

3. INFORMATION ON COHO AND CHINOOK SALMON STOCKS ORIGINATING IN PUGET SOUND AND WASHINGTON COASTAL STREAMS NORTH OF THE COLUMBIA RIVER

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Editor's Preface: This report was provided by the U.S. National Section in partial response to a 1966 request of the Japanese National Section for "Explanation of the changes in salmon fisheries in recent years and evaluation of the condition of the salmon stocks in recent years by major region . . ." It is INPFC Doc. 1603, received in October 1973. In October 1975, the U.S. Section provided data to update and revise information given in INPFC Doc. 1603. These data (INPFC Doc. 1838) are incorporated in the tables presented here and appear in italics. No changes have been made in the text or figures of the original document. The original language is English.

INTRODUCTION

This report is another in the series prepared in response to Japan's request and contains information on coho and chinook salmon originating in Puget Sound and Washington coastal streams north of the Columbia River (Fig. 1) and the fisheries in which they are caught.

THE FISHERIES

Coho salmon originating in streams and hatcheries in Puget Sound are caught in troll fisheries from the northern end of Vancouver Island to the Columbia River; in net fisheries in the Strait of Juan de Fuca and Puget Sound; and in sport fisheries along the Washington coast, in southern British Columbia, in the Strait of Juan de Fuca, and in Puget Sound. Relatively small numbers are caught south of the Columbia River or north of Vancouver Island.

Chinook salmon of Puget Sound origin are also taken in the fisheries indicated for coho salmon of Puget Sound origin, and in troll fisheries off northern British Columbia. Catches in troll and sport fisheries along the Washington coast are minor compared to other fisheries, because of the predominantly northward ocean migration of Puget Sound chinooks.

Coho salmon produced in streams emptying into Grays Harbor and Willapa Bay on the Washington coast are caught mainly in ocean fisheries from the central part of the Washington coast to Vancouver Island; in net and sport fisheries in the outer portion of the Strait of Juan de Fuca; and in net and sport fisheries in Grays Harbor and Willapa Bay. Coho salmon produced in Washington's coastal streams north of Grays Harbor contribute to ocean fisheries both to the north and south of their points of origin, judging from limited information available.

Chinook salmon originating in Washington coastal streams have a pronounced northward ocean migration and are taken in troll fisheries as far north as southeastern Alaska. They are also caught in net and sport fisheries in or near their streams of origin.

Trends in those troll, net, and sport fisheries which account for most of the catch of coho and chinook salmon originating in Puget Sound and Washington coastal streams are indicated in Table 1 and Fig. 2. There has been a general increase in angler trips by salmon sports fishermen in Washington, in the number of licenses issued by the State of Washington for gillnetting in Puget Sound, in the number of troll licenses issued in the Puget Sound and coastal fishing districts of Washington, and in the number of days fished by the British Columbia troll fishery off the west coast of Vancouver Island.

FACILITIES FOR ARTIFICIAL PRODUCTION AND FISH PROTECTION

Maintenance of the stocks in the face of diverse,

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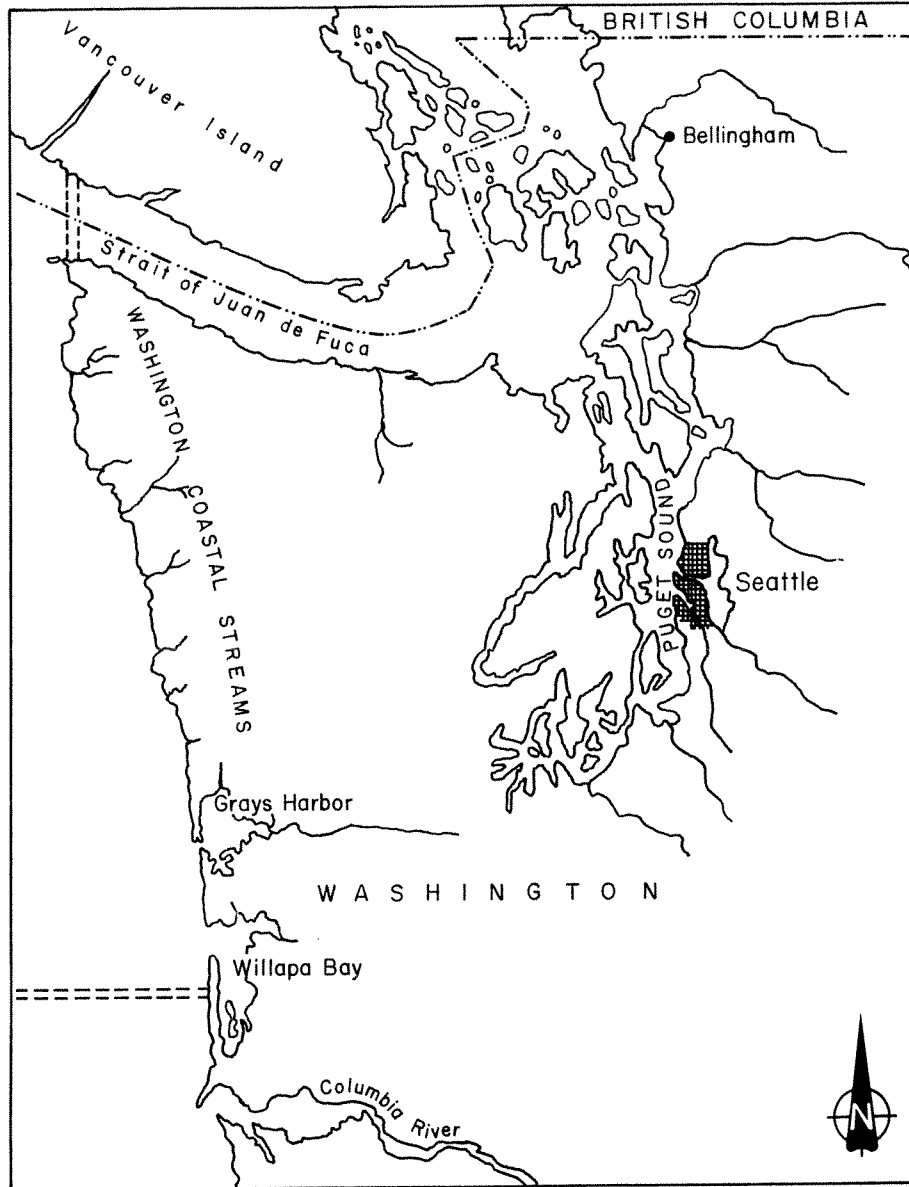


