

Incidental Trawl Catches of Chinook
Salmon in Relation to Western
Alaska Chinook Salmon Fisheries

By

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Fishery Description

Chinook salmon fisheries for western Alaska occur primarily in the Port Moller area of the Alaska Peninsula, in Bristol Bay, especially the Nushagak district, Kuskokwim Bay and lower Kuskokwim River, the Yukon River, and Southern Norton Sound. Most of the chinook salmon of western Alaska origin are produced in the Yukon, Kuskokwim, and Nushagak river systems.

Chinook salmon are taken for both commercial and subsistence purposes in all these areas. The majority of the catch is sold commercially. The harvest is conducted in nearshore coastal waters, except for the Yukon and Kuskokwim Rivers where commercial and subsistence effort takes place within the rivers. The gear types used to capture chinook are primarily nylon gillnets of eight inch or smaller mesh size, fished in either a set or drift net fashion. Some harvest by fishwheel occurs in the upper Yukon and Kuskokwim Rivers.

Approximately 4,400 commercial salmon limited entry fishing permits have been issued for the areas in western Alaska where chinooks are harvested commercially. It is estimated that approximately half that number participated in the 1980 commercial harvest of chinook salmon. A conservative estimate of 2,500 families utilize chinook salmon for subsistence food needs in Western Alaska.

The following is intended to provide a brief historical perspective of the three major chinook commercial fisheries in western Alaska.

Bristol Bay

Initial exploitation occurred from 1893 to 1899. Until 1952 virtually the entire commercial harvest took place in the Nushagak district; since then approximately 25% has occurred in other Bristol Bay districts, partly as incidental catches in the major sockeye fishery.

The chinook fishery averaged less than 100,000 per year until the mid-seventies either because of resource abundance or market limitations. Since 1976 catches have increased in response to increased effort and resource availability. The MSY for the Bristol Bay chinook fishery is estimated to be approximately 100,000 fish per year. An indication of catch trends is given in Table 1.

Kuskokwim River

Commercial catches were first documented in 1913. The fishery remained at a low level until after statehood in the early 1960's. Effort levels have increased dramatically since the late 1960's. Commercial catches have been somewhat stabilized by a gradual reduction in fishing time allowed with large mesh nets. This is the only major chinook fishery in which subsistence utilization has always equaled or surpassed the commercial harvest. From 1975-1979 the total annual harvest in the Kuskokwim River

has averaged 87,000 chinook (34,600 commercial; 52,400 subsistence). Following a period of decreased abundance in the early and middle 1970's, catches and escapements have greatly improved (Table 2). Catch statistics in Table 2 do not include harvests made in two smaller coastal fisheries in Kuskokwim Bay at Quinhagak and Goodnews Bay.

Yukon River

The Yukon River commercial chinook salmon fishery in Alaska dates back to 1918. Since 1961 commercial catches in Alaska have ranged from 63,700 to 152,900 fish; the recent 5 year average (1975-1979) is 95,000. In addition to the Alaskan catch, the commercial fishery at Dawson (Yukon Territory) harvests 2-3,000 chinooks annually (recent 10 year average). Throughout the Yukon River drainage approximately 15-25,000 chinooks are taken annually for subsistence use. Commercial fishing effort has increased sharply since 1961.

Yukon River chinook salmon runs during the early 1970's generally declined in magnitude based on available comparative catch and escapement data (Table 3). Countering this trend, good runs have occurred since 1977. Restrictions placed on the commercial fishery during the 1970's have generally resulted in improved escapements compared to the 1963-69 period. However, with the exception of 1971 and 1977-80, escapements have not reached the levels observed during the early 1960's prior to maximum development of the commercial fishery.

Economic value of the chinook fishery in western Alaska

The value of the fishery to fishermen is estimated by utilizing a recent 5 year average (1975-1979) catch and applying an appropriate weight and price factor. Subsistence catches are evaluated in the same manner, assuming that the economic value of the catch is at least equivalent in price per pound.

Area	Commercial Catch (5 yr. Av. <u>1/</u>)	Subsistence Catch (5 yr. Av. <u>1/</u>)	\$ Total Value <u>2/</u>
Bristol Bay	130,105	8,800	3,195,000
Yukon River <u>3/</u>	95,096	21,400	2,700,000
Kuskokwim River <u>3/</u>	50,380	53,060	2,400,000
Norton Sound	5,940	638	151,300
North Ak. Pen.	8,720	<u>4/</u>	200,560
Total	290,241	83,898	Average total value to fishermen: \$8,646,860

1/ 1975-1979.

2/ Total catch times 23 lbs. per fish times \$1.00/lb.

