the Department to study the regeneration rates of kelp. Egg deposition estimates are being developed to document spawning success. This information will help to better define the limits of the resource and prevent overharvest of both herring and kelp which is used extensively as a spawning substrate. The project objectives are to estimate kelp biomass by beach; to estimate *Fucus* sp. regeneration rates; to develop herring egg deposition estimates by beach area; to develop an index of herring reproductive success; to develop estimates of the optimal biological harvest of roe-on-kelp; and to manage the roe-on-kelp fishery by beach area commensurate with optimal harvest levels and guidelines set by the Board of Fisheries.

APPENDICES

Appendix Table 1. Historical catch of Bristol Bay salmon by species, 1884-1982[1].

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1884	0	0	0	0	0	4,171
1885	0	0	0	0	0	146,000
1886	0	0	0	0	0	509,144
1887	0	0	0	0	0	758,157
1888	0	0	0	0	0	937,383
1889	0	0	0	0	0	1,209,558
1890	0	0	0	0	0	1,234,639
1891	0	0	0	0	0	1,391,359
1892	0	0	0	0	0	662,204
1893	44,000	940,000	74,000	0	0	1,058,000
1894	10,500	1,235,400	47,000	0	0	1,292,900
1895	19,925	1,472,137	28,050	0	0	1,520,112
1896	17,301	2,099,740	245,068	0	0	2,362,109
1897	19,897	3,317,523	150,000	35,348	0	3,522,768
1898	19,260	4,927,840	55,744	59,786	0	5,062,630
1899	38,259	5,112,737	100,396	16,758	0	5,268,150
1900	58,307	8,547,335	0	7,803	0	8,613,445
1901	106,047	10,220,577	4,179	231,188	0	10,561,991
1902	109,089	12,808,518	193,838	502,265	0	13,613,710
1903	86,506	16,320,092	60,073	241,504	0	16,708,175
1904	97,953	11,903,352	129,469	398,146	37,308	12,566,228
1905	116,855	14,833,989	78,301	291,015	58,984	15,379,144
1906	143,194	10,823,431	207,257	1,901,945	253,541	13,329,368
1907	137,677	10,193,403	129,065	344,148	508,727	11,313,020
1908	90,009	16,233,802	103,013	399,257	459,899	17,285,980
1909	130,489	15,497,883	80,513	101,279	378,138	16,188,302
1910	101,755	11,593,609	139,200	652,129	310,218	12,796,911
1911	113,163	8,815,114	129,971	91,764	347,866	9,497,878
1912	97,728	19,696,343	195,093	1,680,652	354,627	22,024,443
1913	74,249	20,581,826	66,807	425,493	284,718	21,433,093
1914	100,964	20,195,107	98,942	564,998	566,947	21,526,958
1915	148,028	14,787,678	130,443	134,798	593,079	15,794,026
1916	105,124	17,521,921	293,498	683,771	1,489,623	20,093,937
1917	91,145	24,513,532	62,263	37,082	356,222	25,060,244
1918	87,048	23,090,665	108,576	619,303	745,824	24,651,416
1919	201,954	7,161,375	46,687	452	204,474	7,614,942
1920	127,350	8,897,915	153,304	2,045,437	434,338	11,658,344
1921	91,982	15,680,076	84,564	939	355,331	16,212,892
1922	74,020	23,632,077	159,984	289,795	515,915	24,671,791
1923	67,013	18,181,964	9,274	3	184,902	18,443,156
1924	71,663	10,302,066	40,379	103,056	285,463	10,802,627
1925	97,448	7,909,508	16,596	18	231,808	8,255,378
1926	74,604	19,414,094	13,297	288,041	326,018	20,116,054
1927	83,846	11,071,828	146	3	195,803	11,351,626
1928	66,075	19,710,000	4,840	46,665	396,581	20,224,161
1929	150,663	12,188,648	58,620	0	621,554	13,019,485
1930	105,428	4,259,188	34,150	248,727	226,930	4,874,423

-Continued-

Appendix Table 1. Historical catch of Bristol Bay salmon by species, 1884-1982[1] (continued).

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1931	47,175	12,790,614	920	0	635,726	13,474,435
1932	68,286	14,939,552	4,630	172,396	908,522	16,093,386
1933	49,308	23,708,950	15,800	150	255,658	24,029,866
1934	45,945	20,600,510	12,190	33,303	332,069	21,024,017
1935	3,573	3,022,959	2,230	0	72,049	3,100,811
1936	21,703	20,586,884	24,310	523,841	258,964	21,415,702
1937	36,629	21,257,814	1,700	0	302,231	21,598,374
1938	45,934	24,699,788	4,825	0	545,380	25,295,927
1939	33,408	13,332,345	323	48	934,682	14,300,806
1940	15,267	4,726,687	25,035	258,342	293,150	5,318,481
1941	30,661	7,153,704	34,640	0	524,280	7,743,285
1942	19,006	6,343,363	29,257	171,913	168,963	6,732,502
1943	41,146	17,330,218	1,670	0	376,803	17,749,837
1944	16,373	11,545,604	24,520	55,264	315,469	11,957,230
1945	26,609	7,300,247	16,435	23	635,293	7,978,607
1946	27,401	8,051,206	51,008	41,250	236,040	8,406,905
1947	41,641	18,642,028	9,563	421	215,715	18,909,368
1948	49,116	14,544,389	11,818	53,236	496,657	15,155,216
1949	50,752	6,449,321	26,319	38	269,138	6,795,568
1950	45,261	7,157,275	28,737	32,171	146,449	7,409,893
1951	40,183	4,326,543	42,463	34	156,750	4,565,973
1952	52,856	11,266,129	5,014	14,129	249,421	11,587,549
1953	42,556	6,111,500	4,616	12	387,346	6,546,030
1954	56,016	4,652,625	23,536	102,982	400,644	5,235,803
1955	75,429	4,549,106	21,028	9	212,179	4,857,751
1956	66,377	8,881,467	63,459	91,972	315,517	9,418,792
1957	91,420	6,275,502	68,745	29	259,342	6,695,038
1958	103,207	2,985,666	135,828	1,135,542	358,092	4,718,335
1959	84,289	4,608,119	17,335	301	481,516	5,191,560
1960	111,703	13,705,002	16,140	302,032	1,315,957	15,450,834
1961	88,656	11,913,926	20,633	538	727,932	12,751,685
1962	84,047	4,718,016	39,284	913,934	677,545	6,432,826
1963	62,269	2,871,136	41,262	461	370,097	3,345,225
1964	139,536	5,596,120	36,563	1,549,569	802,508	8,124,296
1965	112,967	24,255,239	8,083	700	360,544	24,737,533
1966	77,472	9,314,240	33,942	2,492,851	343,212	12,261,717
1967	117,193	4,330,730	53,796	1,114	476,357	4,979,190
1968	103,723	2,792,849	93,374	1,935,836	363,791	5,289,573
1969	124,908	6,621,698	81,376	1,870	332,989	7,162,841
1970	140,511	20,720,766	14,490	456,911	717,846	22,050,524
1971	123,015	9,583,987	12,709	212	676,906	10,396,829
1972	69,546	2,416,233	13,957	127,023	656,609	3,283,368
1973	44,044	761,322	57,042	387	684,498	1,547,293
1974	45,664	1,362,474	43,745	939,978	286,354	2,678,220
1975	29,992	4,898,815	46,281	422	325,417	5,300,926
1976	95,968	5,619,292	26,646	1,036,543	1,329,052	8,107,501
1977	130,526	4,877,880	107,215	4,517	1,598,164	6,718,302
1978	191,539	9,928,139	94,271	5,152,700	1,158,090	16,524,739
1979	212,873	21,428,606	294,399	3,849	906,797	22,846,524
1980	95,528	23,761,746	348,484	2,563,468	1,301,026	28,070,252
1981	239,065	25,713,416	313,167	7,528	1,475,307	27,748,279
1982	264,619	15,145,505	663,145	1,437,463	942,156	18,452,888

[1] Sources: 1884-1973; Edfelt 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

Appendix Table 2. Total commercial catch of Bristol Bay salmon in numbers of fish by district, 1893-1982[1].