FIG. 1. Puget Sound and Washington coastal streams.

TABLE 1. Angler trips by salmon sport fishermen in Puget Sound and along the Washington coast north of the Columbia River, licenses issued for the Puget Sound net fishery, troll licenses issued by the State of Washington for the Puget Sound and Coastal Districts, days fished by the British Columbia troll fishery off the west coast of Vancouver Island, and days fished by the British Columbia net fishery in the Strait of Juan de Fuca, 1953 to 1974. (Data from Washington Department of Fisheries; and Fisheries and Marine Service, Department of Environment, Canada.)

Year	Washington sport fishery		Puget Sound net fishery			Washington troll fishery		British Columbia fisheries	
	Puget Sound	Coastal	Gillnet	Purse seine	Reef net	Puget Sound district ^a	Coastal district ^b	Troll-west coast of Vancouver I.	Net-Strait of Juan de Fuca
	(Thousands of angler trips)		(Number of licenses issued)			(Number of licenses issued)		(Thousands of days fished)	
1953	632	25	606	334	101	582	30	47	2.3
1954	698	55	631	310	131	525	83	45	2.7
1955	696	77	830	375	102	529	75	45	3.8
1956	757	121	706	211	110	607	47	48	1.7
1957	776	134	887	421	93	529	114	54	7.8
1958	647	101	953	447	107	838	126	52	7.9
1959	577	98	876	425	104	1,168	164	50	7.7
1960	601	100	812	338	89	985	135	45	5.6
1961	776	106	856	452	100	772	116	59	8.3
1962	845	146	827	386	75	759	140	53	7.7
1963	1,157	157	886	431	83	657	200	54	8.0
1964	978	162	787	293	63	844	254	59	6.8
1965	962	191	906	400	76	851	277	67	10.3
1966	841	171	835	324	52	760	346	70	11.2
1967	946	211	970	346	63	913	360	72	10.3
1968	762	199	909	309	54	1,068	432	73	5.8
1969	888	212	1,007	384	63	1,379	575	70	8.0
1970	1,100	246	1,039	319	54	1,312	606	65	9.8
1971	1,026	245	1,419	298	69	2,166	974	82	10.4
1972	1,079	261	1,194	275	61	1,730	1,788	66	5.4
1973	1,085	258	1,303	320	74	1,288	1,372	69	9.3
1974	1,066 ^c	311 ^c	1,989	437	85	1,621	1,639	66	6.9

^a Licenses issued in the Puget Sound fishing district are for trolling in coastal waters.

^b Beginning in 1972, troll licenses were issued for the Columbia River and Coastal districts combined.

^c Preliminary.

