

Collection Of Data From
Marine Tag-Recovery Programs
Conducted From 1925-1977 In
British Columbia Coastal Waters

Volume 5
Chinook Salmon

Northern Natural Resource Services Ltd.

April 1978

Memorandum Report

Salmonid Enhancement Program
Project No. 34



Fisheries
and Environment
Canada

Peches
et Environnement
Canada

265814

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April 30, 1978

Mr. F. E. A. Wood
Acting Chief, Program and Project Planning
Salmonid Enhancement Program
Fisheries and Marine Service
1090 West Pender Street
Vancouver, B. C.

Dear Mr. Wood:

This letter introduces our report entitled:

"Collection of Data from Marine Tag-Recovery Programs Conducted from 1925-1977 in British Columbia Coastal Waters."

The work was performed under the terms of reference of Contract No. 08SB.KF501-7-1397, Serial OS B77-08290.

Information from approximately 100 documents contributed to the development of this report, and a considerable body of material was extracted for inclusion. Because of constraints imposed by the sheer bulk of material, it was necessary to present the report in five volumes. Volume 1 includes the Introduction, Methods, General Results, Discussion and Reference sections plus the extracted material for sockeye salmon. Volumes 2 to 5 contain the extracted material for pink, chum, coho and chinook salmon, respectively. The Table of Contents for the complete report is reproduced in each of Volumes 2-5 for convenience of referencing. The Reference section was positioned in Volume 1 prior to all extracted material to provide a quicker form of indexing; any of Volumes 2-5 cannot be used effectively without reference to Volume 1. This letter is reproduced in all five volumes.

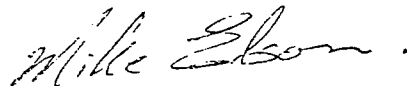
We believe the report has substantial value as an expanded reference to the mass of literature which has accumulated since the inception of salmon tagging programs off the coast of British Columbia. The bibliography will certainly be of value in any further treatment of the data. Tables 2-6 introducing the extracted material for each species and listing the types of information extracted for each tag-recovery program in chronological order should be invaluable as baseline information for future research.

Cont./...

The report has deficiencies, most of them directly related to an insufficient time-frame allowed for adequate treatment of the extensive literature. The limited time available necessarily resulted in a cursory treatment of some of the material. The process of extraction of information may have suffered for the same reason, and some omissions of information may have occurred. Reference is made in some of the Annual Reports of Fisheries and Marine Service, Vancouver, to tagging programs for which the data was not easily available in published form for inclusion in this report. This information might be compiled as an appendix to this report.

Despite its limitations, we believe this collection constitutes an important first step in definition of the problems associated with salmon movements in coastal waters of British Columbia.

Yours truly,



Mike Elson



L. W. Steigenberger

ME/lb

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NOTE: Lists of Figures and Tables were not assembled for this report. Figures and Tables extracted or derived from other sources and reproduced in the Introduction, Methods and General Results sections of this report have been assigned consecutive numbers respectively. Figures and Tables appearing in the Specific Results section retain the numbering system used in the source reports.

VOLUME 5

3.2.5. Chinook Salmon

Table 6. Sources of information, location of tag-recovery programs and associated information extracted for chinook salmon.

Refer- ence No.	Page No.	Year of Publi- cation	Location	Tag-Recovery Data	Migration Routes	Migration Timing
86	826	1927	Pacific Coast	Text, Table	Figure	Table, Text
85	830	1929	Barclay Sound	Text		
87	831	1932	Quatsino, Kyuquot Sound	Text, Table	Figure	Text, Table
1	844	1950	B. C. Coast	Text, Table	Text, Fig.	Table
11	848	1957	Rivers Inlet	Text		Figure
60	851	1957	B. C. Coast	Text, Fig., Table	Fig,Text	Text
51		1960	S.E. Alaska, North- ern B. C.	(Refer to sockeye section for details)		
52		1961	S.E. Alaska, North- ern B. C.	(See sockeye section for details)		
61	878	1964	B. C.	General information		
17	880	1965	Strait of Georgia	Text	Text	
53		1967	S.E. Alaska, North- ern B. C.	(See pink section for details)		
26	816	1967	B. C.	(General information-follows Table 6)		
4	882	1968	S.E. Alaska	Text, Table	Text,Table	
35a		1969	Dixon Entrance	(Refer to sockeye section for details)		
54	885	1969	Pacific Coast	Text	Fig,Text	Text
55	893	1969	Pacific Coast	Text, Figs, Tables	Text (by inference)	
49	948	1970	Dixon Entrance, Hecate Strait	Table, Fig.		
22	951	1970	Juan de Fuca Strait	Text, Table		Text,Fig.

Table 6 (continued)

Refer- ence No.	Year of Publi- cation	Location	Tag-Recovery Data	Migration Routes	Migration Timing
24 910	1971	B. C. Coast	Text, Table	(by infer- ence from report)	
30 915	1972	Lower West Coast of Vancouver Island	Text, Table, Figure	Figures (by infer- ence)	
47 914	1972	Strait of Georgia, Johnstone Strait	Text, Table, Figure		
25 982	1974	B. C. Coast	Text, Table	Figures (by inference)	
44 988	1976	Nass River, Skeena River			Tables
39 990	1977	Bella Bella	Text		

The following information was extracted from Salmon of the North Pacific Ocean - Part IV (Aro and Shepard, 1967). The information is intended as information on the basic biology of the subject species as background before presentation of detailed migration data extracted from the source material. The general information includes: a preliminary descriptive statement, the locations of the spawning grounds and estimated numbers of spawners (Figure), the timing of migration as indicated by harvest (Figure), and spawning times for some populations in rivers within statistical areas of the province (Table). Some of the information may be superceded by more recent publications (research papers and stream catalogues), however, it provides an excellent foundation for future studies.

CHINOOK SALMON

"From 1951 to 1963, the average annual catch of chinooks in British Columbia has averaged 874,100 fish weighing 11.19 million pounds.

"Young chinooks hatch from the gravel in the spring, migrating to sea after spending from a few days up to a year in their natal streams. Most Canadian chinooks return to spawn after spending two or three winters at sea, although some return as jacks (mostly precocious males) after one winter at sea whereas others return after four or five winters. Chinooks are the largest of the five species found in Canada with some individuals weighing more than 100 pounds. Further details on the life history of chinooks are presented by Mason (1965).

"Chinook spawning areas are scattered throughout British Columbia (see Figure 33) although spawning is reported to take place in less than 260 streams, fewer than for the other species of Pacific salmon found in British Columbia. Chinooks spawn in significant numbers in areas located from immediately above the tidal limit to locations as far away as the Fraser River at Tête Jaune Cache, over 600 miles upriver from the sea. The bulk of the chinook escapement, as with sockeye and pink salmon, is accommodated by a very few streams; about 50% of the escapement is accommodated in only 14 streams, about 5.5% of the total number of streams in which spawning takes place.

"The largest catches of chinooks are made in southern British Columbia (Figure 34). As with cohos, most

chinooks are taken by trollers operating on mixed stocks (both Canadian and United States) away from the river mouths (trollers took an average of 73% of the total British Columbia chinook catch from 1951 to 1963). The most important trolling area is off the west coast of Vancouver Island (Figures 5, 6, and 35). Chinooks can be caught throughout most of the year but the bulk of the catch is made in the five-month period from May through to September, over which period the catch is fairly evenly distributed.

"Maturing chinooks move inshore and into the rivers throughout much of the year. Net fisheries operate in a number of inshore areas to intercept these maturing fish (Figure 36). By far the most important of these net fisheries is that in the Fraser River (Area 29). There, some chinooks move upstream throughout most of the year. Large catches are made in Area 29 from early June to early October with peak catches occurring usually in August or September (Figure 37). The extensive net fisheries in Juan de Fuca and Johnstone Straits, which are the most important in British Columbia for cohos, catch relatively few chinooks. In these latter two fishing areas most chinooks are taken in July and August (Figure 37). In addition to the commercial catch, sport fishermen (operating mainly in inshore waters between southern Vancouver Island and the adjacent mainland) take an average of approximately 59,000 chinooks older than two years and about 35,000 during their first year at sea (Canada Dept. Fish., 1956 to 1966).

"Runs of chinooks spawn in many of the tributaries of the Fraser River. The largest of these runs migrate into the Harrison, Nicola, and Shuswap Rivers. The peak period of chinook spawning in Fraser River tributaries varies from as early as July to as late as November.

"In southern British Columbia, aside from the Fraser River, the most important chinook spawning grounds in order of importance are the Squamish River (Area 28), the Nimpkish and Klinaklini Rivers (Area 12), the Somass River (Area 23), the Cowichan River (Area 18), the Homathko River (Area 13), the Puntledge River (Area 14), and the Southgate River (Area 13). Most of the spawning takes place in August and September in the mainland streams and in October in the Vancouver Island streams.

"In northern British Columbia net fishing provides small catches of chinooks in the estuaries of the Nass and Skeena Rivers and in Area 8 near the Bella Coola River system. In these northern areas, the runs are relatively earlier than in the south with most chinooks being taken in June and July (Figure 37). The largest chinook runs in northern British Columbia migrate into the Bella Coola River system (Area 8), the Kitimat River at the head of Douglas Channel (Area 6), and into the Bear, Morice, Babine, and Kispiox Rivers, which are all tributaries of the Skeena River (Area 4). The peak period of spawning in these northern rivers is in September.

"Substantial numbers of chinooks have been reported to spawn in the Canadian section of the Yukon River drainage (Canada Dept. Fish., 1963b; Summers, 1966). In the years 1959 to 1963 the Canadian catch on the Yukon River averaged about 11,300 chinooks. It was estimated that in 1961 over 28,000 chinooks spawned in the Canadian tributaries of the Yukon River. In other rivers which drain from Canada to the sea through Alaska, substantial numbers of chinooks are reported in the Canadian sections of the Taku and Stikine River drainages and small numbers in the Canadian portions of the Alsek and Unuk Rivers."