3/ Includes small coastal fisheries adjacent to river.

4/ Information not available.

Although the economic value of the chinook catch in Bristol Bay is overshadowed in comparison to the harvest value of sockeye salmon, in the Yukon River and Kuskokwim River districts the value of the harvest approaches one half of the total value of all fisheries products produced in those areas.

Foreign offshore interceptions of chinook salmon

The Bering Sea incidental trawl catch of chinook salmon must be considered in light of the other offshore fisheries that intercept western Alaska chinook salmon. Recent chinook catches in the various offshore fisheries are summarized below along with the estimated interception of western Alaska stocks where known.

<u>Fishery</u>	<u>Approximate Total Catch (1979)</u>	<u>Estimated W. Alaska Interceptions (1979)</u>
1. Bering Sea Foreign Trawl	100,129	93,120 ^{1/}
2. Japanese mothership gillnet	126,000	65,000 ^{2/}
- dropouts 33% of catch ^{3/}	41,580 ^{3/}	21,450 ^{3/}
3. Japanese landbased gillnet	162,000	^{4/}
- dropouts 33% of catch ^{3/}	53,460	
4. Gulf of Alaska foreign trawl	20,000 (1979)- 45,000 (1978)	^{4/}
Totals	503,169-528,169	179,570

- ^{1/} From R. Major's 7/21/80 letter to B. Larkins (NMFS files). Percentage of W. Alaska chinook in foreign trawl catch estimated at 93%.
- ^{2/} Dahlberg, M. L. 1980. Report of U. S. observations of the Japanese mothership fishery during 1980. (Document submitted to annual meeting of the International North Pacific Fisheries Commission, Anchorage, Alaska, October 1980. 12 pp NW & AK Fish. Center, Nat'l Mar. Fish. Serv., Nat'l Oceanic Atmos. Adm., Auke Bay Laboratory, P. O. Box 155, Auke Bay, AK 99821.)
- ^{3/} Approximate values based on INPFC research.
- ^{4/} Unknown, but may be substantial.

These data show a recent annual catch of in excess of 500,000 chinook salmon by all offshore foreign fisheries in the Gulf of Alaska - Bering Sea region. This is a major harvest considering this species is the least abundant and that the average annual commercial catch of chinook salmon in the entire state of Alaska in the eleven years from 1969-1979 has only been 625,000.

The 179,570 figure represents a very minimum estimate of 1979 Western Alaska chinook interception. If data on stock origins were available for Gulf trawl and landbased gillnet fisheries, it is likely this interception figure would increase substantially. Some of the largest Gulf of Alaska trawl chinook catches are made near Kodiak and the Alaska Peninsula where past tagging studies have shown the presence of substantial numbers of Western Alaska chum stocks which implies that some Western Alaska chinook may also be intercepted.

Estimates of the economic loss to Western Alaska commercial fishermen resulting from the 1979 Bering Sea trawl chinook catch indicate that about \$1.5 million was lost by this fishery alone. When interceptions from other foreign fisheries are considered, the loss probably exceeds \$3.0 million. Since the chinook fishery constitutes the backbone of many Western Alaska fisheries this loss is extremely significant, especially since in many of these same areas low incomes and substandard living conditions prevail. Chinook salmon are also utilized extensively for subsistence, an aspect that needs to be included in a socio-economic analysis.

A fact of disturbing importance at present is that the estimated interceptions by the Bering Sea trawl fishery are greater than anticipated, and in 1979 they surpassed the high seas mothership gillnet fishery in Western Alaska chinook interceptions.

Rivers of origin of salmon intercepted by the trawl fleet.

There is no way of determining accurately the rivers of origin in western Alaska of trawl caught chinook salmon. It has been estimated by NMFS personnel that 93% of the chinook taken in the Bering Sea mothership gill net fishery originated in western Alaskan streams, an estimate based on past analysis of scale characteristics. Sufficient precision in the analysis of scales is not presently available to allow apportionment of western Alaska chinook to specific river drainage of origin.

Trawl interception impacts

It is not known whether inshore fishery harvest rates are similar between western Alaska rivers or whether differential harvest of respective stocks may occur in the trawl fishery due to varying chinook distributional patterns in the Bering Sea. Simply using relative magnitude of inshore harvests between river systems may provide some idea of potential impact of interceptions.