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	100,000	0	200,000	758,000	0	1,058,000
1894	262,550	0	112,850	917,500	0	1,292,900
1895	415,103	54,321	65,219	985,469	0	1,520,112
1896	642,077	21,420	240,472	1,458,140	0	2,362,109
1897	1,411,534	203,715	463,957	1,443,562	0	3,522,768
1898	2,242,958	248,379	548,935	2,022,358	0	5,062,630
1899	1,650,375	284,650	661,524	2,671,601	0	5,268,150
1900	3,210,605	307,615	797,743	4,297,482	0	8,613,445
1901	3,652,169	428,502	772,757	5,708,563	0	10,561,991
1902	6,091,893	403,444	1,653,171	5,465,202	0	13,613,710
1903	7,519,361	784,002	1,705,106	6,699,706	0	16,708,175
1904	5,909,829	139,450	587,133	5,929,816	0	12,566,228
1905	6,834,891	189,000	586,735	7,768,518	0	15,379,144
1906	5,332,042	252,400	289,973	7,454,953	0	13,329,368
1907	6,856,025	503,913	332,989	3,620,093	0	11,313,020
1908	9,113,444	811,541	288,610	7,072,385	0	17,285,980
1909	9,551,706	859,560	231,154	5,545,882	0	16,188,302
1910	6,663,181	625,234	176,519	5,331,977	0	12,796,911
1911	4,696,983	1,162,052	122,434	3,516,409	0	9,497,878
1912	13,988,171	1,462,768	440,397	6,133,107	0	22,024,443
1913	13,707,554	906,101	592,010	6,227,428	0	21,433,093
1914	12,790,059	905,953	270,538	7,560,408	0	21,526,958
1915	7,452,666	1,229,766	529,027	6,582,567	0	15,794,026
1916	11,876,485	1,586,727	698,522	5,932,203	0	20,093,937
1917	15,861,819	1,862,469	1,048,521	6,287,435	0	25,060,244
1918	14,388,434	1,825,308	763,489	7,674,185	0	24,651,416
1919	5,062,156	610,513	153,958	1,788,315	0	7,614,942
1920	6,445,398	505,178	478,346	4,229,422	0	11,658,344
1921	9,813,478	1,145,870	1,144,870	4,108,674	0	16,212,892
1922	15,873,951	2,607,617	1,884,581	4,305,642	0	24,671,791
1923	14,388,491	1,123,620	791,339	2,139,706	0	18,443,156
1924	6,946,706	880,627	460,555	2,514,739	0	10,802,627
1925	3,491,843	223,141	455,798	4,084,596	0	8,255,378
1926	12,871,596	1,524,069	1,171,087	4,549,302	0	20,116,054
1927	8,976,688	1,291,208	220,554	863,176	0	11,351,626
1928	12,323,879	1,312,761	515,731	6,071,790	0	20,224,161
1929	6,905,014	1,126,954	470,045	4,517,472	0	13,019,485
1930	2,448,001	389,905	130,934	1,905,583	0	4,874,423
1931	9,163,835	1,223,642	648,846	2,438,112	0	13,474,435
1932	10,551,616	1,354,994	539,002	3,647,774	0	16,093,386
1933	17,000,267	1,785,769	623,752	4,620,078	0	24,029,866
1934	13,497,472	1,882,061	767,267	4,887,217	0	21,024,017
1935	1,736,009	416,533	0	948,269	0	3,100,811
1936	16,882,410	1,448,055	822,458	2,262,779	0	21,415,702
1937	14,101,277	2,239,694	530,000	4,727,403	0	21,598,374
1938	21,300,374	1,167,220	336,303	2,492,030	0	25,295,927
1939	8,174,987	792,947	692,631	4,640,241	0	14,300,806

-Continued-

Appendix Table 2. Total commercial catch of Bristol Bay salmon in number of fish by district, 1893-1982[1] (continued).

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1940	3,129,089	242,409	36,722	1,910,261	0	5,318,481
1941	5,189,431	368,767	67,498	2,117,589	0	7,743,285
1942	3,257,032	0	668,750	2,806,720	0	6,732,502
1943	13,022,560	0	1,091,944	3,635,333	0	17,749,837
1944	6,752,066	390,374	1,052,970	3,761,820	0	11,957,230
1945	4,404,232	0	850,216	2,724,159	0	7,978,607
1946	5,177,560	360,226	655,464	2,213,655	0	8,406,905
1947	14,086,762	1,034,638	932,481	2,855,487	0	18,909,368
1948	9,379,976	1,142,096	1,493,898	3,139,246	0	15,155,216
1949	4,010,659	1,038,183	728,376	1,018,350	0	6,795,568
1950	4,396,615	798,546	813,436	1,401,296	0	7,409,893
1951	2,971,681	662,852	371,761	559,679	0	4,565,973
1952	9,512,587	905,884	304,365	864,713	0	11,587,549
1953	3,965,466	1,263,830	710,210	606,524	0	6,546,030
1954	1,966,819	1,512,540	1,108,078	632,884	15,482	5,235,803
1955	2,615,317	653,410	298,034	1,222,891	68,099	4,857,751
1956	6,088,995	1,213,837	349,049	1,638,629	128,282	9,418,792
1957	4,631,408	835,527	364,967	775,538	87,598	6,695,038
1958	1,073,616	520,790	449,641	2,613,971	60,317	4,718,335
1959	1,905,246	696,474	450,567	1,973,793	165,480	5,191,560
1960	10,180,691	1,515,133	806,258	2,544,741	404,011	15,450,834
1961	8,360,055	2,750,307	391,650	856,513	393,160	12,751,685
1962	2,501,722	667,856	272,682	2,722,524	268,042	6,432,826
1963	1,069,902	713,655	205,024	1,085,758	270,886	3,345,225
1964	2,462,507	1,132,430	611,548	3,517,089	400,722	8,124,296
1965	19,198,357	3,194,005	945,416	1,059,613	340,142	24,737,533
1966	5,606,584	2,137,148	477,018	3,706,382	334,585	12,261,717
1967	2,391,732	1,085,310	181,331	1,124,019	196,798	4,979,190
1968	1,492,532	697,937	108,005	2,760,285	230,814	5,289,573
1969	4,716,845	905,511	183,240	1,106,307	250,938	7,162,841
1970	17,971,475	1,458,196	192,703	2,132,636	295,514	22,050,524
1971	6,019,188	1,336,865	969,822	1,707,656	363,298	10,396,829
1972	1,277,840	884,350	27,295	809,125	284,758	3,283,368
1973	293,174	248,547	12,612	667,664	325,296	1,547,293
1974	1,089,440	182,969	10,080	1,126,747	268,984	2,678,220
1975	3,166,169	969,315	20,900	827,715	316,827	5,300,926
1976	3,134,716	1,384,323	188,862	2,873,538	526,062	8,107,501
1977	2,514,717	1,870,067	103,144	1,659,379	570,995	6,718,302
1978	6,051,842	1,268,586	17,933	8,300,533	885,845	16,524,739
1979	15,211,128	2,316,037	430,755	4,056,340	832,264	22,846,524
1980	15,628,654	2,732,245	946,588	7,594,946	1,167,819	28,070,252
1981	11,306,039	4,604,860	2,012,637	8,906,901	917,842	27,748,279
1982	5,329,661	2,575,037	1,269,668	8,329,076	949,446	18,452,888

[1] Sources: 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1981-1982; Preliminary data.

Appendix Table 3. Escapement goals and estimates in numbers of fish and percent differences in the Kvichak and Naknek Rivers, 1962-1982.[1]

Year	Actual Run Size		KVICHAK RIVER			NAKNEK RIVER		
	Kvichak	Naknek	Escapement goal	Escapement estimate	Percent difference	Escapement goal	Escapement estimate	Percent difference
1962	4,414,285	1,128,685	2,500,000	2,580,884	+ 3	400,000	723,066	+ 81
1963	562,219	1,526,181	750,000	338,760	- 55	750,000	905,358	+ 21
1964	1,720,606	2,555,936	5,000,000	957,120	- 81	850,000	1,349,604	+ 59
1965	42,111,590	1,832,398	8,000,000	24,325,926	+ 204	800,000	717,798	- 10
1966	7,943,759	2,109,107	6,000,000	3,775,184	- 37	800,000	1,016,445	+ 27
1967	5,016,860	1,225,482	3,500,000	3,216,208	- 8	1,000,000	755,640	- 24
1968	2,945,005	1,791,404	874,000	2,557,440	+ 193	1,000,000	1,023,222	+ 2
1969	12,154,769	2,135,092	6,000,000	8,394,204	+ 40	1,000,000	1,331,202	+ 33
1970	30,516,530	1,725,513	19,000,000	13,935,306	- 27	1,000,000	732,502	- 27
1971	6,152,253	2,706,490	2,500,000	2,387,392	- 5	900,000	935,754	+ 4
1972	1,352,112	1,314,820	2,000,000	1,009,962	- 50	800,000	586,518	- 27
1973	248,345	501,038	2,000,000	226,554	- 89	800,000	356,676	- 55
1974	4,582,439	1,620,554	6,000,000	4,433,844	- 26	800,000	1,241,058	+ 55
1975	14,745,857	3,493,416	14,000,000	13,140,450	- 6	800,000	2,026,686	+ 153
1976	3,423,462	2,354,450	2,000,000	1,965,282	- 2	800,000	1,320,750	+ 65
1977	2,080,608	2,463,472	2,000,000	1,341,144	- 33	800,000	1,085,856	+ 36
1978	7,964,924	1,895,757	2,000,000	4,149,288	+ 108	800,000	813,378	+ 2
1979	24,637,263	2,219,425	6,000,000	11,218,434	+ 87	800,000	925,362	+ 16
1980	35,233,999	4,790,512	14,000,000	22,505,268	+ 61	800,000	2,664,698	+ 233
1981	6,960,212	7,302,430	2,000,000	1,754,358	- 12	800,000	1,796,220	+ 125
1982	3,021,904	3,728,442	2,000,000	1,134,840	- 43	800,000	1,155,552	+ 44

[1] 1981-1982 preliminary catch data.

Appendix Table 4. Escapement goals and estimates in numbers of fish and percent differences in the Egegik and Ugashik Rivers, 1962-1982[1].