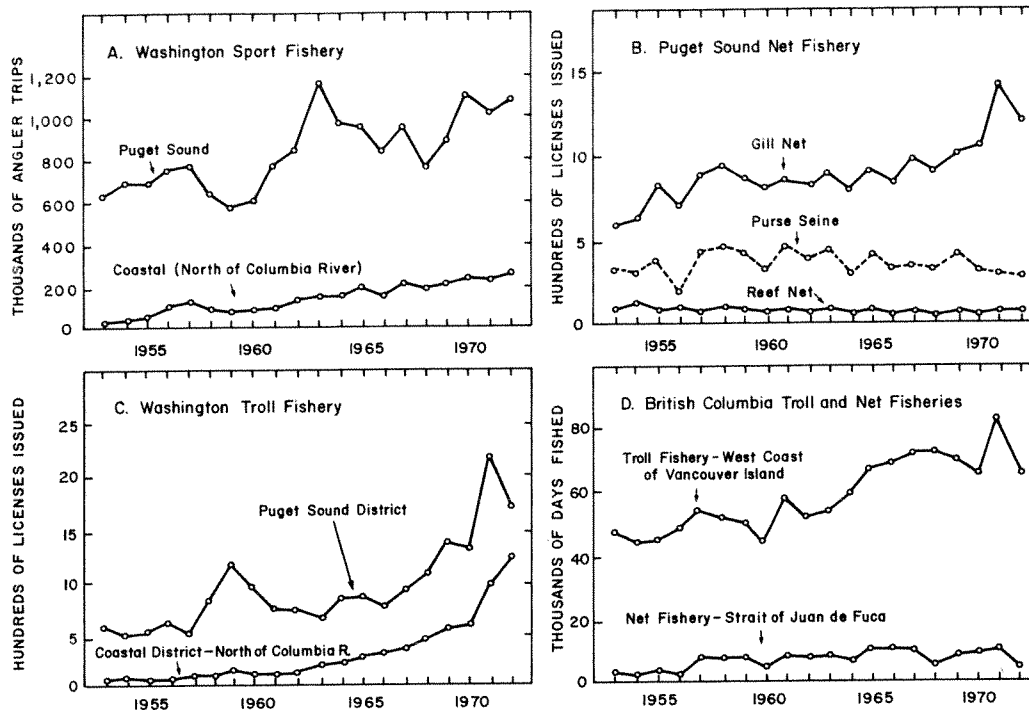


FIG. 2. (A) Angler trips by salmon sport fishermen in Puget Sound and along the Washington coast north of the Columbia River; (B) licenses issued by the State of Washington in the Puget Sound and Coastal fishing districts (north of the Columbia River); and (C) troll licenses issued by the State of Washington in the Puget Sound District and Coastal District-North of Columbia R. and (D) days fished by the British Columbia troll fishery off the west coast of Vancouver Island and the British Columbia net fishery in the Strait of Juan de Fuca, 1953-72. (Data from Table 1.)

intensive fisheries over a large area has been all the more difficult because of environmental changes brought about by dam building, pollution, deforestation, highway construction, housing developments, etc. In an attempt to offset the problems arising from environmental changes and increases in fishermen, various public agencies and private organizations have expended large sums of money for hatcheries, rearing areas, fishways and fish transport facilities, fish screening devices, and habitat improvement. Major expenditures are summarized in Table 2.

MANAGEMENT

In addition to construction and maintenance of facilities for propagation and protection of salmon, the commercial and sport fisheries are regulated by means of size limits, fishing seasons, area closures, gear restrictions and other measures to achieve escapement goals. Limitation of the amount of gear that can engage in the fisheries is being considered.

The spawning and rearing habitat is protected by means of regulations designed to provide adequate quality and quantity of water.

RESEARCH

Commercial and sport catches are sampled routinely to obtain biological data. Catches are also sampled for marks or tags that have been used for evaluation of hatchery production, identification of specific runs, determination of optimum time of release of young salmon for maximum return, and estimation of the contribution of individual runs to various fisheries. Spawning grounds are surveyed annually to enumerate escapements. Escapements to hatcheries are counted.

Special research projects have been undertaken to increase the yield from natural spawning and from hatcheries and other artificial rearing methods, to develop new methods for assessment of stocks, and to solve the many problems associated with environmental changes and management of the fisheries.

CATCHES

As indicated previously, coho and chinook salmon originating in Puget Sound and in Washington's

TABLE 2. Expenditures for artificial production and fish protection facilities for salmon originating in Puget Sound and coastal streams of Washington north of the Columbia River, in thousands of dollars.

Item	Area ^a		Capital cost	Annual operation and maintenance cost	
Fish hatcheries	Puget Sound				
		Dungeness Hatchery	1902	\$ 329	770
		Green River Hatchery	1901	727	
		Hood Canal Hatchery	1953	554	
		Issaquah Hatchery	1937	454	
		Minter Creek Hatchery	1937	337	
		Nooksack Hatchery	1899	207	
		Puyallup Hatchery	1917	118	
		Samish Hatchery	1899	249	
		Skagit Hatchery	1947	358	
		Skokomish Hatchery	1961	264	
		Skykomish Hatchery	1905	156	
		Quilcene Hatchery	1911	570	
		TOTAL		4,323	863
		Coastal			
		Nemah Hatchery	1953	304	150
		Satsop Hatchery	1949	415	
		Soleduck Hatchery	1970	1,660	
		Willapa Hatchery	1899	244	
		TOTAL		2,623	150
Controlled natural rearing ponds	Puget Sound		602	165	
	Coastal		58	31	
Fishways and transport facilities	Puget Sound		1,348	16	
	Coastal		109	2	
Fishscreens, diverters, collectors, and transportation	Puget Sound		3,011	48	
	Coastal		24	2	
Habitat improvement	Puget Sound		67	4	
	Coastal		78	5	
TOTAL			\$12,243	\$1,286	

^a Hatchery location and year of construction indicated.

coastal streams north of the Columbia River are caught over a wide area and by a variety of fisheries. In most of these fisheries coho and chinook salmon of other origins such as the Columbia River, Fraser River, and other British Columbia streams are intermingled with coho and chinook from Puget Sound and Washington's coastal streams. Thus, catch statistics for a particular fishery or area do not adequately reflect trends in total catches of Puget Sound or Washington coastal coho and chinook. We have, however, compiled data on annual catches of coho and chinook salmon by those fisheries that account for most of the catch of coho and chinook originating in Puget Sound and in coastal streams of Washington north of the Columbia River (Table 3 and Figs. 3 and 4).