To calculate the ultimate inshore loss one must apply appropriate age and sex specific mortality factors to the catch. A rough approximation yields a loss to the inshore fisheries and stream escapements of 81,000 chinook salmon in western Alaska in 1979. Based on relative inshore catches alone the distribution could be:

	<u>Numbers of Fish</u>
Nushagak	26,000
Togiak	6,000
North Peninsula	1,000
Kuskokwim	22,000
Yukon	24,000
Norton Sound	2,000
Total	<u>81,000</u>

Since river of origin of offshore catches is not known with any assurance it is possible that some river systems sustain more offshore interception than is depicted here. Stock specific management of these offshore fisheries is not feasible at this time.

During the decade of the 1970's, chinook abundance in Western Alaska apparently fluctuated from a high level during 1970 and 1971 to very low levels in 1974 and 1975. Following 1976, returns have followed a trend of increasing abundance as judged from inshore catches and escapements (Tables 1, 2, & 3).

An important biological factor in determining run strength in a given year is the age, sex, and size composition of incoming runs. Reproductive potential and fishery success are affected by variations in the sex ratio, and size of average chinook in the run.

Although information on size and sex compositions of runs in western Alaska is available from many return years it has not yet been compiled and analyzed in one place. Accurate depictions of run composition are difficult due to the bias involved in data collection. Gillnet fisheries remove selected shapes and sizes of salmon, while spawning ground surveys suffer from the fact that the fisheries have already removed certain components. Data available indicate that some year to year variability in age and sex composition is present.

Size at age of return has been analyzed for three return years in Table 4. Depicted there is the average weight in pounds of chinook taken in the inshore fisheries of Bristol Bay, the Yukon River, and the Kuskokwim River. The similarity between areas and between years is apparent.

In general, Western Alaska female chinook salmon mature when they are six years old, and weigh on the average about 24 lbs. Males, on the other hand, tend to return at 4 and 5 years of age, as well as at older ages. Very often the sex ratio of chinooks in spawning streams is skewed in favor of males, sometimes as much as 2 or 3 to 1 or more. This is apparently due to at least three factors. The first involves the tendency of males to mature and return at an earlier age than females. Secondly, gillnet fisheries targeting chinooks utilize mesh sizes to optimize the capture of the larger salmon which are often females, and to minimize the capture of younger, more streamlined males. Third, and important for this discussion, is that since females return at an older age, they are subject to both natural marine mortality factors, and offshore fishing for a longer time period. Offshore interception fisheries which occur during the marine life history thus further exacerbate a natural tendency in the species to produce higher proportions of males in the spawning population. Management of inshore fisheries must take this into account through conservative management schemes based not only on the escapement magnitudes, but on the sex and size composition of escapements.

Management

The management of the western Alaskan chinook salmon runs is necessarily conservative due to an inadequate biological data base, the complexity

of the fisheries, the immense geographical area, and the number of salmon stocks involved. These problems are especially acute in the drainages of the Yukon and Kuskokwim Rivers.

Forecasts of chinook salmon returns in actual number are unavailable. Escapement/ return relationships have not been developed. Except for the Bristol Bay area (Nushagak River system) total escapement estimates are not available. In-season management is essentially limited to analysis of comparative catch data assuming that catches reflect the abundance of the run. The catch data itself is difficult to compare since the fisheries have undergone changes in recent years (mesh size restrictions, reduced fishing time, delayed openings of the seasons, increased fishing efficiency, etc.).

In addition to the poor biological data base there are several other factors which hamper management. Chinook salmon are generally subjected to intensive commercial fisheries in the lower rivers (Yukon and Kuskokwim) or in the coastal waters near the mouths of major river systems (Nushagak River). Often clear water spawning tributaries are located several hundred miles and several weeks distant from mouths of the major turbid rivers. Consequently, escapement information is not available for in-season management. The Yukon and Kuskokwim River fisheries fish on mixed stocks and some stocks, especially smaller ones, may be subjected to overfishing since it is impossible to manage each stock separately.

Although western Alaskan chinook salmon stocks are of lesser abundance than other species, they are usually subjected to greater fishing effort. This is a result of their high market value in the commercial fishery and the importance for human consumption in the subsistence fishery. In the major river systems (Yukon and Kuskokwim), chinook salmon bound for upriver spawning tributaries several hundred miles from the mouth are fished extensively along the main stem rivers prior to reaching their natal streams.

Further complicating management of the chinook salmon fisheries are allocation problems that exist between various competing user groups. This is most acute in the Kuskokwim and Yukon rivers. In the Yukon River drainage for example (330,000 square miles) commercial and subsistence fisheries in Alaska are scattered over more than 1,400 river miles in the main stem of the Yukon and Tanana Rivers. Also significant commercial and subsistence fisheries occur in the Canadian portion of the drainage. After passing through the lower river area where the major commercial fishery is concentrated, chinook salmon are subjected to additional fishing pressure from the upper river areas. In most salmon fisheries elsewhere, once the commercial harvest is taken at the mouths of rivers or in bays, the surplus is available for escapement. In the Yukon River management of the downriver fishery must also provide for the upriver fishery and escapement requirements.