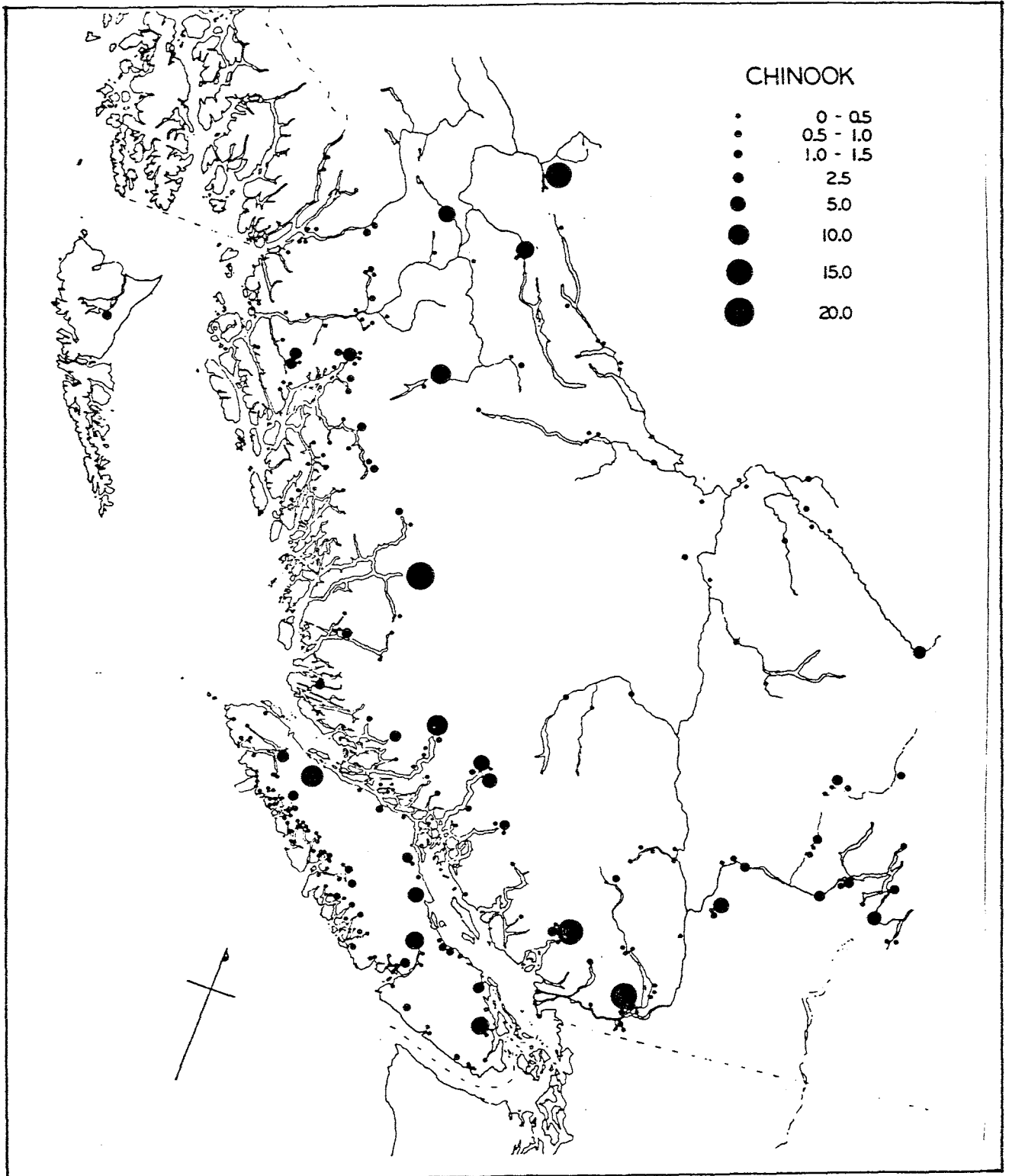


Figure (Figure 33, Aro and Shepard, 1967.) Estimated average annual numbers, in thousands, of chinook salmon spawners in British Columbia streams from 1951 to 1962.

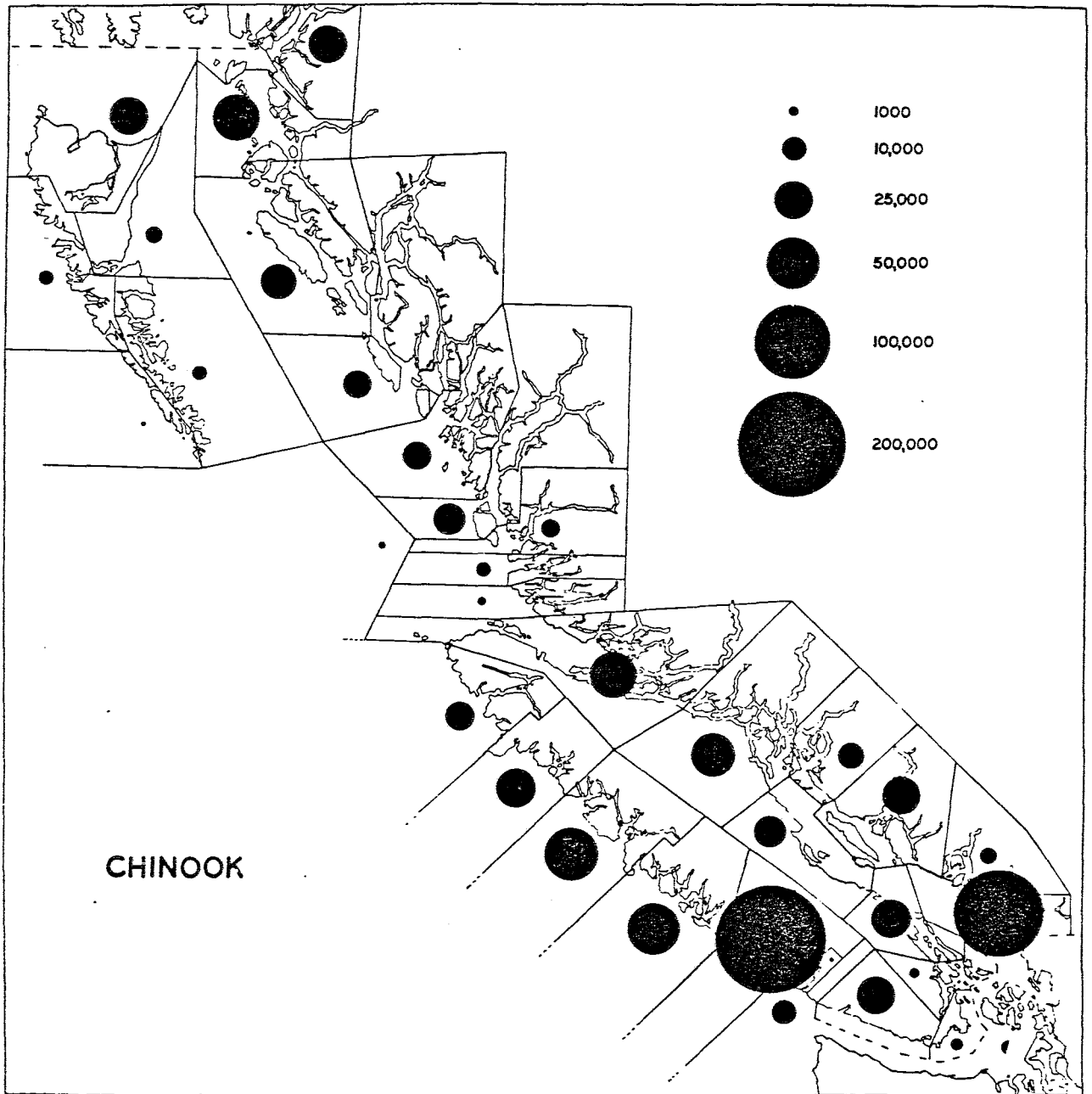


Figure (Figure 34, Aro and Shepard, 1967.) Average catches of chinook salmon in the various British Columbia Statistical Areas in the period 1951 to 1963, inclusive.

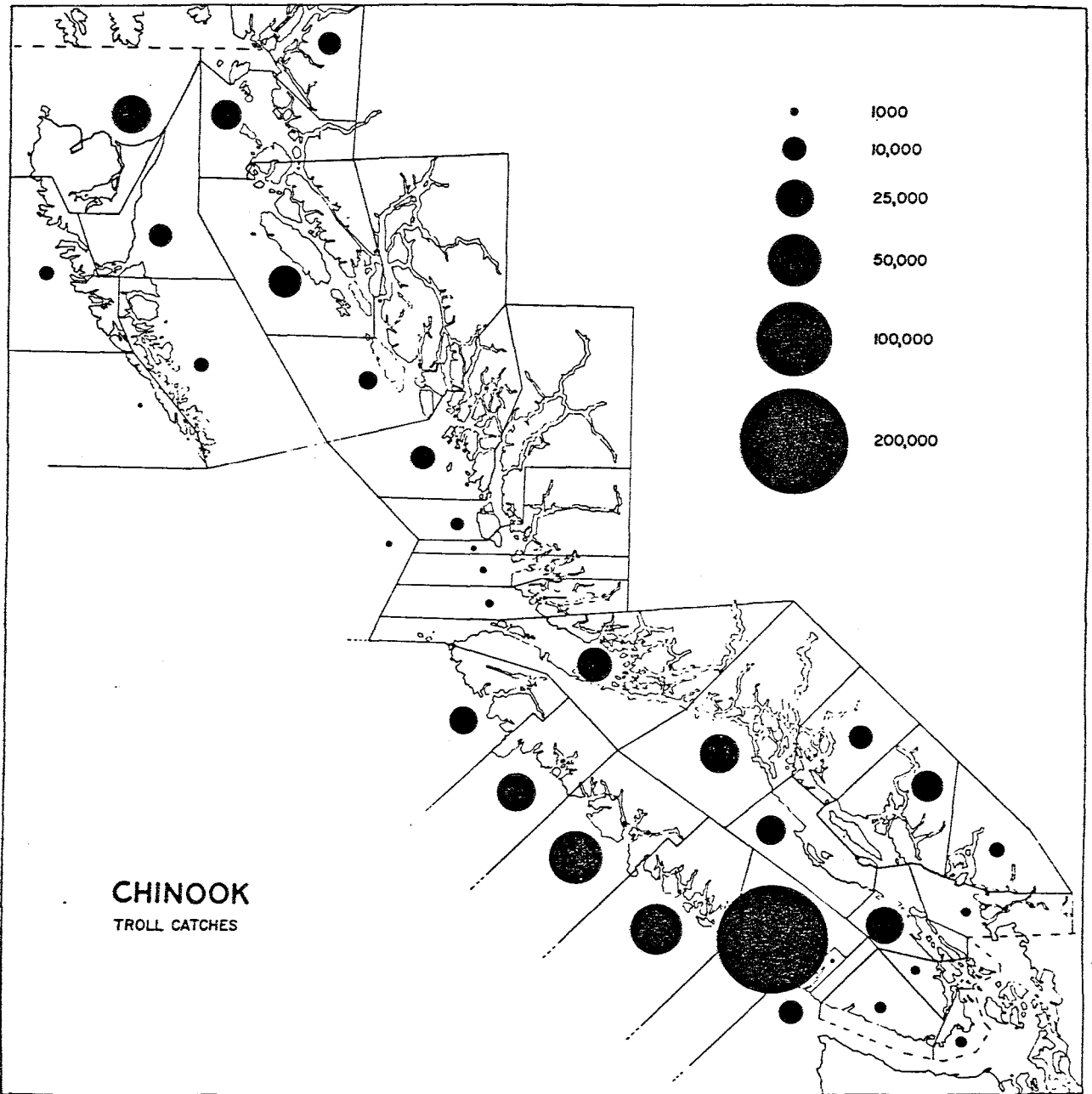


Figure (Figure 35, Aro and Shepard, 1967.) Average troll catches of chinook salmon in the various British Columbia Statistical Areas in the period 1951 to 1963, inclusive.