COHO

Catches of coho salmon by the British Columbia troll fishery off the west coast of Vancouver Island increased from an average of about 680,000 fish during 1953-59 to 1.3 million fish during 1963-72. Catches by the Washington ocean sport fishery north of the Columbia River increased from approximately 55,000 coho annually in 1953-57 to about 255,000 during 1968-72. Catches by the Washington troll fishery north of the Columbia River have fluctuated about an average of 500,000 coho annually. Average annual catches of coho salmon by the British Columbia net fishery in the Strait of Juan de Fuca and the Puget Sound net fishery during 1965-72 were 420,000 and 510,000 fish, respectively, compared to an average

TABLE 3. Catches of coho and chinook salmon by the British Columbia troll fishery off the west coast of Vancouver Island, Washington troll fishery north of the Columbia River, Washington ocean sport fishery north of the Columbia River, British Columbia net fishery in the Strait of Juan de Fuca, and Washington net and sport fisheries in Puget Sound, 1953-74, in thousands of fish. (Data from Fisheries and Marine Service, Dept. of Environment, Canada, and Washington Dept. of Fisheries.)

Year	British Columbia troll fishery off west coast of Vancouver Island ^a		Washington troll fishery north of the Columbia River		Washington ocean sport fishery north of Columbia River		British Columbia net fishery in the Strait of Juan de Fuca ^a		Washington net fishery in Puget Sound		Washington sport fishery in Puget Sound	
	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook
1953	654	409	601	383	14	12	356	33	342	59	190	121
1954	543	374	344	340	29	27	112	19	214	59	209	179
1955	522	417	416	340	36	52	256	32	300	57	214	163
1956	640	516	613	272	86	76	126	19	409	46	249	208
1957	662	479	662	351	113	61	452	19	294	49	302	251
1958	824	394	523	261	58	40	258	22	352	50	204	165
1959	919	352	506	191	69	43	401	16	348	55	160	123
1960	370	262	131	113	35	46	82	13	104	65	53	105
1961	1,096	231	425	168	64	46	456	30	384	81	122	132
1962	1,069	233	526	150	152	52	390	16	414	48	114	129
1963	1,079	279	465	188	130	56	345	13	233	94	178	175
1964	1,210	344	461	143	82	70	303	12	402	75	113	108
1965	1,700	405	659	87	221	74	454	26	405	96	150	118
1966	1,420	523	707	134	132	72	564	25	635	103	158	136
1967	1,002	395	545	111	163	90	460	19	288	99	144	120
1968	1,839	420	530	134	210	98	399	22	450	108	170	126
1969	1,043	460	307	168	180	108	259	38	360	104	152	125
1970	779	354	555	182	252	87	464	109	850	151	85	147
1971	2,176	616	793	224	373	111	598	56	554	160	170	162
1972	988	579	350	187	254	130	158	38	551	118	121	204
1973	1,405	610	595	295	282	111	474	58	802	136	93	211
1974	1,644	628	657	312	352 ^b	204 ^b	438	48	872	145	127 ^b	208 ^b

^a Catches for 1953-62 are estimated from pounds landed and average weight per fish.

^b Estimated.