Year	Actual Run Size		EGEGIK RIVER			UGASHIK RIVER		
	Egegik	Ugashik	Escapement goal	Escapement estimate	Percent difference	Escapement goal	Escapement estimate	Percent difference
1962	1,666,344	517,185	350,000	1,027,482	+ 194	750,000	255,426	- 66
1963	1,693,184	585,699	850,000	997,602	+ 17	650,000	388,254	- 40
1964	1,953,511	1,059,538	850,000	849,576	0	600,000	472,770	- 21
1965	4,624,167	1,923,552	1,000,000	1,444,608	+ 45	800,000	996,612	+ 25
1966	2,905,420	1,160,294	1,000,000	804,246	- 20	850,000	704,436	- 17
1967	1,707,806	407,674	1,000,000	636,864	- 36	850,000	238,830	- 72
1968	1,010,208	153,353	1,000,000	338,654	- 66	750,000	70,896	- 91
1969	1,904,876	330,225	700,000	1,015,554	+ 45	400,000	160,380	- 60
1970	2,323,243	906,565	1,000,000	919,734	- 8	700,000	735,024	+ 5
1971	1,940,696	1,483,820	600,000	634,014	+ 6	500,000	529,752	+ 6
1972	1,386,222	96,868	600,000	546,402	- 9	450,000	79,428	- 82
1973	550,179	42,908	500,000	328,842	- 34	188,000	38,988	- 79
1974	1,447,883	64,005	600,000	1,275,630	+ 113	500,000	61,854	- 88
1975	2,137,864	443,894	600,000	1,173,840	+ 96	500,000	429,336	- 14
1976	1,838,948	531,231	600,000	509,160	- 15	500,000	341,808	- 32
1977	2,473,081	294,143	600,000	692,514	+ 15	500,000	201,486	- 60
1978	2,102,992	90,429	600,000	895,698	+ 49	500,000	70,434	- 86
1979	3,285,374	2,098,022	600,000	1,032,042	+ 72	500,000	1,700,904	+ 240
1980	3,683,926	4,221,159	600,000	1,060,860	+ 77	500,000	3,231,384	+ 564
1981	5,175,390	3,277,230	600,000	694,680	+ 16	500,000	1,326,762	+ 165
1982	3,448,563	2,346,668	600,000	1,034,628	+ 72	500,000	1,157,526	+ 132

[1] 1981-1982 preliminary catch data.

Appendix Table 5. Escapement goals and estimates in numbers of fish and percent differences in the Wood and Igushik Rivers, 1962-1982[1].

Year	Actual Run Size		WOOD RIVER			IGUSHIK RIVER		
	Wood	Igushik	Escapement goal	Escapement estimate	Percent difference	Escapement goal	Escapement estimate	Percent difference
1962	2,182,301	94,770	450,000	873,888	+ 94	60,000	15,660	- 74
1963	1,254,787	181,108	1,200,000	721,404	- 66	400,000	92,184	- 77
1964	2,151,375	318,999	900,000	1,076,112	+ 20	250,000	128,532	- 49
1965	1,143,652	314,051	500,000	675,156	+ 35	250,000	180,840	- 28
1966	1,963,416	445,248	900,000	1,208,682	+ 34	200,000	206,360	+ 3
1967	1,045,526	300,481	1,100,000	515,772	- 53	153,000	281,772	+ 84
1968	1,055,961	439,396	1,000,000	649,344	- 35	150,000	194,508	+ 30
1969	1,056,375	751,554	750,000	604,338	- 19	200,000	512,328	+ 156
1970	1,758,492	670,920	1,000,000	1,161,964	+ 16	200,000	370,920	+ 86
1971	1,437,643	618,943	750,000	851,202	+ 14	150,000	210,960	+ 41
1972	587,060	157,056	750,000	430,602	- 43	150,000	60,019	- 60
1973	443,728	96,465	700,000	330,474	- 53	150,000	59,508	- 60
1974	2,131,529	420,595	800,000	1,708,836	+ 114	150,000	358,752	+ 139
1975	1,493,174	387,073	800,000	1,270,116	+ 59	150,000	241,086	+ 61
1976	1,442,743	328,331	800,000	817,008	+ 2	150,000	186,120	+ 24
1977	825,436	148,901	800,000	561,828	- 30	150,000	95,970	- 36
1978	4,058,797	1,074,510	800,000	2,267,238	+ 183	150,000	536,154	+ 257
1979	3,543,542	1,814,049	800,000	1,706,352	+ 133	150,000	859,560	+ 473
1980	4,438,309	3,056,015	800,000	2,969,040	+ 271	150,000	1,987,530	+ 1,225
1981	4,365,085	2,423,190	800,000	1,233,318	+ 54	150,000	591,144	+ 294
1982	3,616,731	1,827,690	800,000	976,470	+ 22	150,000	423,768	+ 183

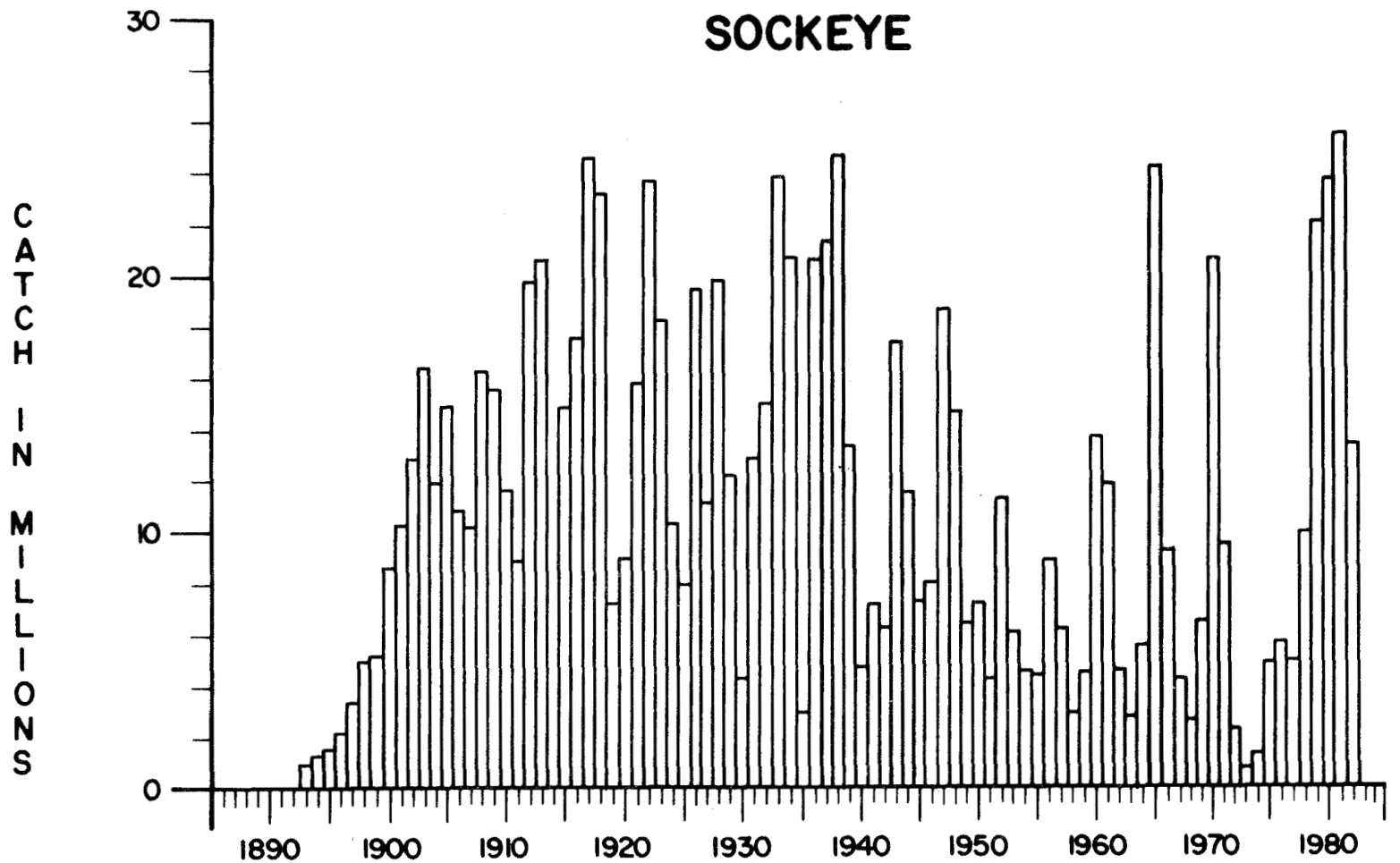
[1] 1981-1982 preliminary catch data.

Appendix Table 6. Escapement goals and estimates in numbers of fish and percent differences in the Nuyakuk and Togiak Rivers, 1962-1982[1].