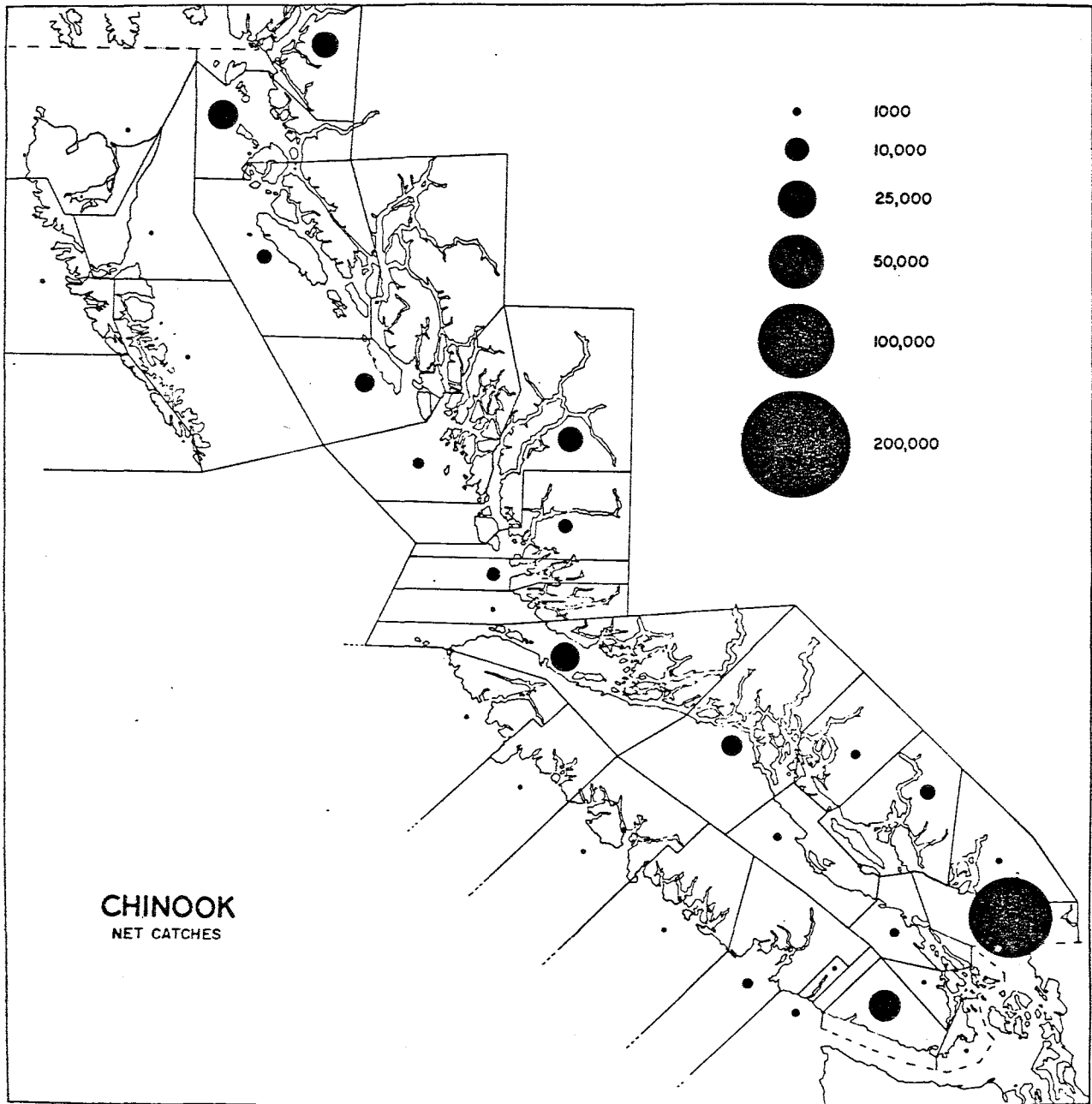


Figure (Figure 36, Aro and Shepard, 1967.) Average net catches of chinook salmon in the various British Columbia Statistical Areas in the period 1951 to 1963, inclusive.

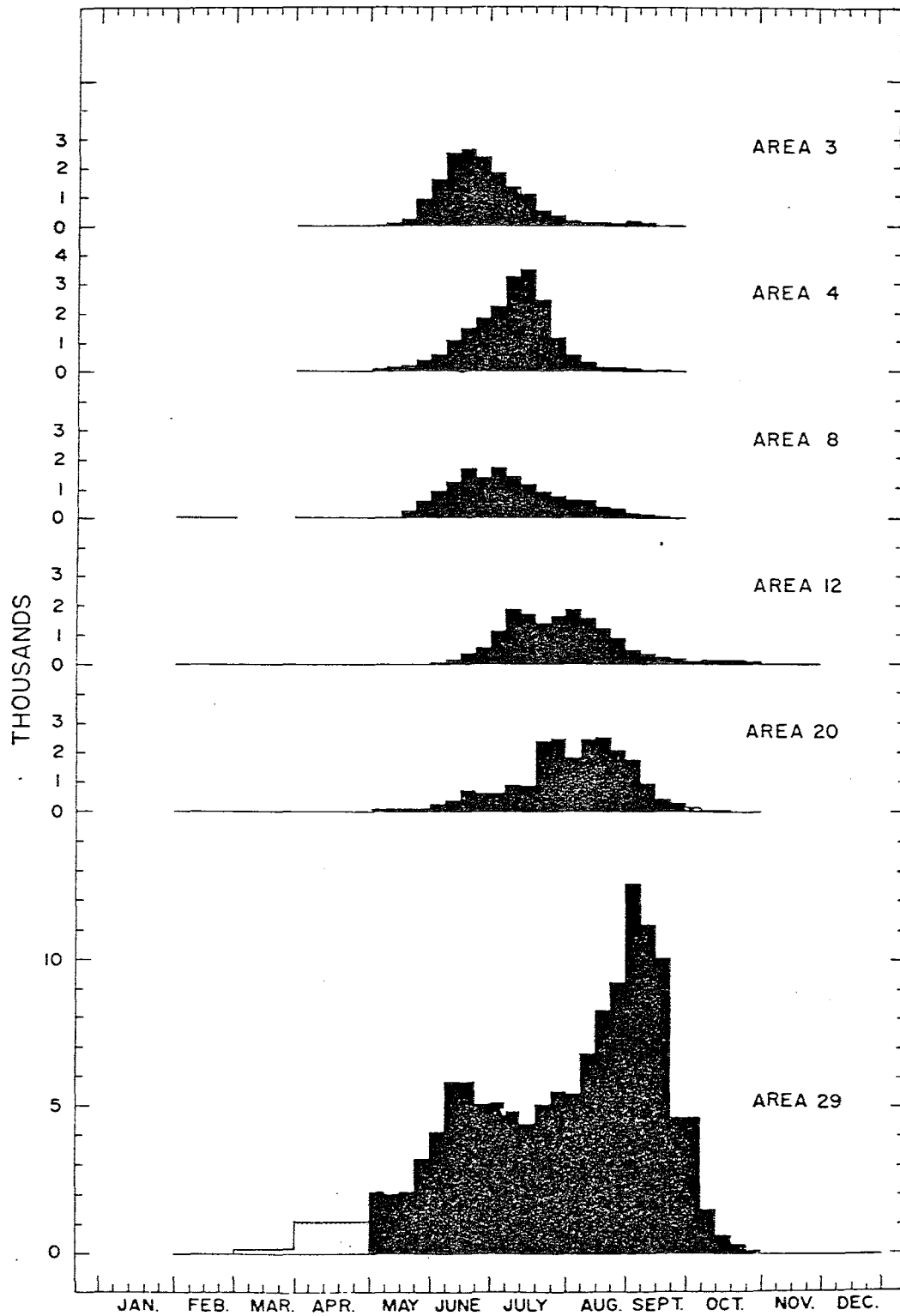


Figure (Figure 37, Aro and Shepard, 1967.) Average weekly catches of chinook salmon by the net fisheries in British Columbia Statistical Areas 3, 4, 8, 12, 20, and 29 in the period 1951 to 1963, inclusive. The weekly catches in February, March, April, November, and December are derived from monthly catch data.

Table (Appendix Table A-VI, Aro and Shepard, 1967.) Estimated average escapements of chinook salmon to British Columbia streams which supported "major" stocks of chinook salmon, 1951 to 1962.

Statistical area	Stream	Map index number (App. Fig. A-6)	Average escapement (thousands)	Spawning times		
				Start	Peak	End
1	Yakoun River	6	1- 2	Aug.	Sept.	Sept.
3	Kitsault River	38	0.3-0.5	Aug.	Sept.	Sept.
	Nass River ^a	40				
	Kwinamass River	41	0.3-0.5	Aug.	Sept.	Sept.
	Seaskinnish River	42	0.5- 1	Aug.	Aug.	Sept.
	Tseax River	44	1- 2	Aug.	Aug.	Sept.
4	Babine River (lower)	46	5-10	Sept.	Sept.	Sept.
	Bear River	49	10-20	Sept.	Sept.	Oct.
	Bulkley River (upper)	50	0.5- 1	Aug.	Sept.	Sept.
	Cedar River	52	0.5- 1	Aug.	Aug.	Sept.
	Cloyah River	53	0.5- 1	Aug.	Sept.	Sept.
	Ecthall River	55	2- 5	Aug.	Sept.	Sept.
	Kispiox River	64	5-10	Aug.	Sept.	Sept.
	Morice River	69	5-10	Aug.	Sept.	Oct.
6	Dala River	95	1- 2	Aug.	Sept.	Sept.
	Kemano River	103	1- 2	Aug.	Sept.	Oct.
	Khutze River	104	0.5- 1	Aug.	Sept.	Sept.
	Kildala River	105	0.5- 1	Aug.	Sept.	Sept.
	Kitimat River	108	2- 5	Aug.	Sept.	Oct.
	Kitlope River	110	1- 2	Aug.	Sept.	Oct.
8	Atnarko and Bella Coola Rivers	132	10-20	July	Sept.	Sept.
	Dean River	134	0.3-0.5	July	Sept.	Sept.
	Kimsquit River	138	1- 2	July	Sept.	Sept.
9	Wannock River	155	2- 5	Aug.	Oct.	Nov.
10	Docec River	158	1- 2	Sept.	Sept.	Oct.
12	Ahnuhati River	165	0.3-0.5	July	Aug.	Sept.
	Franklin River	170	0.5- 1	July	Aug.	Sept.
	Kingcome River	175	2- 5	July	Aug.	Sept.
	Klinaklini River	176	10-20	July	Aug.	Oct.
	Nimpkish River System	181	10-20	Aug.	Oct.	Oct.
	Wakeman River	189	0.5- 1	July	Aug.	Sept.
13	Campbell River	192	2- 5	Aug.	Sept.	Nov.
	Cumsack Creek	193	0.5- 1	Aug.	Sept.	Sept.
	Homathko River	195	5-10	Aug.	Sept.	Oct.
	Orford River	196	0.5- 1	Aug.	Sept.	Sept.
	Phillips River	197	0.5- 1	Aug.	Sept.	Oct.
	Salmon River	200	1- 2	Aug.	Sept.	Oct.
	Southgate River	201	2- 5	Aug.	Sept.	Oct.
14	Little Qualicum River	206	1- 2	Sept.	Oct.	Nov.
	Puntledge River	208	2- 5	Sept.	Oct.	Nov.
	Qualicum River	209	1- 2	Oct.	Oct.	Nov.
15	Toba River	216	2- 5	Aug.	Sept.	Sept.
17	Nanaimo River	226	2- 5	Aug.	Sept.	Oct.
18	Cowichan River	227	5-10	Sept.	Oct.	Oct.
20	Gordon River	232	0.3-0.5	Aug.	Sept.	Sept.
22	Nitinat River	235	1- 2	Sept.	Oct.	Nov.
23	Anderson River	236	0.5- 1	Sept.	Oct.	Nov.
	Nahmint River	238	1- 2	Sept.	Oct.	Nov.
	Sarita River	239	0.3-0.5	Sept.	Oct.	Oct.
	Somass River System	240	5-10	Aug.	Oct.	Nov.
24	Bedwell River	243	0.5- 1	Sept.	Sept.	Oct.
	Cypre River	246	0.3-0.5	Sept.	Sept.	Oct.
	Lower Kennedy River	249	0.5- 1	Sept.	Sept.	Nov.

Continued ...