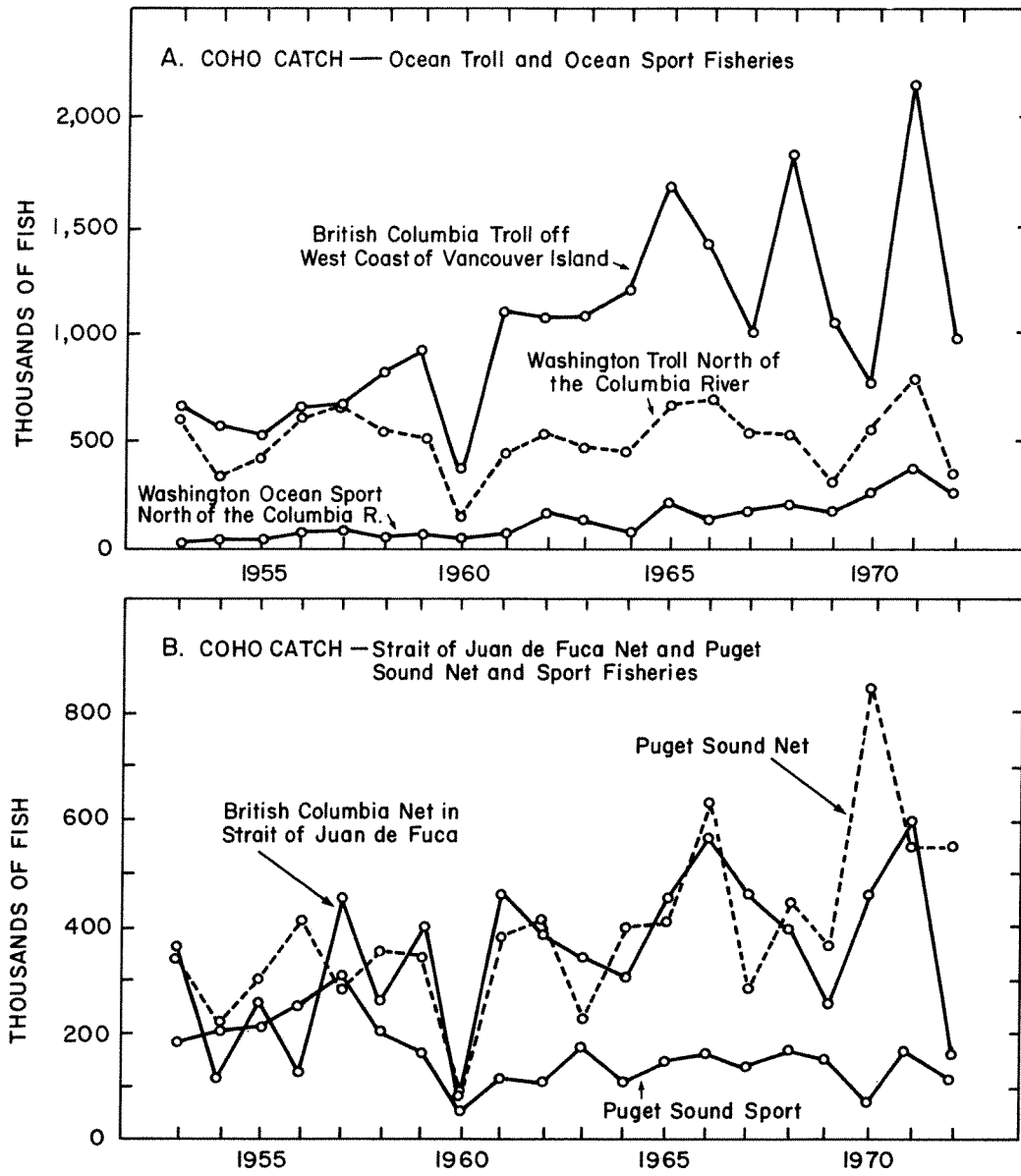


FIG. 3. Catch of coho salmon in (A) British Columbia troll fishery off the west coast of Vancouver Island and Washington troll and ocean sport fisheries north of the Columbia River, and (B) net fisheries in the Strait of Juan de Fuca and Puget Sound and sport fishery in Puget Sound. (Data from Table 3.)