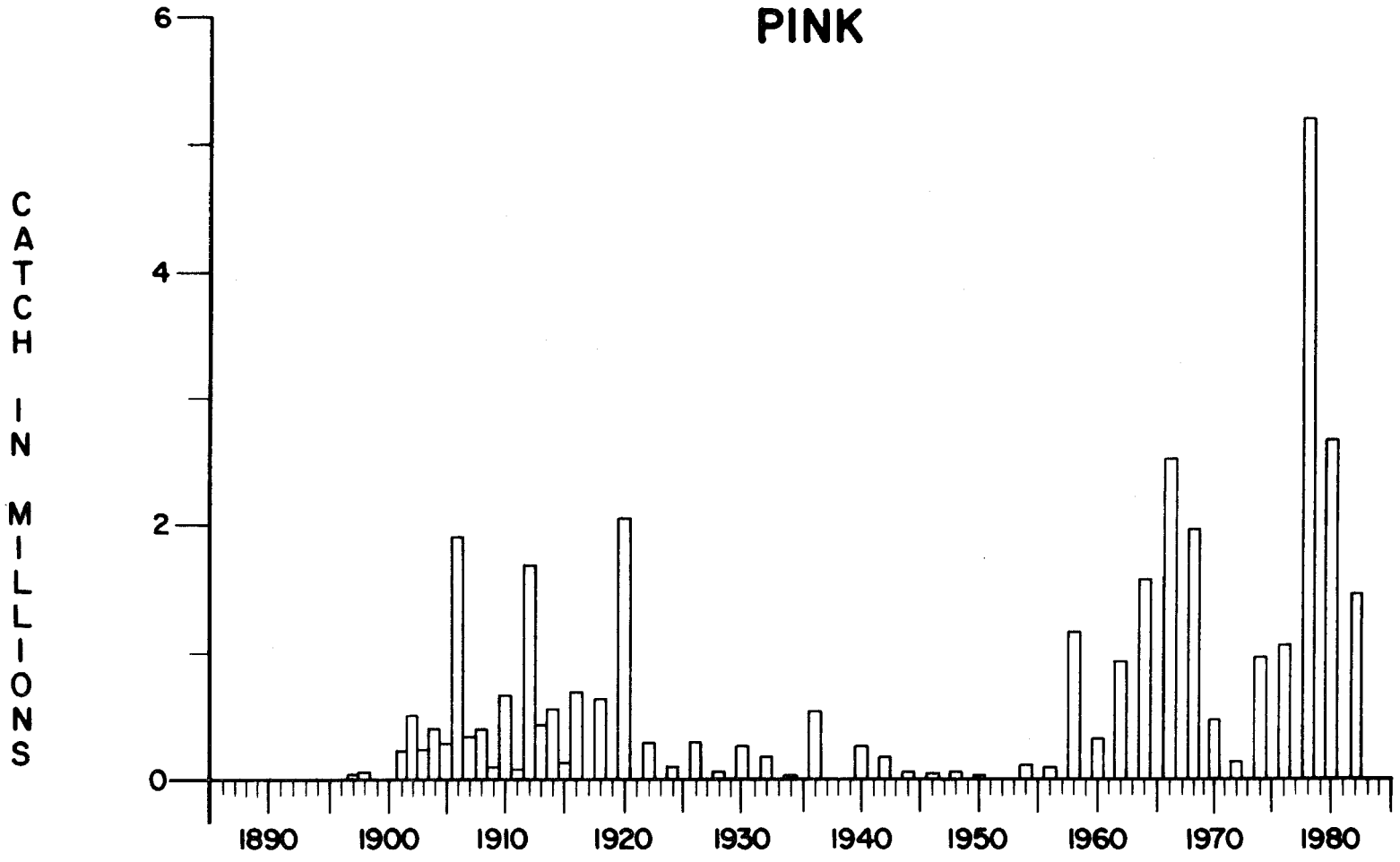
Year	Actual Run Size		NUYAKUK RIVER			TOGIAK RIVER[2]		
	Nuyakuk	Togiak	Escapement goal	Escapement estimate	Percent difference	Escapement goal	Escapement estimate	Percent difference
1962	94,541	154,225	30,000	37,890	+ 26	80,000	61,952	- 23
1963	344,039	301,855	200,000	166,608	- 17	100,000	116,196	+ 16
1964	214,671	347,363	100,000	103,224	+ 3	100,000	104,874	+ 5
1965	364,356	310,321	200,000	203,070	+ 2	150,000	96,486	- 36
1966	293,546	294,677	150,000	161,010	+ 7	120,000	104,198	- 13
1967	53,317	152,842	80,000	20,250	- 75	90,000	81,330	- 10
1968	167,753	115,393	200,000	96,642	- 52	110,000	49,918	- 55
1969	129,464	246,281	150,000	69,828	- 53	100,000	116,666	+ 17
1970	604,215	355,644	214,000	364,648	+ 70	100,000	202,896	+ 103
1971	431,897	400,749	132,000	224,382	+ 70	115,000	200,242	+ 74
1972	146,476	129,924	71,000	28,596	- 60	70,000	78,570	+ 12
1973	176,209	182,624	150,000	110,016	- 27	80,000	106,930	+ 34
1974	171,783	214,478	250,000	154,614	- 38	100,000	103,592	+ 4
1975	889,149	365,418	250,000	669,918	+ 168	100,000	180,562	+ 81
1976	855,956	482,406	250,000	425,220	+ 70	100,000	183,390	+ 89
1977	365,144	363,538	250,000	232,554	- 7	100,000	162,534	+ 63
1978	1,262,332	728,276	250,000	576,666	+ 131	100,000	306,176	+ 206
1979	742,632	591,575	250,000	360,120	+ 44	100,000	198,238	+ 98
1980	4,694,598	1,118,220	250,000	3,026,568	+ 1,111	100,000	526,750	+ 427
1981	3,138,475	907,800	250,000	834,204	+ 234	100,000	307,130	+ 207
1982	2,289,996	834,164	250,000	537,864	+ 115	100,000	270,274	+ 170

[1] 1981-1982 preliminary catch data.

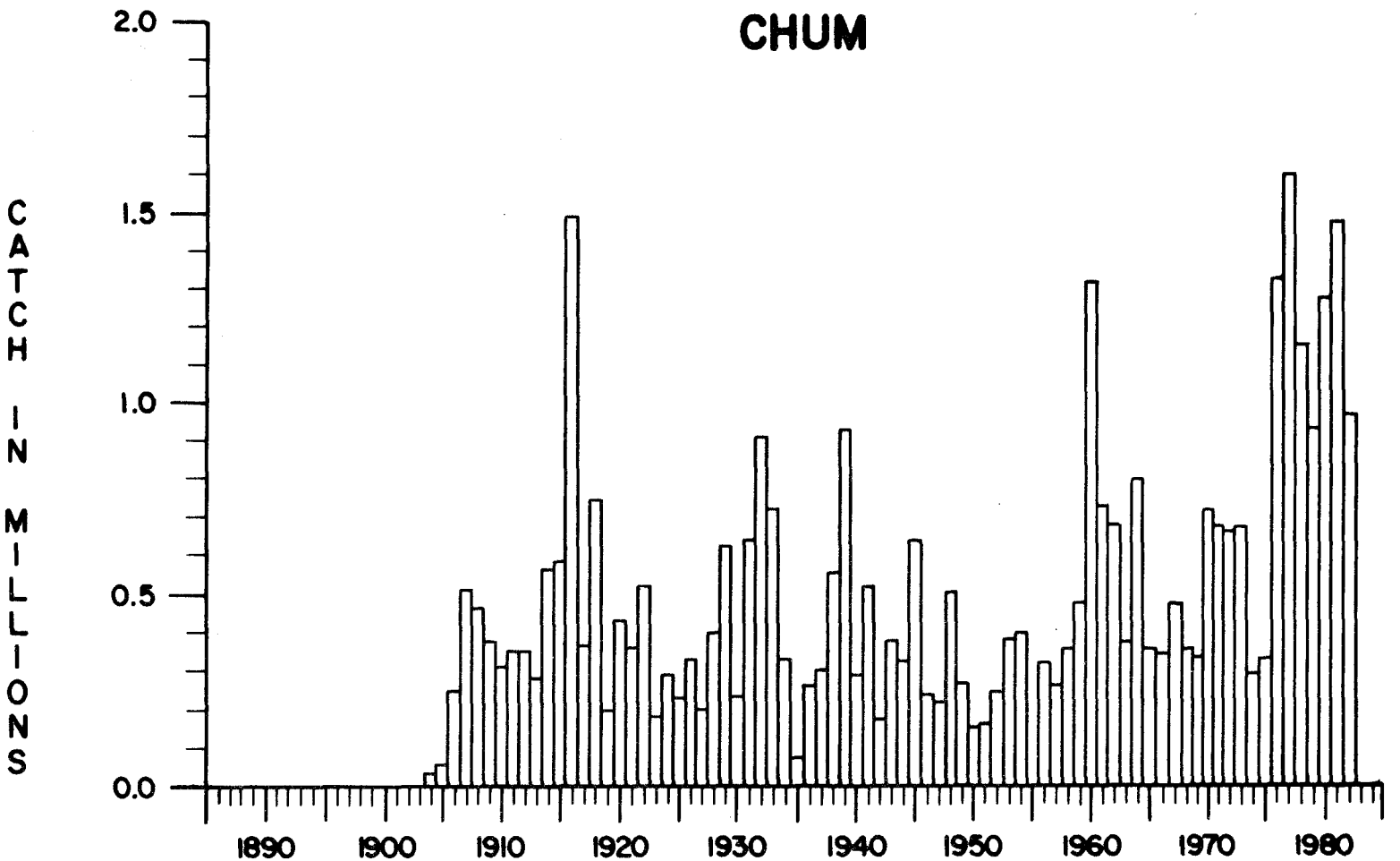
[2] Includes Togiak River tributaries.