Table (Continued)

Statistical area	Stream	Map index number (App. Fig. A-6)	Average escapement (thousands)	Spawning times		
				Start	Peak	End
24 (cont.)	Megin River	250	1- 2	Sept.	Sept.	Oct.
	Moycha River	251	0.5- 1	Sept.	Sept.	Nov.
	Tranquil River	252	0.5- 1	Sept.	Sept.	Nov.
25	Burman River	254	1- 2	Sept.	Sept.	Oct.
	Conuma River	255	0.5- 1	Aug.	Sept.	Oct.
	Gold River	256	1- 2	Sept.	Sept.	Oct.
26	Tahsis River	258	0.3-0.5	Sept.	Oct.	Oct.
	Artlish River	260	1- 2	Sept.	Oct.	Oct.
	Kaooinch River	263	0.3-0.5	Sept.	Sept.	Oct.
27	Kaouk River	264	0.5- 1	Sept.	Oct.	Oct.
	Tahsish River	267	2- 5	Sept.	Sept.	Oct.
	Marble River	276	2- 5	Aug.	Sept.	Sept.
28	Checakamus River	279	1- 2	Aug.	Sept.	Sept.
	Squamish River	282	10-20	Aug.	Sept.	Sept.
29	Birkenhead River	285	1- 2	July	Aug.	Sept.
	Bowron River	287	0.5- 1	Aug.	Aug.	Sept.
	Chchalis River	288	0.1-0.3	July	Aug.	Sept.
	Chilcotin River	289	0.5- 1	July	Aug.	Aug.
	Chilko River	290	0.5- 1	July	Aug.	Aug.
	Chilliwack River	291	0.5- 1	June	July	Sept.
	Clearwater River	292	2- 5	Sept.	Sept.	Oct.
	Coldwater River	293	0.5- 1	Aug.	Sept.	Sept.
	Deadman River	295	0.5- 1	Aug.	Sept.	Sept.
	Eagle River	298	1- 2	Sept.	Sept.	Oct.
	Finn Creek	299	1- 2	Aug.	Aug.	Sept.
	Fraser River at Tête Jaune Cache	301	2- 5	Aug.	Sept.	Sept.
	Harrison River	305	10-20	Oct.	Nov.	Dec.
	Louis Creek	313	0.5- 1	Aug.	Sept.	Sept.
	Lower Adams River	314	2- 5	Sept.	Oct.	Nov.
	Lower Shuswap River	315	2- 5	Aug.	Oct.	Oct.
	McGregor River	316	0.5- 1	Aug.	Aug.	Sept.
Nechako River	320	0.5- 1	Aug.	Sept.	Oct.	
Nicola River	321	5-10	Aug.	Sept.	Sept.	
North Thompson River	323	1- 2	Aug.	Sept.	Sept.	
Quesnel River	325	0.5- 1	Sept.	Sept.	Oct.	
Raft River	326	0.5- 1	Aug.	Sept.	Sept.	
South Thompson River	333	2- 5	Sept.	Oct.	Nov.	
Spilus Creek	334	0.3 0.5	Aug.	Sept.	Sept.	
Stuart River	336	0.3 0.5	Aug.	Sept.	Oct.	
Taseko River	339	0.3 0.5	July	Aug.	Aug.	
Thompson River	340	1- 2	Aug.	Sept.	Oct.	
Upper Pitt River	342	0.5- 1	July	Aug.	Sept.	
Upper Shuswap River	343	1- 2	Aug.	Oct.	Oct.	

* Chinook salmon are believed to spawn in the main channel of the Nass River. No estimates of abundance have been made.

The following information was extracted from reference no. 86 (Williamson, 1927). See coho section for further information.

Additional tagging data on sockeye and coho are included in other sections of the report. Some of this information is included in Godfrey (1968). A complete summary of returns from spring salmon tagged off Barclay Sound in 1925 and 1926 is included in reference no. 87 (Williamson and Clemens, 1932).

The International Pacific Salmon Investigation Federation at its Seattle meeting in March, 1925, resolved to carry out an extensive salmon tagging programme with a view to throwing light on the migration of the different species of salmon. The United States Bureau of Fisheries had already outlined a programme for Alaskan waters. The States of Washington, Oregon and California decided to tag spring salmon off the west coast of the United States from Cape Flattery to Monterey Bay. The Fisheries Branch and the Biological Board of Canada undertook to tag spring and sockeye salmon along the coast of British Columbia.

The arrangements were made by Major J. A. Motherwell, Chief Inspector of Fisheries, Vancouver, B.C. and Dr. W. A. Clemens, Director of the Pacific Biological Station, Nanaimo, B.C. The writer was instructed to take charge of the tagging work.

It was decided that the tagging of spring salmon (*Oncorhynchus tshawytscha*) should be carried on off the west coast of Vancouver Island and off the west coast of Graham Island, Queen Charlotte Islands; and that the sockeye salmon (*Oncorhynchus nerka*) should be tagged at Haystack Island (near Wales Island) and at Deepwater Bay (near Seymour Narrows).

The records of the recaptured fish were reported to Major Motherwell who paid the reward of fifty cents for each tag delivered accompanied by information of the species of salmon and place and date of recapture. A list of the recaptured salmon was prepared in the Fisheries Office and is incorporated in this report.

A. WEST COAST OF VANCOUVER ISLAND. BARCLAY SOUND

The work was commenced at Ucluelet on May 23rd and continued until June 25th. During that period 1125 spring salmon, and 51 coho salmon were labelled. The tagging staff consisted of Messrs. F. H. Bell and A. Fee of the University of British Columbia, C. Sayer and B. H. Symns, of the Dominion Hatchery staff, Captain House and the writer.

Messrs. Bell and Symns were engaged here during the whole period. The writer and Messrs. Sayer and Fee left for Graham Island on June 7th and Mr. Bell had charge of the operations at Ucluelet after that date until June 25th.

Of fifty-one tagged cohoes liberated on the Barclay Sound grounds two were recaptured in that region. Of these one was caught in Barclay Sound five months after the date upon which it was tagged. The question whether it had remained the whole time in that district cannot of course be answered. The remaining three were retaken in the Strait of Juan de Fuca and Puget Sound. None of the recaptured cohoes had travelled far.

B. HIPPA ISLAND—WEST COAST OF GRAHAM ISLAND,
QUEEN CHARLOTTE ISLANDS

The salmon trolling season lasts here from May to the end of July. Spring salmon are still found in considerable numbers in August but very little fishing is done in that month. The fleet of trollers have by that time left the district in order to fish for cohoes in Dixon Entrance and at other places. There are said to be salmon in the Hippa district throughout the whole year.

The fish are caught within two or three miles of the shore. The salmon do not frequent the same parts of the district every year. In 1924 Seal Inlet was the best centre; the ground near Hippa proved to be the most productive in 1925. A considerable quantity of fish has been taken off the east end of Hippa, a part which has not been much frequented by the salmon during the past few years. The fish are met with at one time or another all along the coast from Marble Island in the south to Frederick Island in the north and they no doubt occur farther afield.

An accurate knowledge of the bottom is important as there is risk of losing lines and weights through entanglement on rocks and kelp. The region has not been surveyed. Some men know the bottom to some extent and they will probably be more successful, but the main point is to locate the fish. A fisherman striking the fish when alone, or in the company of only one or two boats will make a good catch. Even then, however, one man will take more than another. As a rule a big fleet quickly assembles at the place where the school is located. The other boats are quick to notice that a boat is getting fish. But it sometimes happens that one or two boats come across the fish when at a distance from the fleet, and they may have the field to themselves for that day.

The sunken reef off Seal Point known as the Breaker is a prolific fishing ground. Here it is necessary to troll as close to the rock as can be done with safety. It cannot be fished in foggy weather as the fisherman cannot get his bearings from the land. Formerly when salmon were plentiful in Rennel Sound it was possible to work even in a fog. The fisherman could take his bearings from the Breaker (if it were visible, i.e. breaking) and steer a compass course towards Cartwright Point for 1½ hours, returning on the same line, and getting fish at any part of the run.

Opinions vary as to whence the fish come. Instances are given of the salmon being found first in the north, and later on in the southern part of the region. At another time the fish may appear first at Marble Island and later at the Breaker. There seems to be a coastwise movement of the salmon but whether

Tag number	Date tagged	Date of recapture	Days free	Place of recapture.
		1925		
2188	July 16	July 15?		Off Hippa Island. Picked up dead.
2197	" "	Sept. 21	67	Oregon, Coos. Bay, Marshfield.
2034	" 17	" 12	57	Columbia River, 2 miles from Altoona.
2045	" 19	" 22	65	In ocean off Oregon Coast. (Troll).
†2050	" "	Oct. 19	92	Oregon, Umpqua River.
2067	" "	No date		Columbia River.
†2070	" "	Sept. 14	57	Columbia River, Wauna.
2073	" "	Oct. 10	83	Oregon, Umpqua River.
2096	" 23	Nov. 8	108	Barclay Sound, Uchucklesit.
2098	" "	Sept. 21	60	Oregon, Coos Bay, Marshfield.
**2251	" "	Oct. 9	78	Oregon, Alsea River.
2272	" 24	" 8	76	14 miles inside Gray's Harbor Bar, Wash.
2288	" 25	Sept. 1	38	Boundary Bay, Strait of Georgia.

†On recapture was in poor condition.

‡On recapture had a tan-like color.

**Reported on recapture as a Pink.

Map II shows the distribution of the recaptured fishes.