Regulation of both the commercial and subsistence fisheries has become more restrictive in recent years as fishing effort and efficiency has increased. Fishing time has been sharply reduced in most of the fisheries. In the lower Kuskokwim River allowable commercial fishing time during the season has been cut back drastically (only 12 hours were allowed in 1976 compared to 228 hours in 1961). Other restrictions imposed in

recent years on the various chinook fisheries include conservative guideline harvest levels, delayed season openings, gill net mesh size and depth limitations, and in-season fishing time reductions and season closures.

Unregulated foreign offshore trawl interception of chinook salmon substantially increases the risk of overharvesting the resource, primarily because of the imprecise management system presently in place to regulate inshore harvests. Harvest regulation with greater precision is hampered by all the factors discussed above.

Table 1. Bristol Bay Chinook salmon catch and escapement data, 1971-1980

Year	Comm. Catch	Subsistence Catch	Total Catch	Escapement ^{1/}	Total Run
1971	123,015	4,600	127,615	-	-
1972	69,546	4,500	74,046	39,000	113,046
1973	44,044	7,200	51,244	46,000	97,244
1974	45,664	9,900	55,564	85,000	140,564
1975	29,992	8,600	38,592	81,000	119,592
1976	95,968	8,400	104,368	114,000	218,368
1977	130,526	7,000	137,526	85,000	222,526
1978	191,539	9,000	200,539	170,000	370,539
1979	202,500	11,000	213,500	115,000	328,500
1980	96,700	10,000 ^{2/}	106,700 ^{2/}	155,000 ^{2/}	261,700 ^{2/}

^{1/} Nushagak and Togiak systems aerial surveys. These 2 systems comprise about 90% of the total Bristol Bay king salmon run (B. Bay Data Report 73).

^{2/} Preliminary estimates 9/10/80.

Table 2. Kuskokwim River Comparative Cook Salmon Data.

Year	Total Catch ^{1/}	Subsistence Catch ^{1/}	Commercial Catch ^{1/}	Numbers of Commercial Fishing Vessels ^{2/}		Hours open to Commercial Fishing ^{3/}	Test Fishing Catch/Hour ^{4/}	Escapement Index ^{5/}
				Licensed Fishing Vessels	Actual Fishing Vessels			
1961	50,054	31,136	18,918	139		228	<u>6/</u>	<u>6/</u>
1962	29,997	14,656	15,341	252		96	<u>6/</u>	<u>6/</u>
1963	46,631	34,615	12,016	111		144	<u>6/</u>	<u>6/</u>
1964	46,166	29,017	17,149	139		96	<u>6/</u>	<u>6/</u>
1965	49,132	27,143	21,989	195		120	<u>6/</u>	<u>6/</u>
1966	75,151	49,606	25,545	189	210	120	.82	824
1967	87,861	57,875	29,906	237	233	168	1.40	<u>6/</u>
1968	64,508	30,230	34,278	343	303	144	.32	972
1969	84,135	40,138	43,997	355	329	120	.45	537
1970	100,509	69,219	39,290	373	361	84	.61	932
1971	83,200	42,926	40,274	440	418	48	.35	<u>6/</u>
1972	80,940	40,145	40,795	428	405	66	.42	476
1973	71,364	38,526	32,838	474	456	48	.25	191
1974	45,229	26,665	18,564	730	606	36	.27	73
1975	69,704	47,569	22,135	642	541	30	.41	419
1976	97,107	66,372	30,735	657	561	12	.65	596
1977	91,169	55,339	35,380	618	563	12	.71	1,079
1978	82,641	37,000	45,641	<u>6/</u>	615	26	.73 ^{7/}	2,540
1979	94,490	55,524	38,966	<u>6/</u>	591	12	0.35	<u>6/</u>
1980	85,900 ^{7/}	50,000 ^{7/}	35,900 ^{7/}	<u>6/</u>	553	12	<u>6/</u>	<u>6/</u>

1/ Catches from entire Kuskokwim River drainage; includes catches made during chum salmon season.

2/ Data from subdistrict 1 (lower 100 river miles) only, actual fishing vessel represent vessels that delivered fish at least once during the season.

3/ Data from subdistrict 1 (lower 100 river miles) only, includes only fishing time with large mesh gillnets.