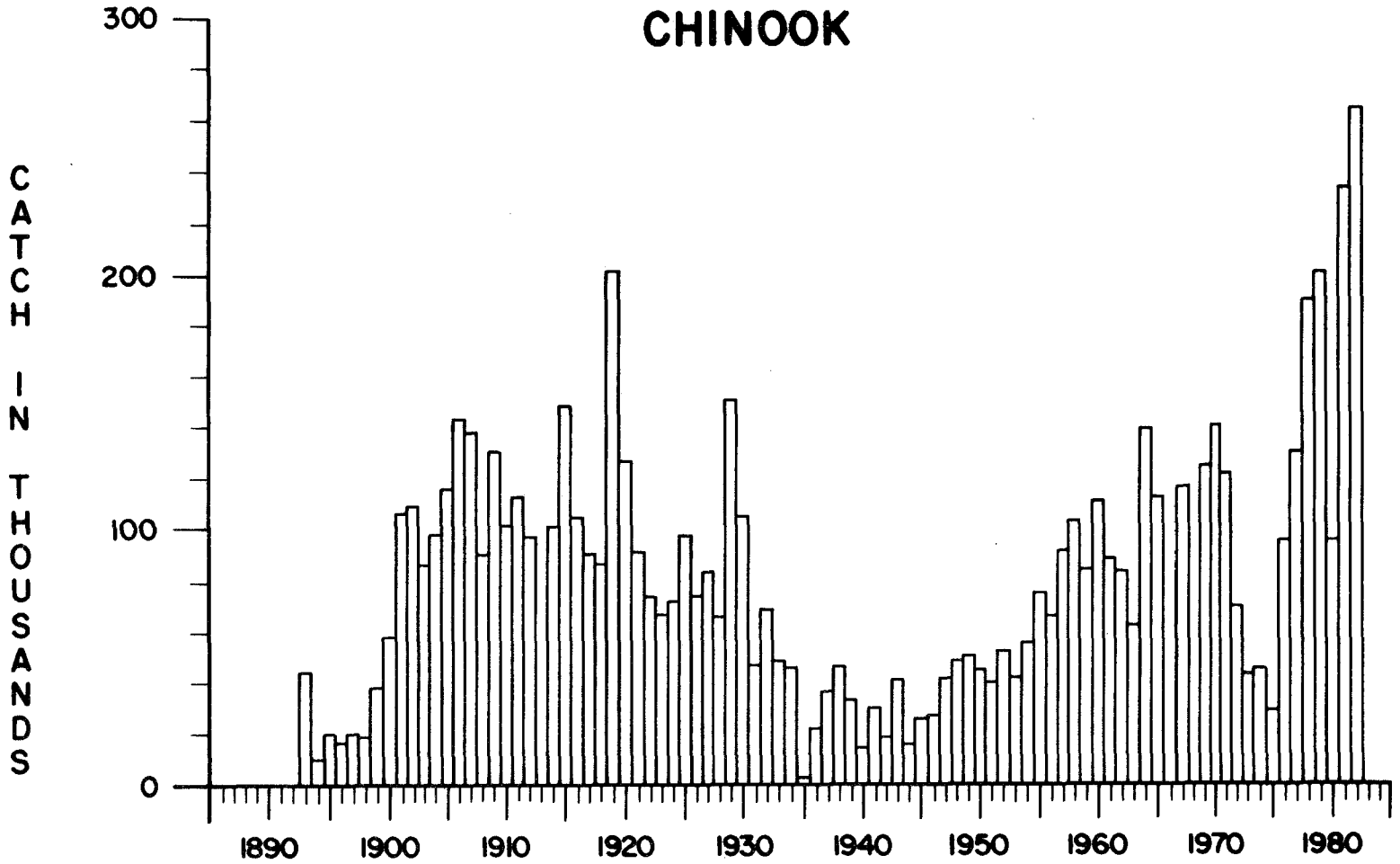
Appendix Figure 1. Commercial catch of Bristol Bay sockeye salmon in numbers of fish, 1893-1982.



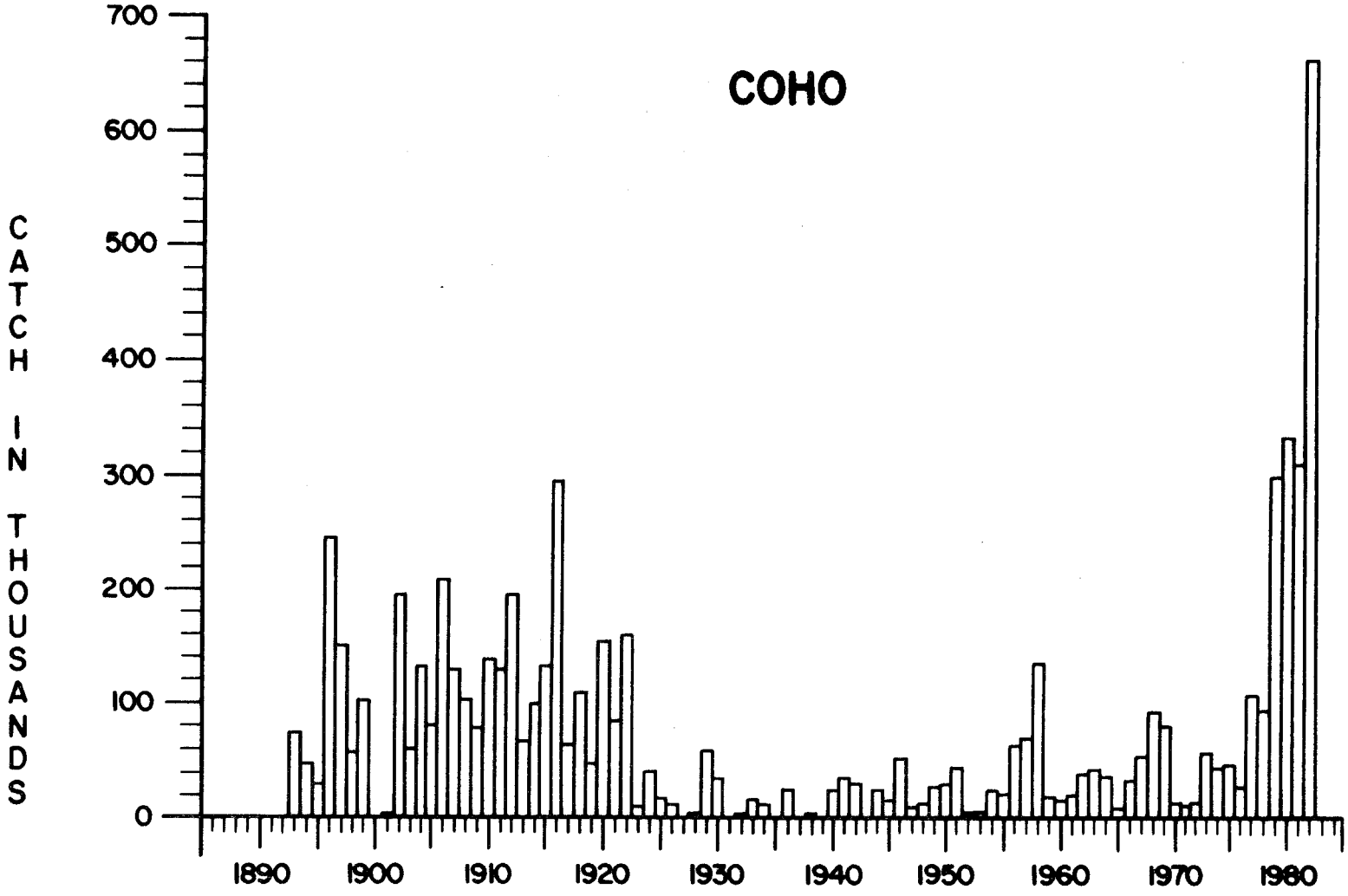
Appendix Figure 2. Commercial catch of Bristol Bay pink salmon in numbers of fish, 1897-1982.



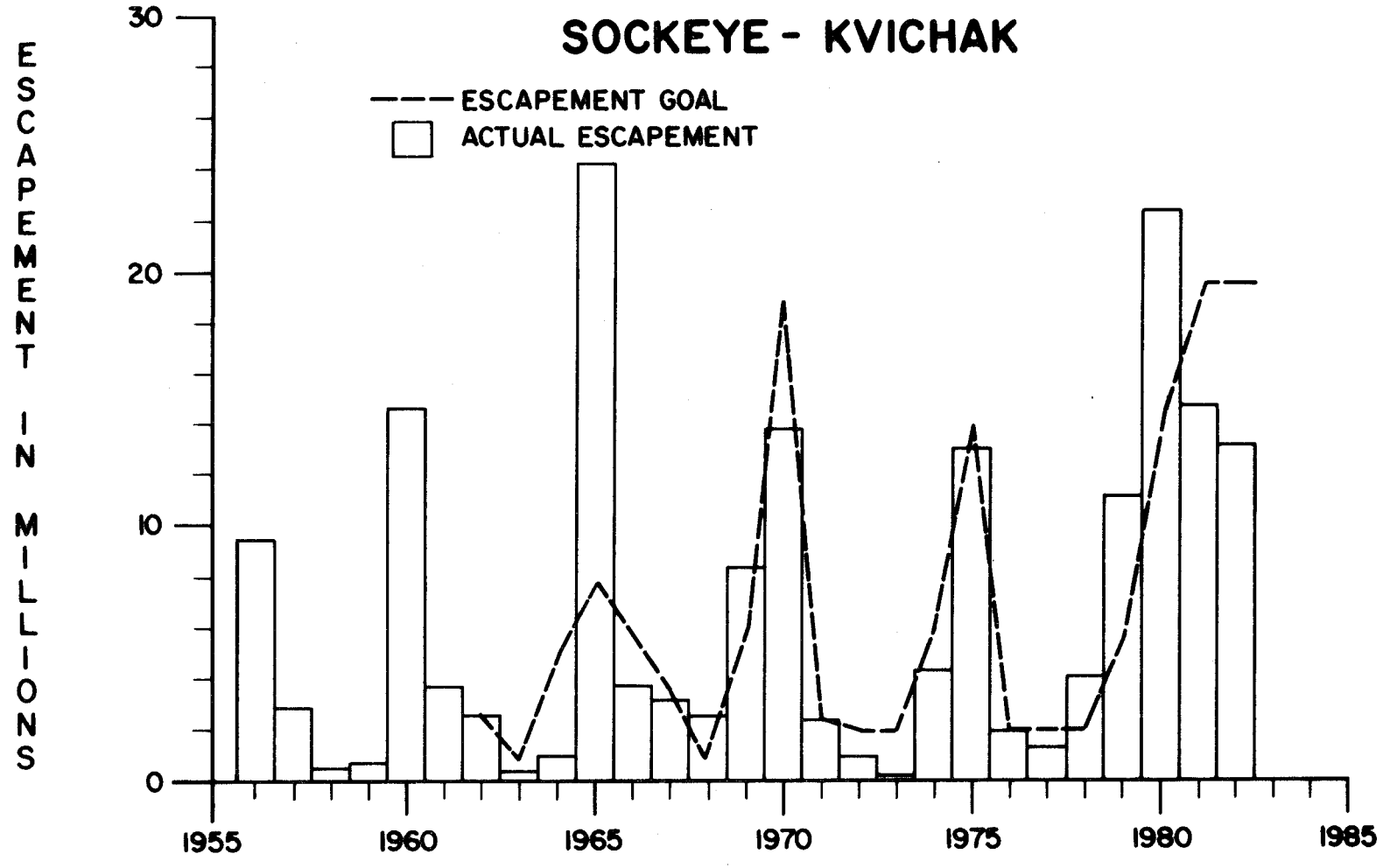
Appendix Figure 3. Commercial catch of Bristol Bay chum salmon in numbers of fish, 1904-1982.