The distribution of the recaptured salmon was as follows:—

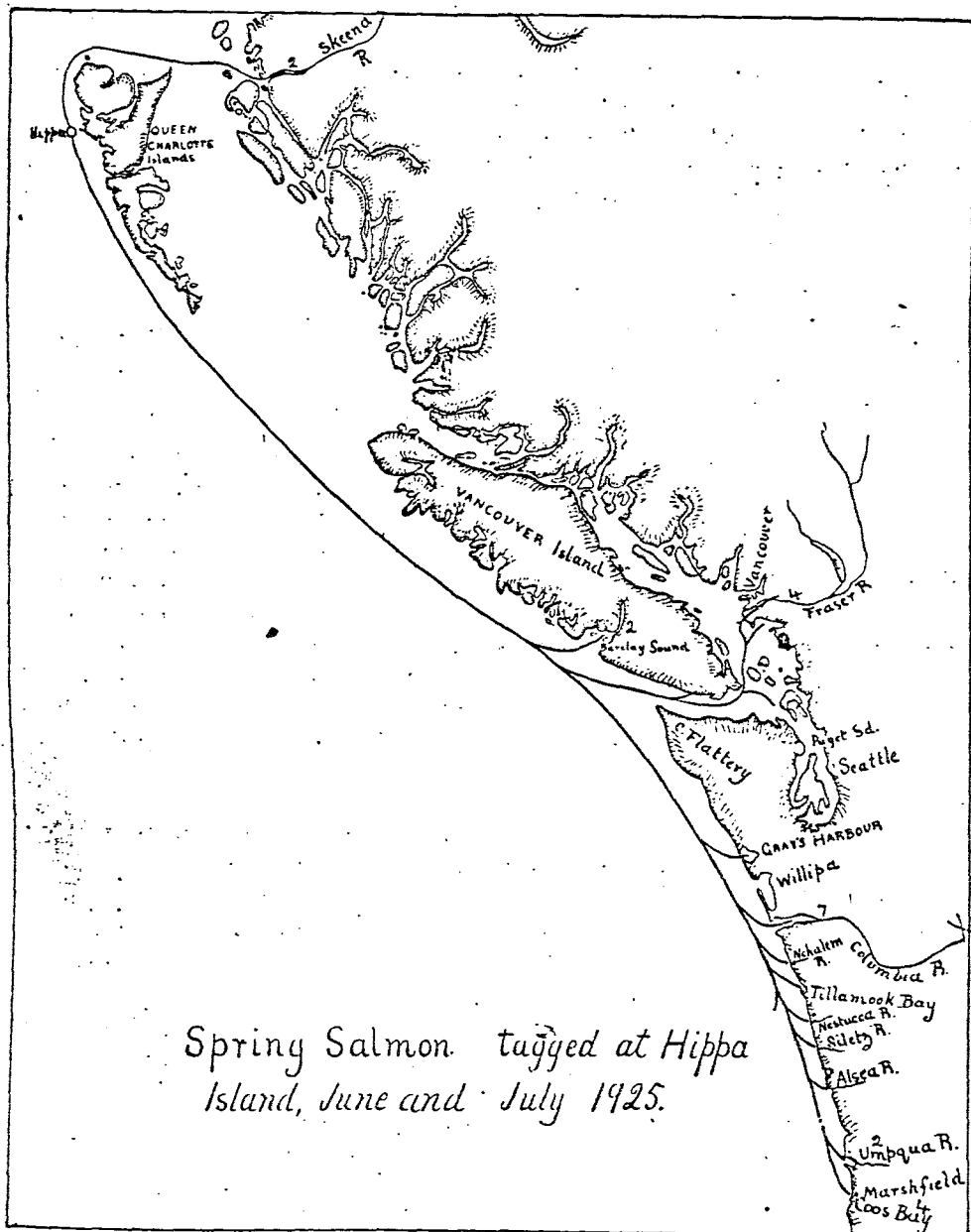
Skeena River.....	2
Barclay Sound, Alberni Canal.....	2
Strait of Juan de Fuca, Sooke, V.I.....	1
Puget Sound, U.S.....	1
Fraser River.....	4
Boundary Bay.....	1
Gray's Harbour, Wash.....	1
Columbia River, U.S.....	7
Nehalem River, Oregon.....	1
In ocean off Oregon Coast.....	1
Tillamook Bay, Oregon.....	1
Nestucca River, Oregon.....	1
Siletz River, Oregon.....	1
Alsea River, Oregon.....	1
Umpqua River, Oregon.....	2
Coos Bay, Oregon.....	4

Ten were taken in British Columbia waters, twenty in United States waters, and one in International waters.

Of those recaptured only two were taken to the north of Hippa, viz., the two recaptured in the Skeena River in July. The remainder were caught well to the south, from Barclay Sound southwards. Two were got in Barclay Sound. One was taken at Sooke, V. I., one in Boundary Bay, one in Puget Sound, and four in the Fraser River. The probability is that the latter seven fish had entered by the Strait of Juan de Fuca. Twenty had proceeded farther south past Cape Flattery and they were recovered in United States waters.

Tagged salmon had arrived in the Skeena, Fraser and Columbia rivers in July. Others had reached the Fraser by August and September, and some

the Columbia by September. It is interesting that the majority which had proceeded in a south-easterly direction had distributed themselves in generally similar regions to the Ucluelet fishes. Salmon that were feeding at Hippa distributed themselves later on to ten different rivers. It does not seem reasonable to suppose that these fishes were able to make a direct journey from Hippa to their respective native streams. There seems to be a factor which caused



Map II—Showing the distribution of recaptured spring salmon tagged off Hippa Island.

a number of the salmon to move southwards. That is likely to have been the search for food—herring possibly. It is not necessary that the fishes travelled simultaneously nor at the same distance off-shore. They would eventually come individually within the influence of the particular river which they entered. The probability of the river attracting the fish will depend on the physiological condition of the fish at the time. Thus if two salmon came under the influence of the river at one time, one might be attracted to it, the other might not respond to the influence.

The longest distance travelled was from Hippa to Marshfield, Oregon, viz., 870 miles, a journey performed within 60 days; that gives a minimum average rate of 14 miles per day. The journey from Hippa to the Columbia River, a distance of 650 miles was accomplished within 19 days; that gives a minimum average speed of 34 miles per day.

The following information was extracted from reference no. 85 (Williamson, 1929):

"The tagging of spring and coho salmon off Barclay Sound, Vancouver Island, was continued during 1926. In the previous year, 1925, the tagging was carried out only during the period May 23 to June 25. It seemed desirable to extend the operations in 1926 throughout practically the entire fishing season, and the work therefore was commenced on March 24 and continued until September 2. During this period 1,353 spring salmon, 180 cohos and 1 pink salmon were tagged."

Some information from this tagging experiment is included in reference no. 86 (Williamson, 1927). A complete summary of returns is included in reference no. 87 (Williamson and Clemens, 1932). Some of this information is included in Godfrey (1968).

The following information was extracted from reference no. 87 (Williamson and Clemens, 1932). Some of this information is included in Godfrey (1968). Additional tagging data on coho and sockeye salmon are included in this section of the report.

TAGGING OPERATIONS IN 1927

Following the extensive tagging operations off Barkley sound in the years 1925 and 1926, it was decided to extend the study to areas farther west along the coast of Vancouver island. In 1927, therefore, Spring salmon, as well as Coho salmon to a limited extent, were tagged in the usual way off Quatsino and Kyuquot sounds.

QUATSINO, SPRING SALMON

The early fishing season at Quatsino is a short one of two months, *viz.*, February and March. The fish are caught mostly at the mouth of the sound, but some are taken at Quatsino narrows. They are usually large and of fine quality. In 1927 the early fishing was comparatively poor, although there were large numbers of herring in Forward inlet in the beginning of March. The success of the fishery is believed to be dependent on the presence and movements of the herring.

Fifty-four salmon were tagged by Mr. W. F. Baxter, between February 14 and March 30, forty-four in Forward inlet and ten inside Quatsino sound. Mr. J. Johnson kindly afforded facilities for the tagging work on his boat.

The estimated weights of the Spring salmon tagged are given in table X. Twenty-one were under, and thirty-three over, twenty pounds.

The eight fish that were recaptured (see table I) had all been tagged in Forward inlet in March. Seven were recaptured within six months of liberation, and one after a period of a year and four months.

Four were recaptured in the Columbia river (2 in May, 1 in July and 1 in August), three in Puget sound (2 in May and 1 in July), and one off Long Beach, Vancouver island (in July).

Two fish had arrived in the Columbia river and two in Puget sound in May,

TABLE I.—Returns from Spring salmon tagged at Quatsino in 1927

Tag number	Date of tagging	Date of recapture	Period of freedom	Place of recapture
3860	March 3	May 10, 1927	68 days	Columbia R., Deer I.
3871	" 4	July 20, "	138 "	Long Beach, V. I. (troll).
3873	" 4	" 12, 1928	495 "	Swinomish slough, Wash.
3877	" 7	" 29, 1927	144 "	Columbia R., Tongue Pt.
3886	" 9	Aug. 18, "	162 "	Columbia R.
3892	" 9	May 14, "	66 "	San Juan I., west shore.
3897	" 19	" 11, "	53 "	Columbia R., Pt. Ellice.
3899	" 20	" 10, "	51 "	Swinomish slough, Wash.

i.e., in from 51 to 68 days. There is here indicated an early migration along the coast of Vancouver island to Puget sound and to the Columbia river.

The fact that one fish was caught at Long Beach, an intermediate position, may be taken as an indication that the other recaptured salmon passed along the west coast of Vancouver island.

The fastest rate of travel indicated by these fishes was an average of 5.8 miles per day to the Columbia river. The journey to Swinomish slough was at an average rate of 5.3 miles per day. The two other salmon that went to the Columbia river and to Puget sound respectively showed averages of 4.5 and 3.7 miles per day.

KYUQUOT

The writers are indebted to Messrs. Baxter and Mottley for notes on the fishing off Kyuquot during the 1927 season.

Until recently the salmon fishing at Kyuquot was carried on near the shore, on the Inside bank at the Western rocks and off Highest island. In 1927, salmon were discovered on the Outside bank, 14 miles S. of Lookout island and on another bank situated 12 miles S.E. of Highest island. The fishing area has therefore been considerably extended. From March to the middle of May the fishing had been comparatively poor and bad weather had interfered. Better catches were made during the latter half of May when the weather permitted fishing on the outside bank. Until the middle of June, the best fishing was on the outside banks, but from then on through June and in July good fishing prevailed on the inside grounds.

The Kyuquot fish are usually large red Spring salmon and there is only a small admixture of white Springs.

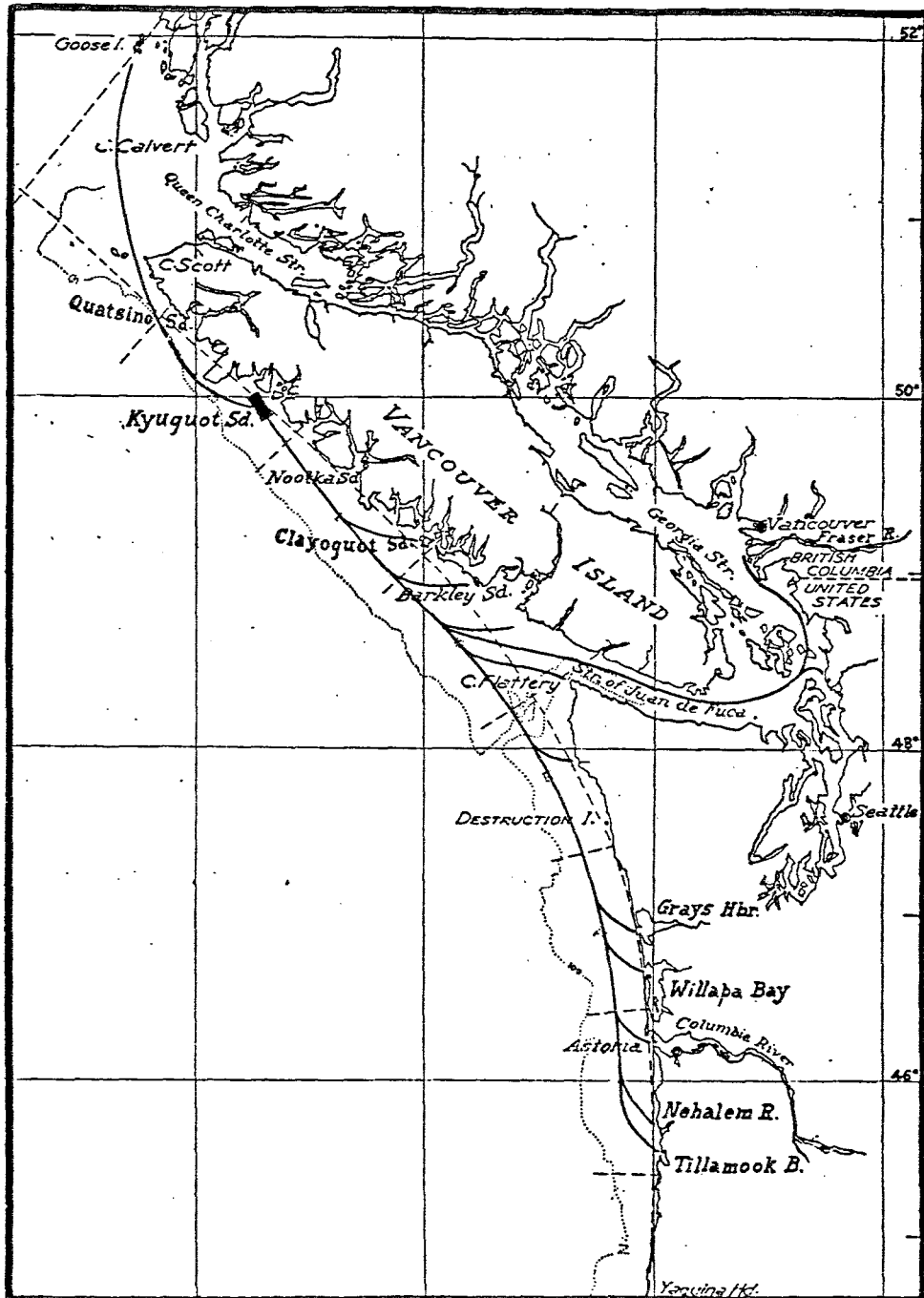
The number of salmon tagged amounted to 517 Spring, 145 Coho, and 3 Sockeye salmon, the operations being carried out by Messrs. W. F. Baxter and C. McC. Mottley between April 26 and July 16. Messrs. W. Silda, H. Skogman, J. Johnson and W. Petrie kindly afforded facilities on their boats.