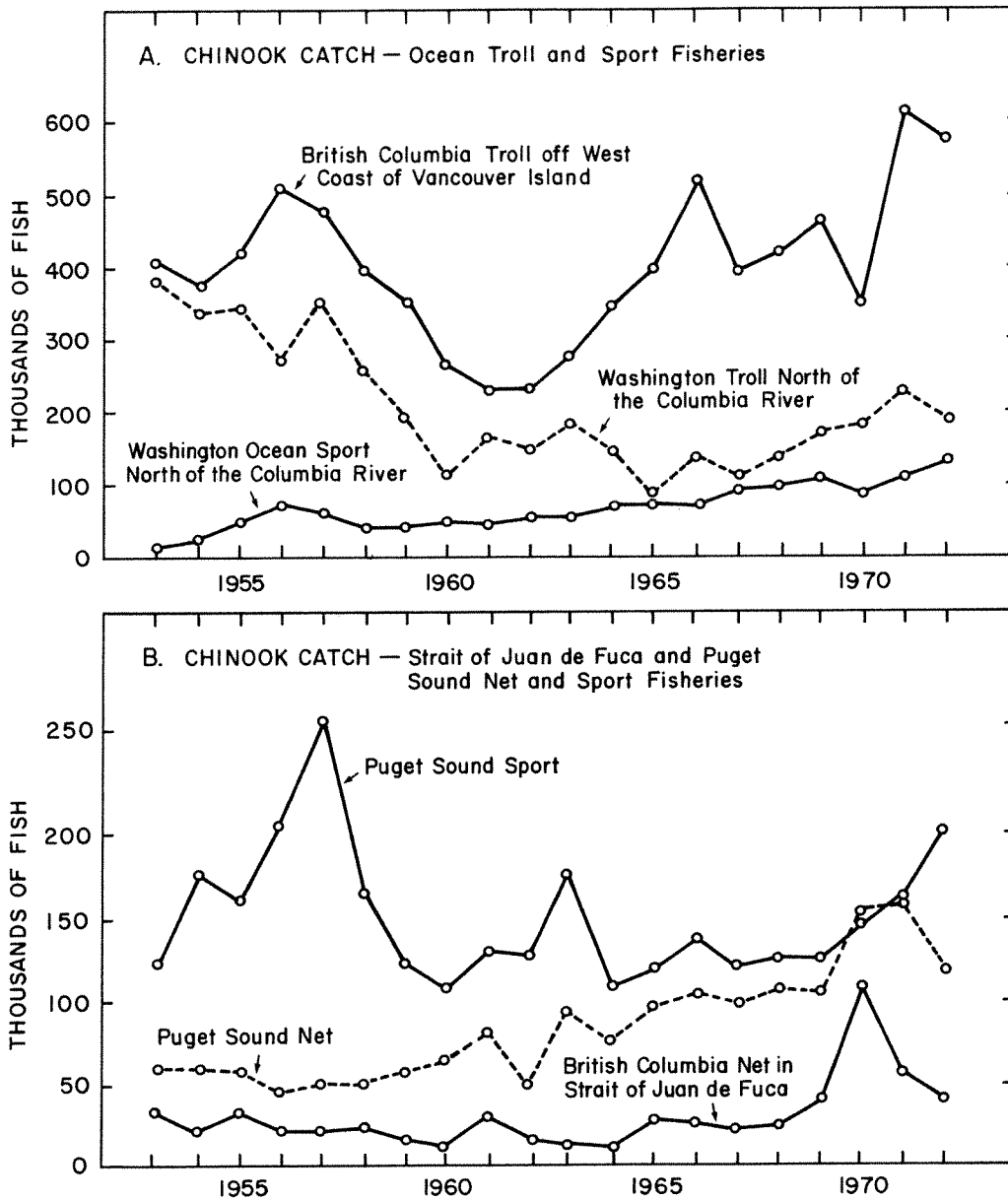


FIG. 4. Catch of chinook salmon in (A) British Columbia troll fishery off the west coast of Vancouver Island and Washington troll and ocean sport fisheries north of the Columbia River, and (B) net fisheries in the Strait of Juan de Fuca and Puget Sound and sport fishery in Puget Sound. (Data from Table 3.)

of around 300,000 fish for the two fisheries during 1953–59. Catches of coho salmon by the Puget Sound sport fishery, on the other hand, have not shown a corresponding increase. Since 1960, sport fishery catches of coho in Puget Sound have averaged 136,000 fish annually as compared to 220,000 fish during 1953–59.

CHINOOK

Catches of chinook salmon by the British Columbia troll fishery off the west coast of Vancouver Island

declined during the late 1950s and early 1960s but have since increased to or above the catch level of the mid-1950s (approximately 450,000 fish). Catches of chinook by the Washington troll fishery north of the Columbia River declined sharply from 1953 to 1960 (from nearly 400,000 fish in 1953 to somewhat over 100,000 fish in 1960), and have averaged only 155,000 fish during the past 12 years. Catches by the Washington ocean sport fishery increased from 45,000 chinook during 1953–62 to 72,000 chinook in 1963–67 and 105,000 chinook in 1968–72. Catches

of chinook by the British Columbia net fishery in the Strait of Juan de Fuca averaged 60,000 fish during 1969–72, compared to 20,000 during 1953–68. Catches by the Puget Sound net fishery have had an upward trend since the early 1960s averaging 110,000 chinook in 1963–72 compared to 55,000 in 1953–62. Catches by the Puget Sound sport fishery reached a peak of 250,000 chinook in 1957, dropped sharply by 1960, remained at a level of about 125,000 fish during 1960–69, and increased to slightly over 200,000 fish in 1972.

ESCAPEMENTS

Weir counts of coho and chinook salmon at hatcheries in Puget Sound and on the Washington coast during 1953–72 are shown in Table 4 and Fig. 5, together with indices of escapements of non-hatchery fish as obtained from stream surveys.

Counts of coho salmon at hatchery weirs in Puget Sound and on the Washington coast increased from 1953–70, but fell off sharply in 1971–72. The index of escapements of non-hatchery fish in Puget Sound streams increased between 1953 and 1958, but have exhibited a downward trend since then. The index of escapements of non-hatchery fish in coastal streams generally increased from the mid-1960s through 1971, but dropped considerably in 1972.

Counts of chinook salmon at hatcheries in Puget Sound increased from 10,000 fish in 1953 to 90,000 in 1964, dropped sharply in 1965, and fluctuated around a level of about 40,000 fish during 1966–72. Weir counts at coastal hatcheries increased from a few hundred fish in the early 1950s to approximately 3,000 fish in 1970–72. Indices of abundance of non-hatchery spawners in Puget Sound have fluctuated considerably, but with a downward trend during 1964–72. The stream index of non-hatchery spawners

TABLE 4. Weir counts of coho and chinook salmon at Puget Sound and Washington coastal hatcheries and indices of escapements of non-hatchery fish to streams surveyed in Puget Sound and on the coast, 1953–74. (Data from Washington Department of Fisheries.)