4/ Data from Department of Fish and Game test fisheries site located at river mouth, 25 fathoms 8-1/2 inch mesh set gillnets.

5/ Average numbers of fish counted during aerial surveys of the following index streams: Kwethluk, Kisarialik, Aniak, (upstream of Salmon River), Kipchuk, Chukowan and Kogruluk Rivers, does not include counts made during "poor" survey conditions.

6/ Information not available.

7/ Preliminary data.

8/ Figure adjusted for early project start-up date.

Year	Total Catch ^{1/}	Subsistence Catch ^{1/}	Commercial Catch ^{1/}	Numbers of Commercial Fishing Vessels ^{2/}		Hours open to Commercial Fishing ^{3/}	Test Fishing Catch/hour ^{4/}	Escapement Index ^{5/}
				Licensed Fishing Vessels	Actual Fishing Vessels			
1961	155,570	31,364	123,706	322	-6/	852	6/	1,650
1962	120,381	21,610	98,771	447	-6/	818	6/	1,218
1963	152,247	32,970	119,277	305	-6/	774	6/	484
1964	119,672	22,877	96,795	415	-6/	606	6/	652
1965	140,006	19,723	120,363	433	-6/	720	6/	655
1966	109,529	14,272	95,257	478	-6/	552	6/	507
1967	151,554	19,661	131,893	507	-6/	744	.37	533
1968	123,744	15,006	108,732	464	-6/	746	.65	476
1969	106,863	15,000	91,863	454	-6/	660	.70	334
1970	98,854	15,974	82,880	492	-6/	636	.67	1,057
1971	142,169	20,044	113,685	561	559	528	.86	1,348
1972	116,524	21,868	94,609	579	579	552	.41	794
1973	103,657	26,433	77,224	625	605	540	.49	523
1974	123,476	23,343	100,133	619	550	576	.26	805
1975	82,785	15,645	66,740	708	590	420	.20	696
1976	116,477	19,329	92,171	716	642	372	.48	783
1977	121,422	20,388	101,034	598	580	386	.19	1,247
1978	130,074	30,297	100,577	6/	633	336	.36	1,943
1979	170,436	35,205	135,231	6/	635	312	6/	2,063
1980 ^{7/}	188,400	30,000	158,400	6/	636	246	6/	2,651

- 1/ Catches from entire Yukon River drainage including Canada.
- 2/ Numbers of commercial fishing vessels in lower 150 miles of river (subdistricts 1 and 2). "Actual numbers of fishing vessels" represents those vessels delivering at least once during the king salmon season.
- 3/ "King salmon season" (June-early July) in lower 150 miles of river (subdistricts 1 and 2).
- 4/ Located in south mouth; 25 fathom 8 1/2 inch set gill nets.
- 5/ Average numbers of fish counted in four index areas: West Fork, Andreafsky River; East Fork, Andreafsky River; Salcha River; Whitehorse fishway, does not include counts made during "poor" aerial survey conditions.
- 6/ Information not available.
- 7/ Preliminary data.

Table 4. Comparison of King Salmon pooled weights ^{1/} (Lbs.) by age and sex derived from 1964 thru 1966 Bristol Bay, Kuskokwim River and Yukon River commercial catch sampling information. The data are presented as summaries by Region which, in turn, are pooled for a western Alaska summary.

<u>WESTERN ALASKA</u>					
Age ^{2/}	Mean Weight	<u>Male</u>		<u>Female</u>	
		Number in sample	Mean Weight	Number in sample	Mean Weight
<u>BRISTOL BAY</u>					
1.2	7.0	151		None in sample	
1.3	14.7	89		19.4	46
1.4	23.8	75		26.1	99
1.5	32.6	15		29.7	21
<u>KUSKOKWIM RIVER</u>					
1.2	8.0	9	10.0		2
1.3	16.5	272	18.6		89
1.4	23.8	374	24.8		517
1.5	31.9	38	28.6		77
<u>YUKON RIVER</u>					
1.2	6.4	48	5.0		1
1.3	14.7	265	17.3		51
1.4	24.0	616	23.3		691
1.5	34.6	131	28.0		109
<u>WESTERN ALASKA SUMMARY</u>					
1.2	6.9	208	8.3		3
1.3	15.5	626	18.4		186
1.4	23.9	1065	24.1		1307
1.5	33.9	184	28.4		207

1/ The three years of mean weights by age and sex are weighted by sample size.

2/ European system of age designation. Number preceding decimal denotes winters spent in freshwater; number following decimal denotes winters spent in the ocean; for example the notation 1.4 means that the fish has spent one winter in freshwater, 4 winters in the ocean, and that the total age is 6 years old.