SPRING SALMON

The estimated weights of the Spring salmon tagged are shown in table X. Ninety-six (19%) were under, and four hundred and twenty-one (81%) over, twenty pounds.

TABLE II.—Returns from Spring salmon tagged at Kyuquot in 1927

Tag number	Date of tagging	Date of recapture	Period of freedom	Place of recapture
3907	May 7	1927		Columbia R.
3918	" 14	{ Before Dec. 7, 1927		Off cape Flattery (troll).
3926	" 16	July 15, "	60 dys.	Columbia R., Astoria.
3927	" 16	July 11, 1930	3 yrs. 56 "	Skagit R.
3928	" 16	Sept 1, 1927	108 "	Columbia R., Astoria.



Distribution of Spring salmon tagged in 1927 at Kyuquot sound.

TABLE II.—Continued

Tag number	Date of tagging	Date of recapture	Period of freedom	Place of recapture
3939	" 26	Sept. 16, "	113 "	Columbia R., Astoria.
3944	" 26	" ? "	98 "	Columbia R., Kalama R. (hatchery).
3947	" 26	" 14, "	111 "	Columbia R., Astoria.
3954	" 26	July 18, "	53 "	Columbia R., Flavel.
3956	" 26	Sept. 1, "	98 "	Columbia R., Pillar rock.
3968	" 27	Aug. 19, "	84 "	Columbia R., Sand I.
3754	" 27	Aug. 30, "	95 "	Columbia R., Pt. Ellice.
3765	June 2	Aug. 1, "	60 "	Columbia R., N. Jelly sands.
3986	" 2	Aug. 4, "	63 "	Columbia R., Chinook.
3990	" 2	June 16, "	14 "	Columbia R., Flavel.
3993	" 2	Sept. "	90 "	Columbia R., Hammond.
3998	" 3	Aug. 26, "	84 "	Columbia R., Warrenton.
5003	" 3	Aug. 8, "	66 "	Anacortes.
5012	" 3	Sept. 23, "	112 "	Columbia R., Cecilo.
5015	" 3	Aug. 1, "	59 "	Columbia R., Dahlia.
5017	" 3	June 29, "	26 "	Columbia R., Pt. Ellice.
5019	" 3	Aug. 12, "	70 "	Columbia R., Sand I.
5020	" 3	July 10, "	37 "	Off Ucluelet.
5023	" 3	Sept. 11, "	100 "	Columbia R., Pt. Ellice.
3768	" 3	July 10, "	37 "	Columbia R. (?).
3773	" 3	July 15, "	42 "	Columbia R., Browns Pt.
3776	" 3	Aug. 23, "	81 "	Columbia R., Warrenton.
3777	" 3	July 30, 1928	1 yr. 57 "	Swinomish slough, Wash.
3778	" 3	July 13, 1927	40 "	Columbia R., Altoona.
3780	" 3	Aug. 17, "	75 "	Swiftsure Lt. (troll).
3785	" 4	Sept. 10, 1928	1 yr. 98 "	Similk bay, Wash.
3795	" 4	Sept. 18, 1927	106 "	Pt. Roberts.
3797	" 4	July 20, "	46 "	Columbia R., Osterwold.
5038	" 4	Sept. 1, "	89 "	Columbia R., Astoria.
5054	" 5	Aug. 8, "	64 "	Columbia R., Ilwaco.
5058	" 5	Aug. 8, "	64 "	Columbia R., Ilwaco.
3806	" 5	Aug. 23, "	79 "	Columbia R., Astoria.
3818	" 5	Oct. 4, 1928	1 yr. 121 "	Fraser R., Deas I.
3825	" 6	July 4, 1927	28 "	Off cape Beale.
3843	" 11	July 20, "	39 "	Columbia R., Astoria.
5303	" 12	Sept. 25, "	105 "	Grays Hbr., Humptulips R.
5304	" 14	Aug. 8, "	55 "	Columbia R., Astoria.
5087	" 18	Sept. 14, "	88 "	Columbia R., Warrenton.
5095	" 19	July 22, "	33 "	Pt. Roberts.
5306	" 19	June 9, 1930	2 yrs. 355 "	Skagit R.
5322	" 21	Sept. 26, 1927	96 "	Willapa, Nasel R., Wash.
5328	" 22	{ Before Dec. 7, 1927		Off cape Flattery (troll).
5120	" 22	Aug. 18, "	57 "	Columbia R., McGowan.
5329	" 22	Aug. 29, "	61 "	Grays Hbr., Satsop R.
5330	" 22	Oct. "	100 "	Columbia R., Warrenton.
5331	" 22	July 22, "	30 "	Columbia R., Astoria.
5336	" 22	Aug. 20, 1927	59 "	Columbia R., Chinook.

TABLE II—Continued

Tag number	Date of tagging	Date of recapture	Period of freedom	Place of recapture
5343	" 23	June 20, 1928	362 "	35 mi. S.W. of Goose I.*
5344	" 23	Sept. 15, 1927	84 "	Columbia R., Astoria.
5150	" 26	July 18, "	22 "	Swinomish slough, Wash.
5357	" 26	July 15, "	19 "	Columbia R., Cathlamet.
5364	" 27	July 20, "	23 "	Columbia R., Altoona.
5370	" 29	July 20, "	21 "	Columbia R., Astoria.
5375	" 29	July 21, "	22 "	Tillamook bay, Wilson R.
5384	July 2	Aug. 4, "	33 "	Columbia R., Astoria.
5385	" 2	Sept. 20, "	80 "	Nehalem R., Ore.
5399	" 3	July 25, "	22 "	Columbia R., Astoria.
5409	" 3	Aug. 23, "	51 "	Columbia R., Altoona.
5186	" 3	Sept. 1, "	60 "	Columbia R., Hammond.
5208	" 3	July 25, "	22 "	Queets R., Wash.
5232	" 5	Aug. 19, "	44 "	Clayoquot Sd., Trout R.
5423	" 6	July 28, "	22 "	Columbia R., Chinook.
5233	" 8	Aug. 12, "	35 "	Neah bay (troll).
5432	" 12	Sept. 1, "	51 "	Grays Hbr., Humptulips R.
5435	" 12	June 29, "	11 mos.	Columbia R.
5446	" 12	Aug., "		Willapa Hbr., Nemah R.
5449	" 13	Mar. 5 "	7 mos.	2 mi. off Clanewah, V.I.
5453	" 13	{ Before Sept. 27, 1927		(San Juan Fish Co., Seattle).
5255	" 13	July 15, 1928	367 dys.	Swinomish slough, Wash.
5262	" 13	Aug. 6, 1927	24 "	Columbia R., Astoria.
5455	" 13	July 13, 1928	365 "	Swinomish slough, Wash.
5466	" 15	Aug. 16, 1927	32 "	Columbia R., Sand I.
5476	" 15	{ Before Sept. 15, 1928		(Oregon Fish Commission).
5277	" 17	Oct. 4, "	1 yr. 79 dys.	Bush Pt.
5503	" 16	Aug. 12, "	1 yr. 27 "	Swinomish slough, Wash.

*Caught on halibut gear.

The tagged fishes do not represent all the salmon that were captured by the tagging boats. In addition to the fish tagged, 107 large salmon were brought to the buyer's scow, so that the record of fish actually caught by the tagging boats should read 96 salmon under 20 lbs. weight, and 528 weighing 20 lbs. and over, the latter being a percentage of 85. This is a fair representation of the catch in this district and indicates the preponderating number of large fish taken in this area. Small salmon do occur inshore, but they evidently do not come in large numbers to this feeding ground. There is evidently a migration from the west in spring and summer. If there were any extensive migration from the east of fish nearing maturity, it would have been shown by recaptures of fish tagged at Ucluelet.

Table II gives the particulars of the localities and dates of recapture of the Spring salmon.

The following is a summary of the localities and the number of salmon captured in each:

Queen Charlotte sound: 35 m. S.W. of Goose island,—1.

Outer coast of Vancouver island: Clayoquot sound, Trout river,—1; off Ucluelet,—1; off cape Beale,—1; off Clanewah,—1; off cape Flattery,—1.

Strait of Georgia and Washington sound: Fraser river,—1; point Roberts,—2; Similk, 1; Swinomish slough,—5; Bush point and Anacortes, 2; Skagit river,—2.

Pacific coast of U.S.: Queets river, Wash.,—1; Grays harbour, Hump-tulips river,—2; Grays harbour, Satsop river,—1; Willapa, Nasel river,—1; Willapa, Nemah river,—1; Columbia river,—48; Nehalem river, Ore.,—1; Tillamook bay, Ore.,—1.

Unknown,—2.

Total,—80.

Of the 517 Spring salmon tagged, the recaptures were 80, or 15 per cent. The returns from the Columbia river totaled 48, or 60 per cent., and from other rivers of the outer coasts of Washington and Oregon, 8, or 10 per cent. The number of fish which turned into the strait of Juan de Fuca were 13, or 16 per cent. It is interesting to note that eight fish were recaptured while on the migration route or on the feeding grounds. Only one tagged fish was recovered to the westward of Kyuquot. It was taken 35 miles S.W. of Goose islands.

Attention may be drawn to the times of arrival of the salmon at the river and in this connection the recaptures in the various months are shown as follows:

Region—Clayoquot to cape Flattery:

Month of tagging	Month of recapture	
	July	Aug.
1927		
May		
June	2	1
July		2

Region—Strait of Georgia and Washington sound:

Month of tagging	Month of recapture		
	July	Aug.	Sept.
1927			
May			
June	2	1	1
July			

Region—Columbia and other rivers of Pacific coast of United States

Month of tagging	Month of recapture				
	June	July	Aug.	Sept.	Oct.
1927					
May		2	2	5	
June	2	9	12	6	1
July		2	4	1	

Judging from the returns, the fish at Kyuquot in May do not include many, if any, that are ready to go to the river. None were recaptured east of Clayoquot till July. The June fish have a proportion ready to go to the river. Two arrived in the Columbia in June; two arrived at the Fraser and Skagit rivers respectively in July. Of the June fish, the majority of those recaptured had arrived at the rivers by July and August. Some July fish (10) reached the Columbia that month, but the majority (12) arrived there in August. None of the July Kyuquot fish were recovered in the strait of Georgia and Washington sound.