Year	Puget Sound				Washington coast			
	Hatchery weir counts		Escapement indices— non-hatchery fish		Hatchery weir counts		Escapement indices— non-hatchery fish	
	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook
	(Thousands of fish)				(Thousands of fish)			
1953	38.6	10.9	90	113	4.2	0.3	102	36
1954	39.4	15.6	184	90	2.5	0.5	23	35
1955	27.1	13.4	162	94	3.8	0.6	44	48
1956	28.8	29.2	144	79	3.8	0.7	97	37
1957	38.6	19.0	221	68	4.7	0.4	80	37
1958	34.2	25.4	355	104	5.4	0.8	61	42
1959	30.0	26.3	158	117	3.1	0.7	68	35
1960	19.2	32.9	212	209	2.1	0.5	64	23
1961	50.5	49.8	298	161	7.0	0.6	76	37
1962	59.2	46.8	248	105	5.9	0.8	69	26
1963	41.2	84.9	96	70	3.7	0.8	36	40
1964	58.8	90.0	291	221	6.2	2.1	100	49
1965	75.5	48.4	160	118	13.5	1.4	117	49
1966	107.5	49.2	183	165	14.0	1.2	86	64
1967	64.0	30.2	38	67	18.2	1.8	102	79
1968	140.8	39.5	160	140	28.0	2.7	158	41
1969	163.5	43.3	33	45	19.2	2.2	65	28
1970	260.5	61.5	140	126	29.5	2.9	139	42
1971	168.7	30.7	67	99	23.3	2.9	196	21
1972	107.8	33.1	50	86	12.1	2.6	44	17
1973	103.9	36.6	43	15	51.0	5.6	81	11
1974	210.7	24.3	a	a	25.0	4.8	a	a

^a Beginning in 1974, the number of streams surveyed and the number of surveys of escapements of non-hatchery fish were increased, thus permitting estimates of total escapements of non-hatchery fish. Estimates, in thousands of fish, are as follows: Puget Sound coho, 163.0; Puget Sound chinook, 45.6; Washington coast coho, 73.4; and Washington coast chinook, 40.4.

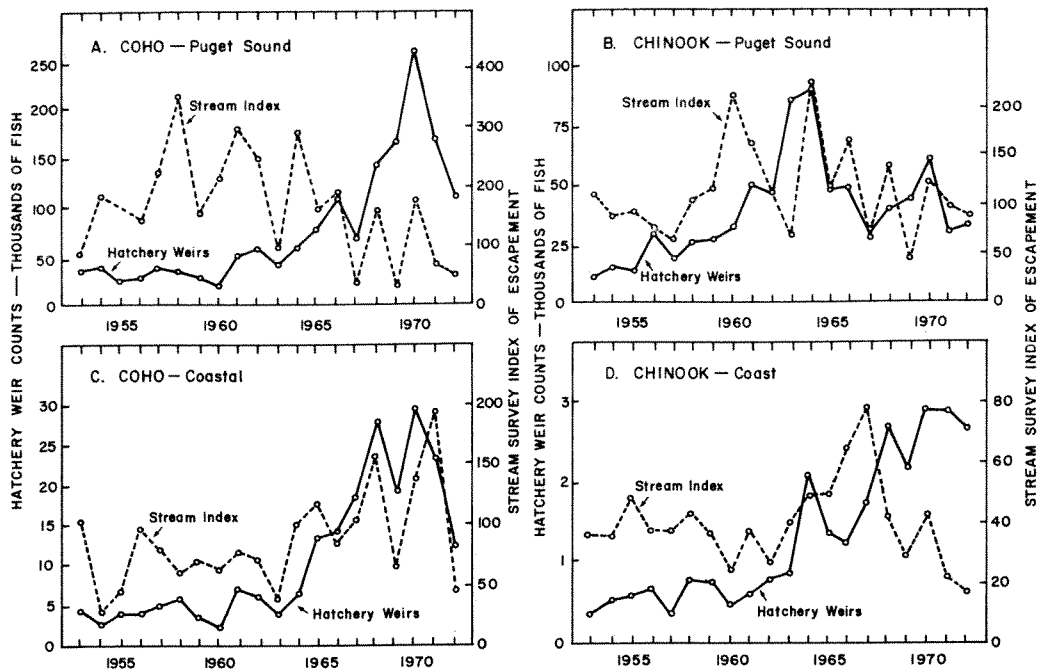


FIG. 5. Weir counts of coho and chinook salmon at Puget Sound and coastal hatcheries and indices of escapements to selected streams in Puget Sound.

in coastal streams increased during the mid-1960s but then declined.

HATCHERY PRODUCTION

Annual plantings of coho and fall chinook salmon smolts from hatcheries in Puget Sound and on the Washington coast have increased greatly over the past 20 years (Table 5 and Fig. 6). Ratios of average annual plantings during 1963-72 as compared to 1953-62 were approximately 4.2 for coho smolts from Puget Sound hatcheries, 2.6 for chinook smolts from Puget Sound hatcheries, 3.8 for coho smolts from coastal hatcheries, and 2.0 for chinook smolts from coastal hatcheries. The increased production of smolts, which is associated with larger brood stocks, improvements in hatchery-rearing techniques, and expansion of rearing and holding facilities at hatcheries, clearly reflects an intensive effort to maintain and increase the coho and chinook salmon runs in Puget Sound and coastal streams.