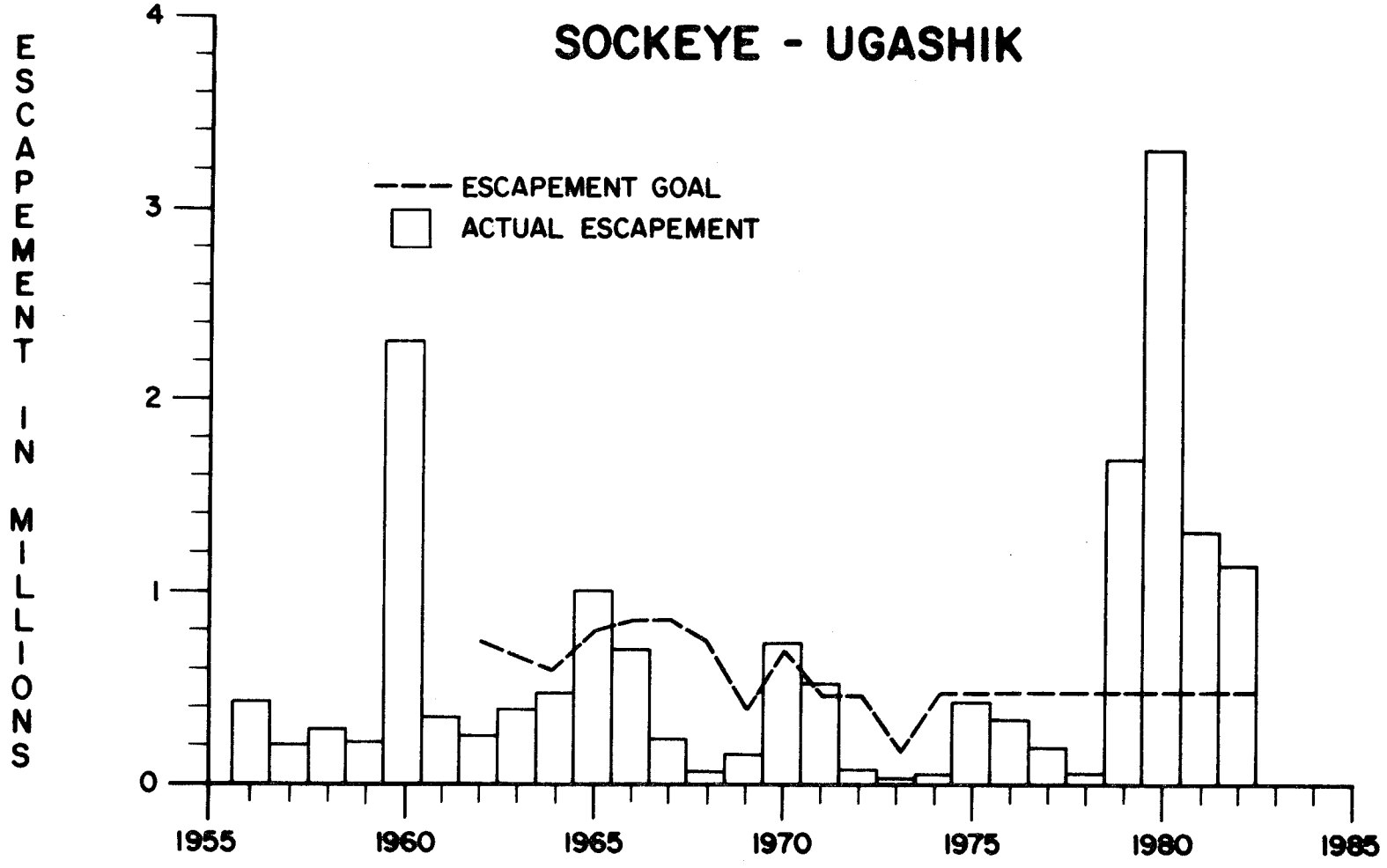
Appendix Figure 4. Commercial catch of Bristol Bay chinook salmon in numbers of fish, 1893-1982.



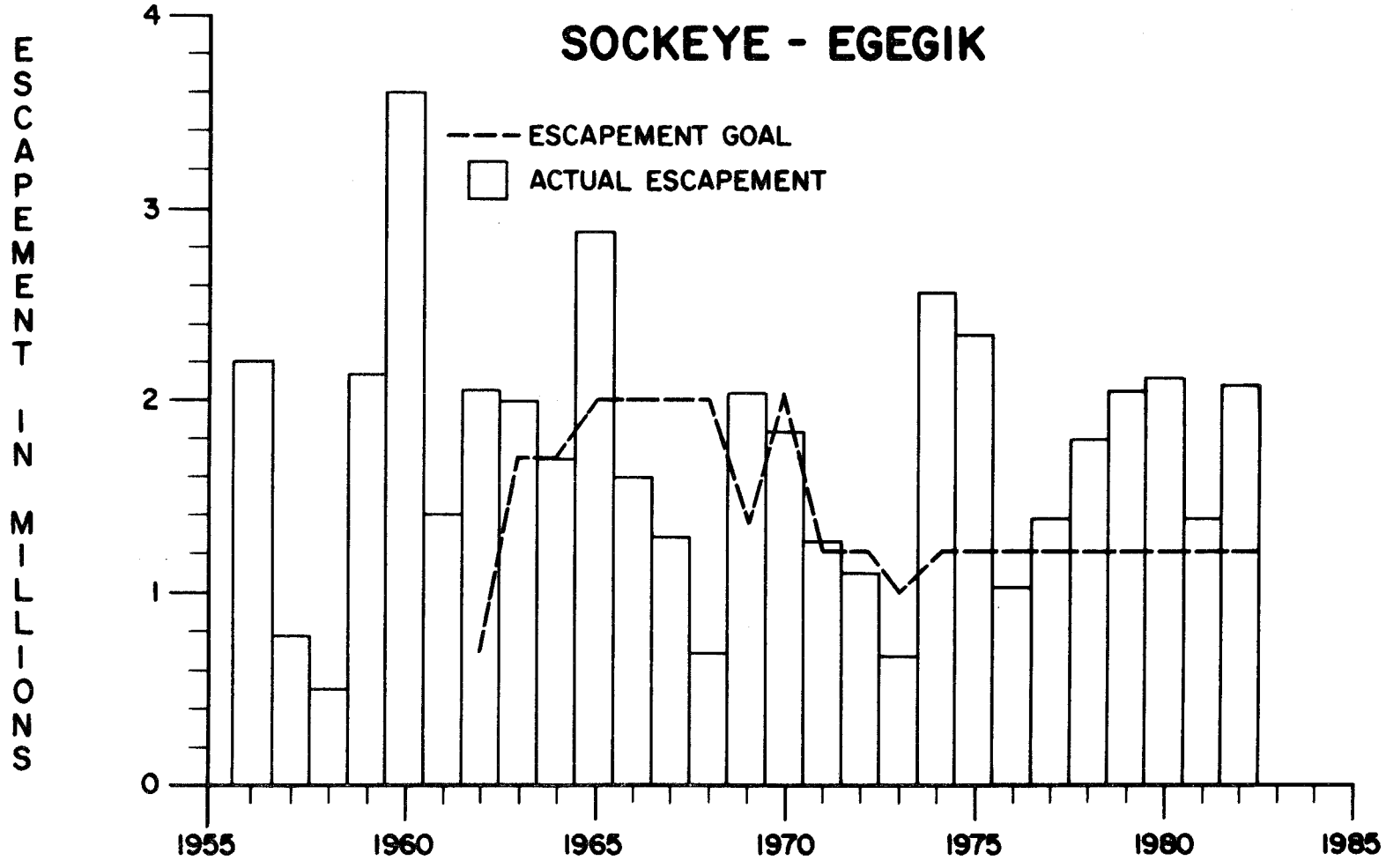
Appendix Figure 5. Commercial catch of Bristol Bay coho salmon in numbers of fish, 1893-1982.