The several tagging experiments exhibit certain differences in migration. None of the salmon tagged at Ucluelet in May-September 1926 were found in the Columbia in May, but some were recovered in the straits of Fuca and Georgia. Two of the salmon tagged at Quatsino were found in the Columbia in May. Of the salmon tagged at Kyuquot in May, those recaptured were found in the Columbia in July, August and September. The fish tagged in June spread over

five months, June to October, in their journey to the Columbia and over July to September in their journey to the Fraser and Skagit rivers. There is evidently a more or less intermittent but steady migration eastward along the coast of Vancouver island, of Spring salmon bound for the rivers.

Attention should be called to the *recaptures in subsequent years*. Nine salmon tagged in 1927 were recaptured in 1928. This number constitutes 11 per cent. of the total returns. Seven of the returns were from fish that apparently had turned eastward into the strait of Juan de Fuca and one was from Goose islands to the northward. The returns in 1930 were from the Skagit river. With one exception all these fish weighed between 25 and 32 lbs. when tagged.

The fastest *rate of travel* exhibited by any of the recaptured salmon of this experiment was an average of 19 miles per day. This salmon, tagged in June, was found in the Columbia river 14 days later. Three other fishes showed rates of 10 to 14 miles per day.

That the *instinct of association* is a strong one in salmon is exemplified by two cases. Two salmon (nos. 5054 and 5058) were tagged at Kyuquot on June 5, 1927, and were both recaptured at Iwaco, Columbia river, 270 miles distant, on August 8, 1927. A similar case occurred in the 1926 experiment at Barkley sound. Two fishes tagged on May 12, 1926, were recaptured at West Beach, Whidbey island, 110 miles distant, on August 21, 1926. It would appear that the fishes had kept company during their entire migration. They were not necessarily travelling alone but may have formed part of a school that made the journey.

As in former experiments it was found that apparently the fish sometimes suffered a *loss in weight after being tagged*. In forty-seven cases the weight of the fish on recapture has been reported. It is not certain whether the figure given is the weight of the fish before or after dressing. Dressing results in a loss of one-seventh of the original weight and in making comparison it is advisable to allow for this possible loss. The weights have been taken as referring to the fish after dressing and an adjustment is made by adding one-seventh. It should be recalled that the weight at time of tagging was estimated.

The result of the examination of the data indicates that soon after tagging the fish often suffer a loss in weight. After an interval of about three months most of the fishes show an increase in weight and this increase, with only an occasional exception, continues up to 2 years and 3 months, the limit of the period of

freedom so far exhibited by the tagged fish. Two fishes, two years after tagging, were of the same weight as when tagged, *viz.*, 11 and 18 lbs. respectively.

The data are summarised as follows:

Time after tagging	Fishes that lost weight		Fishes that gained weight	
	Number	Loss	Number	Gain
Up to 2 months. . . .	12	1-12 lbs.	4	2-10 lbs.
2-3 months.	2	3-6 lbs.	7	1-7, (16 lbs.)*
3-5 "	4	3-8 lbs.	5	1-7 lbs.
10 "			1	7 lbs.
1 yr.-1 yr. 11 mos. . .	1	3 lbs.	12	2-22 lbs.
2 yrs.-2 yrs. 3 mos. .			2	14 lbs.

*This fish weighed 30 lbs. when tagged and 46 lbs. when recaptured 66 days later. It is possible, of course, that an error was made in recording one of the weights.

COHO SALMON

One hundred and forty-five Cohoes were tagged between May 26 and July 16. Seven were recaptured, *i.e.*, 5 per cent.

The weights of the Cohoes were not recorded previous to July 1. The estimated weights of the Cohoes tagged from July 2-16, 1927, were as follows:—

Weight.....	6	7	8	9	10	11	12	13	14
Number of fish.....	1	2	17	14	13	2	1	1	2

In table III are given the dates and localities of recaptures.

TABLE III.—Returns from Cohoes tagged at Kyuquot in 1927

Tag number	Date of tagging	Date of recapture	Period of freedom	Place of recapture
5144	June 25	June 15, 1930	1 yr. 355 dys.	Swiftsure bank
5190	July 3	Before July 18, 1927		Kyuquot
5275	" 16	Oct. 7, 1927	83 "	Fraser R., Canoe pass
5473	" 15	Oct. 6, "	83 "	Sooke (trap)
5482	" 15	Sept. 16, "	63 "	Sooke (trap)
5491	" 15	Before Oct. 15, 1927		Seymour inlet, Harriett Pt.
5506	" 16	Sept. 16, 1927	62 "	Sooke (trap).

All the Cohoes which were recaptured had been tagged in July, with one exception. In contradistinction to the Spring salmon, none were recovered in the Columbia river. One was found at Kyuquot, three were captured at Sooke, one in the Fraser river and one was retaken in Seymour inlet. The seventh is recorded as being captured on Swiftsure bank after a period of liberation of one year and 355 days. The case is exceptional and there is a tendency to question the accuracy of the record. The four fish recaptured at Sooke and in the Fraser river had no doubt proceeded westward. Three were found at Sooke in 62-83 days. The weights given of the Cohoes on recapture are all smaller than the ~~weights at the time of tagging.~~

SOCKEYE SALMON

Three Sockeye salmon were tagged but none has been recovered. On June 19, 1927, a large school of Sockeye was observed 14 miles south of Kyuquot buoy. One was "snagged" by the trolling spoon and was tagged. The other two were taken on June 21 on the troll, one in the above-mentioned locality and the other on Outside bank. They probably belonged to the same school.

ADDITIONAL RETURNS FROM TAGGING OPERATIONS OF 1925 AND 1926

BARKLEY SOUND, 1925, SPRING SALMON,

A few additional returns have been received from this first tagging experiment and are given in table IV. For details concerning the previous returns, reference should be made to the reports by H. C. Williamson (Pacific salmon migration: Report on the tagging operations in 1925, *Contr. Canad. Biol. Fish.*, N.S., 3, 1927) and (Pacific salmon migration: Report on the tagging operations in 1926, with additional returns from the operations of 1925. *Contr. Canad. Biol. Fish.*, N.S., 4, 1929).

TABLE IV.—Returns from Spring salmon tagged off Barkley sound in 1925

Tag number	Date of tagging	Date of recapture	Place of recapture
67	May 23	Oct. end, 1928	Fraser river, near Sunbury
528	June 4	1926-27	Columbia R.
4023	June 23	1926-27	Columbia R.
4218	June 23	1926-27	Columbia R.

TABLE V.—Complete summary of returns of tagging Spring salmon off Barkley sound in 1925

	1925	1926	1927	1928	Total
Off Barkley sound.....	1	7			8
Off cape Flattery.....	1	2			3
Strait of Juan de Fuca—B.C. waters.....	5	2			7
“ “ “ —U.S. “.....	4	3			7
Puget and Washington sounds.....	11				11
Fraser river.....	4	1		1	6
Pacific coast of Washington.....	1	1			2
Columbia river.....	43	27	4		74
Pacific coast of Oregon.....	2				2
Sacramento river.....	2				2
Locality unknown.....	1				1
	75	43	4	1	123

In table V is given a complete summary of the returns from the tagging off Barkley sound in 1925. It will be recalled that 1,125 Spring salmon were tagged in the period from May 23 to June 25. The total recaptures reported amount to 123, which represents a return of 11 per cent. Fifty-nine per cent. of the recaptures took place in the year of tagging, 37 per cent. in the year following, 3

per cent. in the second year following, and one fish was reported recaptured in October, 1928, having thus been carrying the tag for slightly over three years and three months.

As to distribution, 60 per cent. of the returns were from the Columbia river as compared with but 5 per cent. from the Fraser river. Using another basis of comparison, 25 per cent. of the recaptures were of those fish which turned into the strait of Juan de Fuca, while 65 per cent. were of those fish which had proceeded southward beyond cape Flattery. Of the 123 recaptures, 11 per cent. were in Canadian waters as compared with 80 per cent. in American waters.

HIPPA ISLAND, 1925, SPRING SALMON

One tag, no. 2076, was recovered in the Columbia river in the season 1926-27, having been affixed on July 19, 1925.

BARKLEY SOUND, 1926, SPRING SALMON

In the report published in 1929, it was recorded that 156 tagged fish had been recaptured. Since then 27 more tags have been returned, making a total of 183 recaptures. Table VI gives the particulars of the additional records.

Sixteen of the tagged fish were recaptured in 1927, six in 1928 and three in 1929. Eighteen were got in the Columbia river, three in the Fraser river, three in Washington sound, one in Bute inlet and one off Grays harbour. The fish caught in Bute inlet extends the range of distribution of the Spring salmon tagged off Barkley sound, since the Fraser river had previously been the northern limit in the strait of Georgia.

Tag No. 1674 was received without any information of date or place of recapture.

It would seem that all the returns from the tagging operations of 1926 are at hand and a complete summary is given in table VII.

In the tagging operations of 1926, a total of 1,353 Spring salmon were tagged between the dates of March 24 and September 2. The total returns as shown in table VII were 183 individuals or 14 per cent. The returns in the first year, that is the year of tagging, amounted to 10 per cent. of the number tagged and in the year following to 2 per cent. Expressed in relation to the total number of returns, 77 per cent. were received in the year of tagging, 17 per cent. in the year following, 4 per cent. in the second year following, and three fish were recaptured in the third year.

The returns from the Columbia river amounted to 60 per cent. and those from the Fraser to 7 per cent. The recaptures of fish turning into the strait of Juan de Fuca totaled 31 per cent. and of those which had proceeded south of cape Flattery, 62 per cent. Of the 183 recaptures, 13 per cent. were in Canadian waters as compared with 81 per cent. in American waters.

TABLE VI.—Returns from Spring salmon tagged off Barkley sound in 1926
Additional list of recaptures

Tag number	Date of tagging	Date of recapture	Period of freedom	Place of recapture
1421	May 12	Aug. ? 1929	3 yr. 3 mo.	Columbia R.
1462	April 27	Sept. 22, 1927	1 " 5 "	Columbia R.
1618	June 10	1926-27		Columbia R.
1674		Unknown		Unknown
1805	May 2	1926-27		Columbia R.
1838	May 11	1926-27		Columbia R.
3035	June 16	1926-27		Columbia R.
3233	June 23	Oct. 6, 1927	1 yr. 3 mo.	Fraser R.
3240	June 24	1926-27		Columbia R.
3245	June 24	1926-27		Columbia R.
3295	July 8	Oct. 19, 1927	1 yr. 3 mo.	Whidbey Is.
3331	June 28	Oct. 3, 1927	1 " 3 "	Columbia R.
3486	July 27	Aug. 1, 1929	3 " 5 "	Columbia R.
3534	Aug. 2	Oct. end, 1928		Fraser R.
3682	Aug. 19	Sept. 27, 1927	1 " 1 "	Columbia R.
4023	June 23	1926-27		Columbia R.
4261	May 10	Aug. ? 1929	3 " 3 "	Columbia R.
4292	May 14	Sept. 24, 1927	1 " 4 "	Columbia R.
4865	April 18	1926-27		Columbia R.
4872	April 22	1926-27		Columbia R.
4905	June 11	Oct. 1927	1 " 4 "	Columbia R.
3011	June 16	May 3, 1928	1 " 10 "	Columbia R.
3182	June 9	July 18, "	2 " 1 "	5 mi. off Grays harbour
3495	July 27	Oct. 1928	2 " 3 "	San Juan I., Salmon bank
3536	Aug. 2	Oct. 1, 1928	2 " 2 "	Fraser R.
3609	Aug. 9	July 6, 1928	1 " 11 "	Deception pass
*4893	Apr. 23	Aug. 30, 1928	2 " 4 "	Bute inlet

*Reported on recapture as a Coho.