UTILIZATION

The degree of utilization of coho and chinook salmon runs originating in Puget Sound, Grays Harbor, and Willapa Bay in recent years has been estimated from catch statistics, escapement data, and the results of marking experiments.

TABLE 5. Annual plantings of coho and fall chinook smolts (1,000 pounds) from Puget Sound and coastal hatcheries, 1953-74.

Year	Puget Sound		Coastal		Total	
	Coho	Chinook	Coho	Chinook	Coho	Chinook
1953	92	71	27	21	119	92
1954	103	55	38	13	141	68
1955	115	71	37	19	152	90
1956	69	57	40	16	109	73
1957	100	106	32	29	132	135
1958	143	96	53	17	196	113
1959	121	89	23	20	144	109
1960	82	99	33	18	115	117
1961	156	124	36	8	192	132
1962	174	127	48	4	222	131
1963	114	120	14	6	128	126
1964	254	166	72	15	326	181
1965	275	181	86	24	361	205
1966	373	182	111	26	484	208
1967	454	225	137	41	591	266
1968	555	258	149	35	704	293
1969	580	262	177	42	757	304
1970	723	247	191	54	914	301
1971	797	395	236	33	1,033	428
1972	819	358	244	47	1,063	405
1973	775	540	219	76	994	616
1974	597	934	257	47	854	981

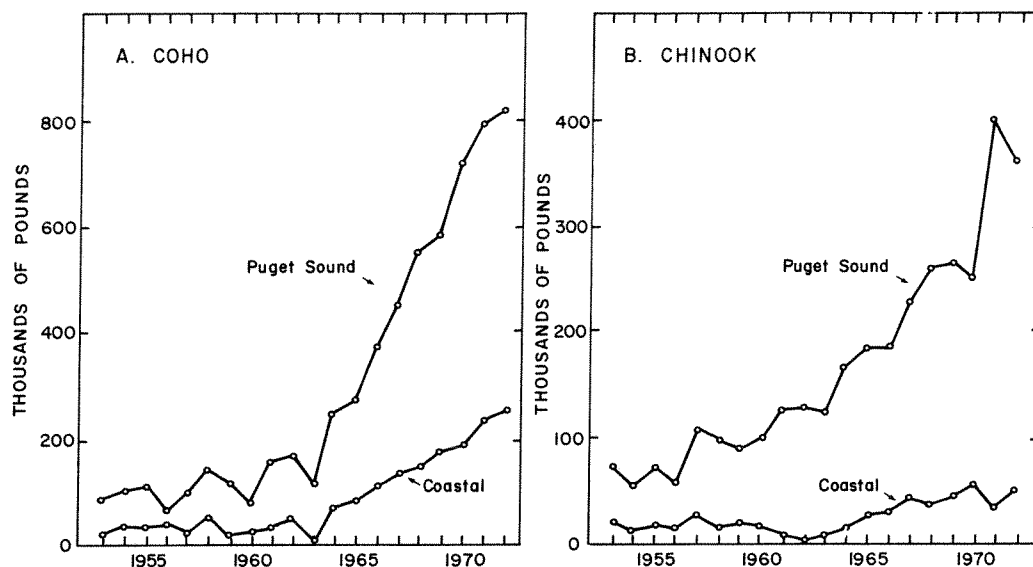


FIG. 6. Annual plantings of (A) coho and (B) fall chinook smolts from Puget Sound and Washington coastal hatcheries, 1953-72.

COHO-PUGET SOUND

Estimates of average annual catches and escapements in 1969-70 of coho salmon originating in Puget Sound hatcheries and streams indicate that approximately 75 percent of the fish were utilized by commercial and sport fisheries (Information Booklet No. 2, Washington Department of Fisheries, 1972).

COHO-GRAYS HARBOR AND WILLAPA BAY

Marking experiments involving hatchery reared fish released into streams emptying into Grays Harbor and Willapa Bay indicated a catch-to-escapement ratio of approximately 3:1 in 1968 (Washington Department of Fisheries, unpublished).

CHINOOK-PUGET SOUND

Estimates of average annual catches and escapements in 1969-70 of chinook salmon originating in Puget Sound hatcheries and streams indicate that approximately 85 percent of the fish were utilized by commercial and sport fisheries (Information Booklet No. 2, Washington Department of Fisheries, 1972).

CHINOOK-GRAYS HARBOR AND WILLAPA BAY

Marking experiments involving the 1963 brood of

chinook originating in streams in Grays Harbor and Willapa Bay indicated a catch-to-escapement ratio of approximately 3.7:1 in 1966-68 (Washington Department of Fisheries, unpublished).

The foregoing percentages and catch-to-escapement ratios clearly indicate a high degree of utilization of coho and chinook salmon originating in Puget Sound and streams along the coast of Washington.

SUMMARY

Coho and chinook salmon originating in Puget Sound and Washington coastal streams are subject to diverse, intensive fisheries over a large area. Large sums of money have been and are being expended for artificial production and fish protection facilities, without which the runs would undoubtedly be at extremely low levels of abundance. The high degree of utilization of the runs by commercial and sport fisheries clearly indicates that more intensive fishing would not provide a substantial increase in sustainable yields.