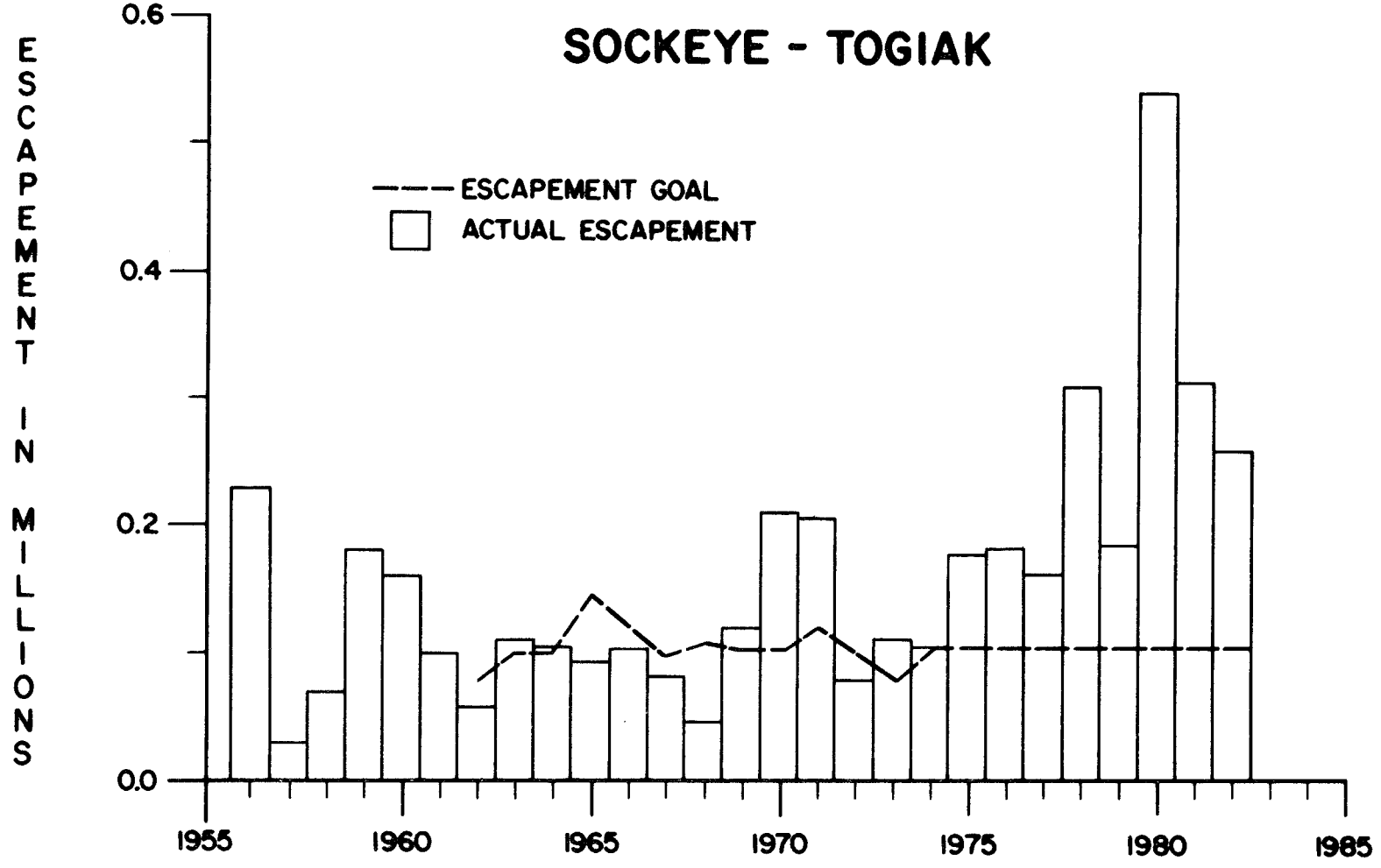
Appendix Figure 6. Escapement and escapement goals of sockeye salmon to the Kvichak River in numbers of fish, 1956-1982.



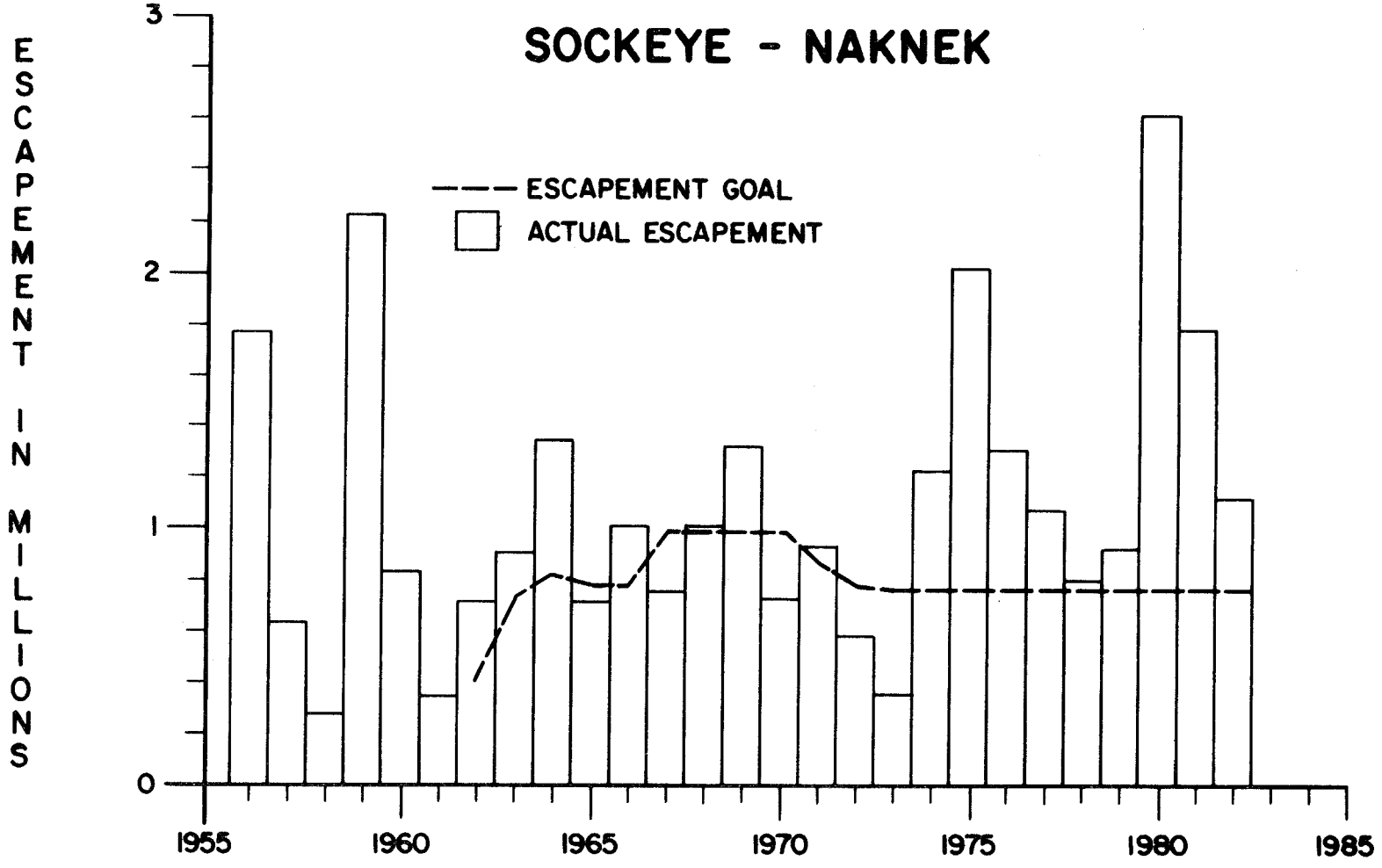
Appendix Figure 7. Escapement of sockeye salmon to the Ugashik River in numbers of fish, 1956-1982.



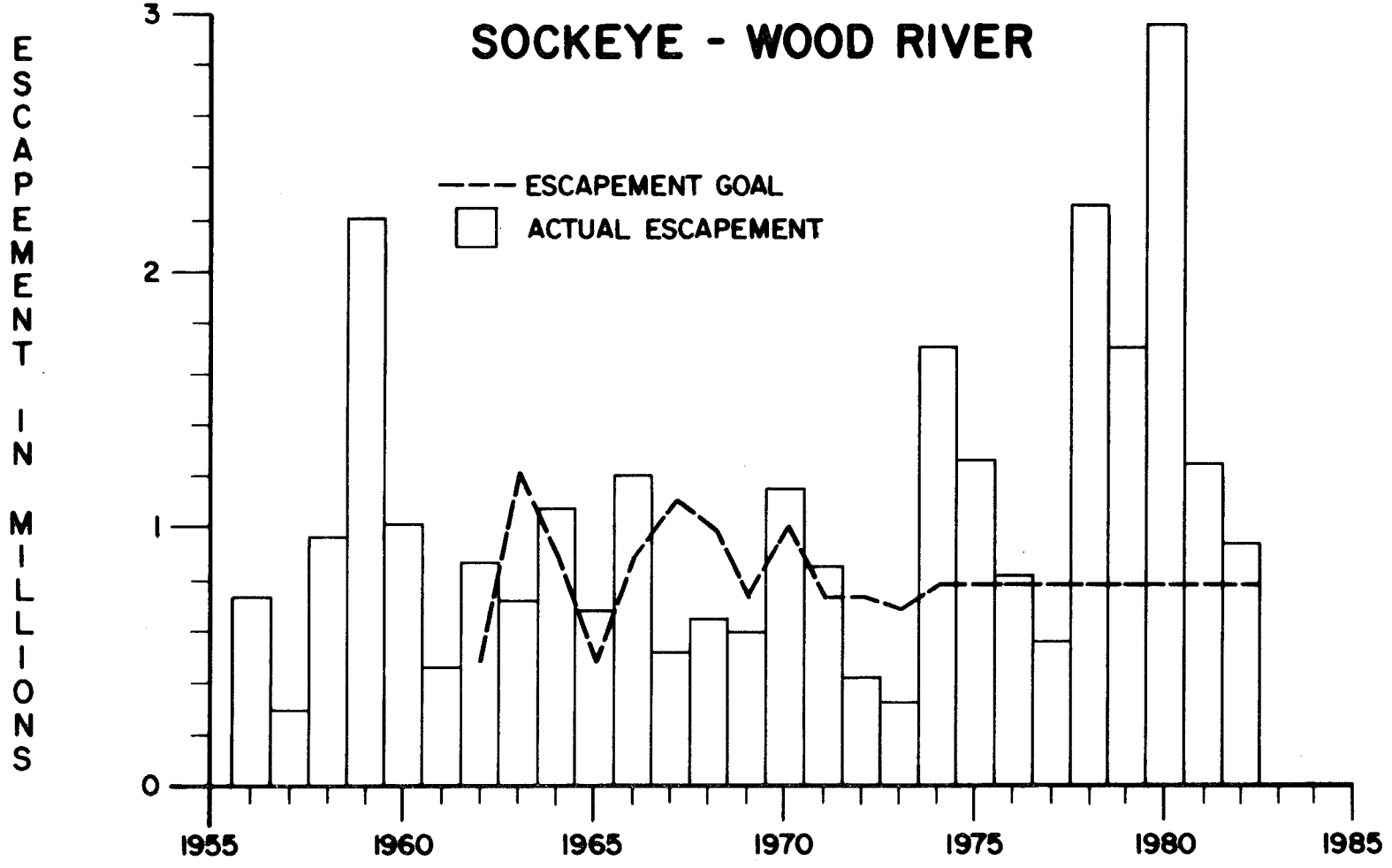
Appendix Figure 8. Escapement of sockeye salmon to the Egegik River in numbers of fish, 1956-1982.



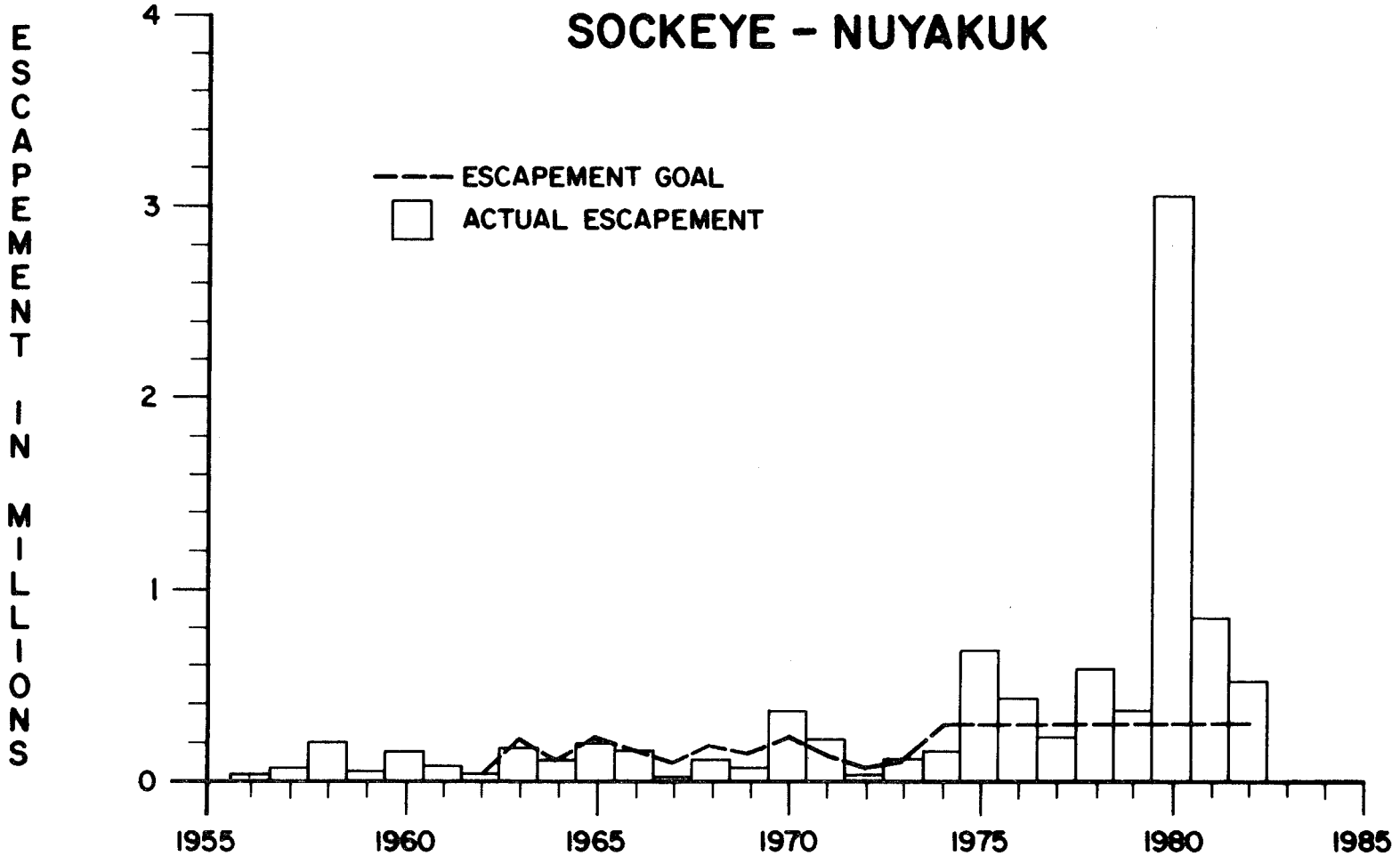
Appendix Figure 9. Escapement of sockeye salmon to the Togiak River in numbers of fish, 1956-1982.



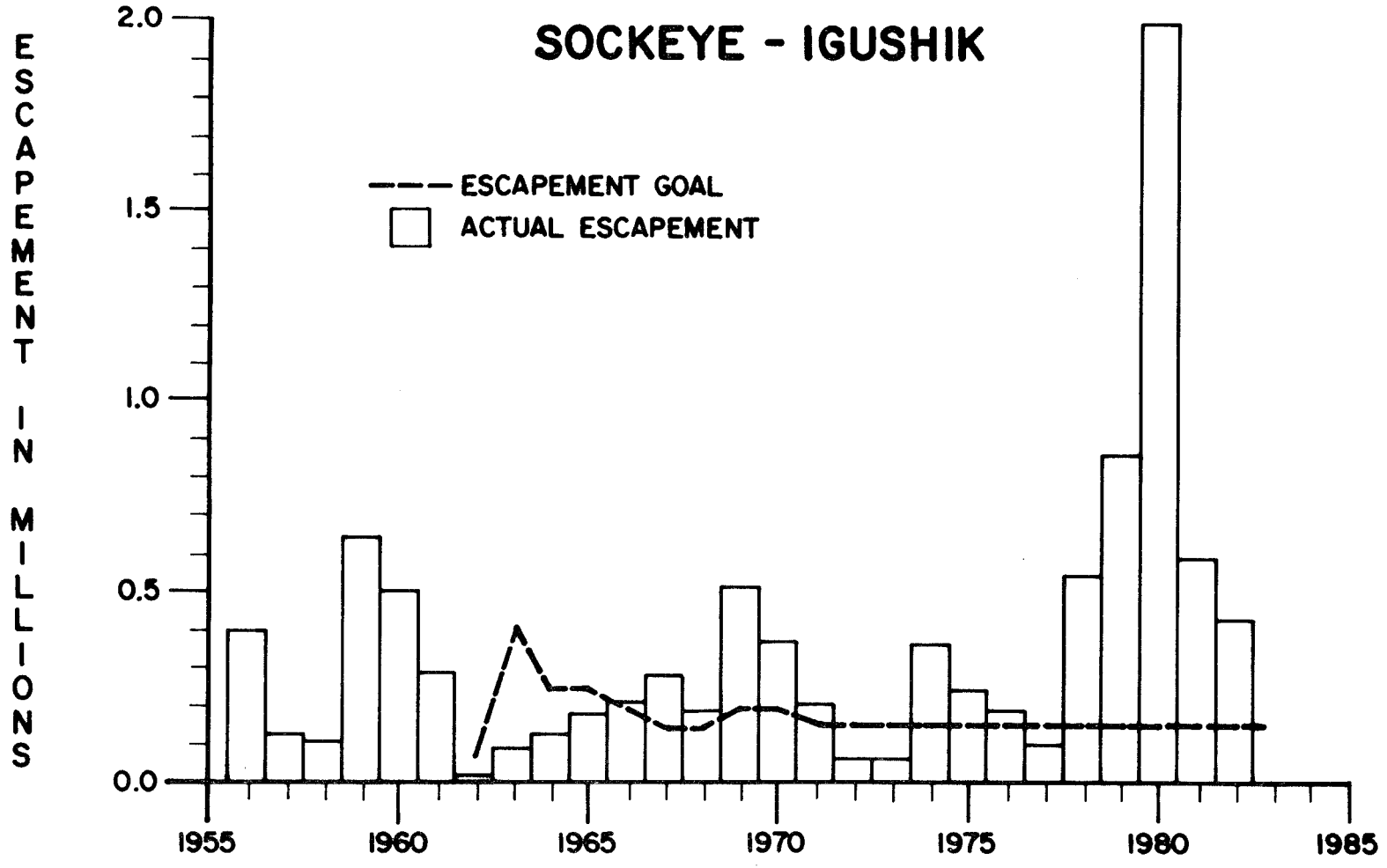
Appendix Figure 10. Escapement of sockeye salmon to the Naknek River in numbers of fish, 1956-1982.



Appendix Figure 11. Escapement of sockeye salmon to the Wood River in numbers of fish, 1956-1982.



Appendix Figure 12. Escapement of sockeye salmon to the Nuyakuk River in numbers of fish, 1956-1982.



Appendix Figure 13. Escapement of sockeye salmon to the Igushik River in numbers of fish, 1956-1982.