TABLE VII.—Complete summary of returns of tagging Spring salmon off Barkley sound in 1926

	1926	1927	1928	1929	Total
Off Clayoquot sound.....	2	1			3
Off Barkley sound.....	4				4
Alberni canal.....	1				1
Off cape Flattery.....	1	1			2
Strait of Juan de Fuca—B.C. waters.....	9				9
“ “ “ —U.S. “.....	5	1	1		7
Puget and Washington sounds.....	26	1	1		28
Fraser river.....	9	1	2		12
Bute inlet.....			1		1
Pacific coast of Washington.....	1	1	1		3
Columbia river.....	80	25	1	3	109
Locality unknown.....	3	1			4
	141	32	7	3	183

GENERAL DISCUSSION OF RESULTS

One of the purposes of the program of 1926 was to determine whether the movements of Spring salmon from the area off Barkley sound were essentially similar in successive years and essentially similar throughout successive months. A comparison of the returns from the operations of 1925 and 1926 shows that the distribution of the fish was very similar in the two years. Tables VIII and IX show the summary features in comparative form. To these tables have been added the returns from the operations off Quatsino and Kyuquot sounds for comparative purposes.

The percentages of returns in successive years for the three areas is of some interest. If the returns have a relation to the maturity of the fish, then a considerably higher percentage of mature fish, that is, fish which will spawn that season, are being caught on the Quatsino and Kyuquot banks than on the Barkley banks. The weight figures, as shown below, would appear to support this belief.

TABLE VIII.—Comparative summary of returns of Spring salmon tagged off west coast of Vancouver island

	Number tagged	Number returns	Per cent. returns	Per cent. returns			
				1st year	2nd year	3rd year	4th year
Barkley sound, 1925.....	1125	123	11	61	35	3	1
Barkley sound, 1926.....	1353	183	14	77	18	4	1
Quatsino sound, 1927.....	54	8	15	88	12	0	0
Kyuquot sound, 1927.....	517	80	15	86	11	0	3

TABLE IX.—Comparative summary of distribution of Spring salmon tagged off west coast of Vancouver island (in percentages)

	Columbia R.	Fraser R.	Juan de Fuca	South of C. Flattery	Can.	Amer.
Barkley sound, 1925.....	60	5	25	65	11	80
Barkley sound, 1926.....	61	7	31	61	13	81
Quatsino sound, 1927.....	50	0	38	50	0	88
Kyuquot sound, 1927.....	60	1	16	70	3	85

TABLE X.—Comparative summary of weights of Spring salmon tagged off west coast of Vancouver island

Weight in pounds	Barkley 1925	Barkley 1926	Quatsino 1927	Kyuquot 1927
1-9	330	337	8	10
10-19.....	498	433	13	86
20-29.....	206	378	17	241
30-39.....	72	158	14	158
40-49.....	11	41	2	22
50-59.....	8	6	0	0

It is evident, from table X, that a much higher percentage of large fish is being taken off Kyuquot than off Barkley sound and the tagging returns indicate that a considerably higher percentage of the Kyuquot fish proceeded to the spawning areas in the year of tagging.

In this connection it may be pertinent to state that the *ages of the spring salmon* tagged off Barkley sound in 1926 were four years for 50% of the fish and five years for 18%, and of those tagged off Quatsino and Kyuquot sounds in 1927 four years for 42% and five years for 40%, all as found by C. McC. Mottley (*Pacific salmon migration; report on the study of the scales of Spring salmon, *Oncorhynchus tshawytscha*, tagged in 1926 and 1927 off the west coast of Vancouver island. Contr. Canad. Biol. Fish., 4, 1929).*

The following data show the number of fish tagged in each month off Barkley sound and the returns in the year of tagging and in later years.

	March	April	May	June	July	Aug.	Sept.
No. tagged, 1925.....			153	972			
No. returns, 1925.....			5	70			
Later.....			15	33			
Per cent., 1925.....			3	7			
Later.....			10	3			
No. tagged, 1926.....	67	245	250	497	151	125	18
No. returns, 1926.....	5	31	30	53	11	10	1
Later.....	2	5	9	13	5	8	0
Per cent., 1926.....	7	13	12	11	7	8	6
Later.....	3	2	4	3	3	6	0

It will be noted that of the fish tagged in May, 1925, only three per cent. were recaptured in that year, while ten per cent. were recaptured in the years following. Such a condition did not occur in any other month of tagging and may have had some relation to the fact that the operations were confined to a very limited period, namely nine days, from May 23 to 31. The condition was completely reversed in May, 1926, when twelve per cent. were returned in that year and four per cent. in succeeding years. The month of April, 1926, provided the highest percentage of returns in the year of tagging, namely, thirteen per cent., with only two per cent. in the later years.

CONCLUSIONS

The tagging of troll-caught Spring salmon off the west coast of Vancouver island during three successive seasons has definitely established an extensive southeastward movement of maturing fish toward the rivers of the coast, extending from the Fraser river in British Columbia to the Sacramento river in California. Sixty per cent. or better, of these fish appear to be bound for the Columbia river. This migration presupposes a prior movement northwestward of immature fish. As C. McC. Mottley has suggested in the paper already referred to, the dispersal movement of the immature individuals has possibly some relation to the distribution of food and current, while the return movement may be a response to current associated with an urge which develops with the maturing of the reproductive elements. There is some evidence indicating that these fish travel when the current attains or surpasses a certain velocity and stop to feed on the banks when the current slackens.

These tagging experiments have thus contributed much information concerning the life history of the Spring salmon and have furnished data upon which adequate conservational measures may be based. It is evident that international cooperation will be necessary when any such measures are to be considered.

The following information was extracted from reference no. 1 (Alaska Department of Fisheries, 1950).

From: Annual Report No. 2, 1950:

"The main efforts were directed toward gathering biological data on the king (chinook) and silver (coho) salmon during their ocean existence.

"The general areas of tagging, dates of tagging and numbers of fish involved are presented in Table 2.

"Figure 3 presents graphically the predominantly southward movement of kings tagged in outside waters. Figure 4 (see coho section - reference 1) portrays the random dispersal of silver salmon from areas of tagging to points of recapture.

"Table 8 presents the average distance travelled, average time free, percentages of stream recoveries and Alaskan recoveries. Table 9 presents the recoveries by year.

"Differences in Behavior of King and Silver Salmon

"The kings showed no counter migration except in one instance, viz. Noyes Island to Snipe Bay, a northward movement of 65 nautical miles in 48 days, and very few were recovered in the same or close to the same locality. The silver salmon, conversely, moved in a random manner from the outside waters to fisheries or spawning streams in inside waters. Much counter movement is evident and no definite migration paths or routes are indicated. The significance of the king salmon experiment may be altered by 1951 tag returns but it is apparent from these preliminary results that the king salmon fishery is largely dependent upon supplies from outside territorial waters while for the silver salmon the opposite is true. Likewise the percentage of Alaskan recoveries has significance for Alaskans when discussions of closed seasons and size limits are entered."

TABLE 2. -- Numbers of king and silver salmon tagged during 1950

AREA	KINGS		SILVERS	
	Number Tagged	Dates Tagged	Number Tagged	Dates Tagged
<u>Outside Waters</u>				
Cape Spencer to Cape Fairweather	149	June and July	81	July
Cape Bingham to Lisianski Strait	276	May thru July and September	264	June and July
Lisianski Strait to Cape Edgecumbe	99	June thru September	0	
Coronation Island to Cape Felix	176	May thru July	473	May thru July
Duke Island	10	July	30	July
<u>Inside Waters</u>				
Northern Stephens Passage	497	May, August thru October	7	August
Northern Chatham Strait	27	May and July	1	August
Behm Canal	274	September thru December	1	October
TOTAL TAGGED	1508		857	

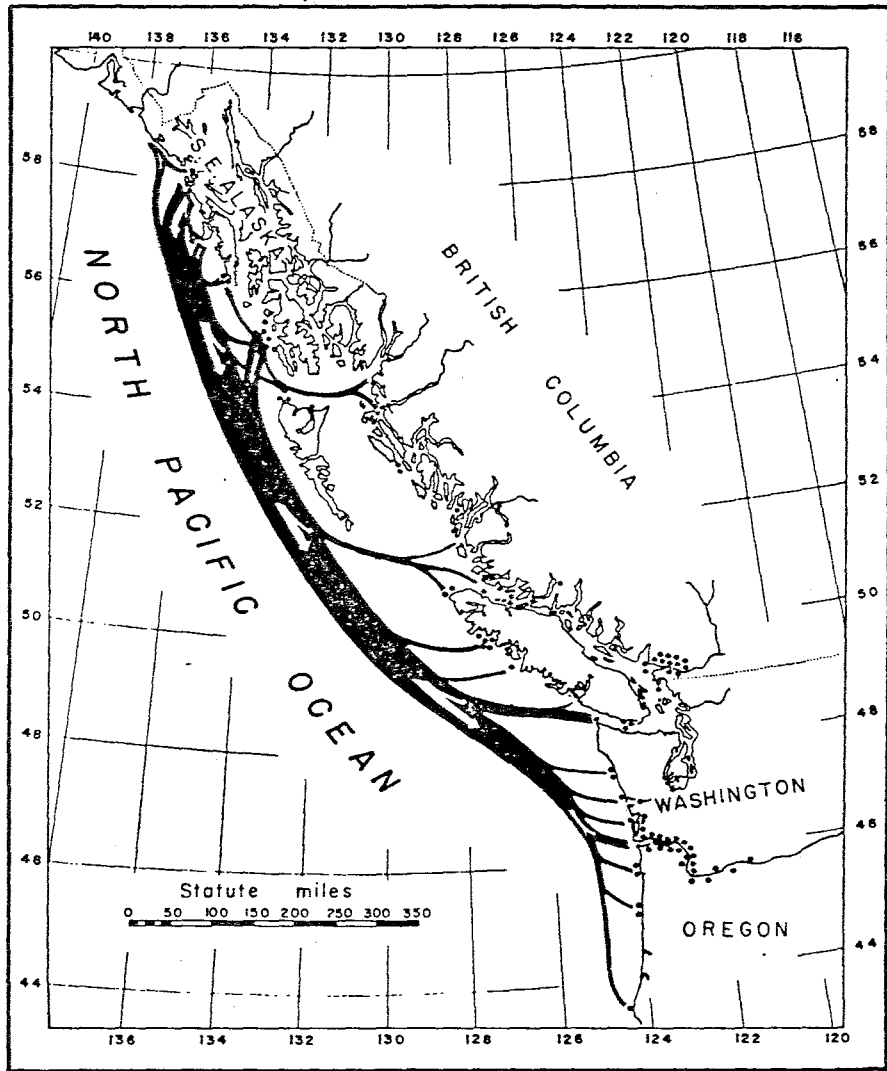


FIGURE 3—Diagrammatic presentation of the predominantly southward movement of king salmon from Southeastern Alaska. Each dot represents one recovery. Thickness of lines is proportional to number of fish in the sample.

TABLE 8. — Comparing statistics of movements of king and silver salmon tagged in outside waters of Southeast Alaska in 1950 (data through Dec. 31).

Species	Average Distance Traveled*	Average Time Free in Days	Percentage of Stream Recoveries	Percentage of Alaskan Recoveries
Kings	615	64	65.2	13.5
Silvers	116	36	25.0	80.3

* Distance in nautical miles

TABLE 9 — Percentage recovery by gear of king and silver salmon tagged in outside waters of Southeastern Alaska in 1950. *

Species	Gill Net	Troll	Trap	Purse Seine	Dip Net	Beach Seine	Spawning Ground	Sport	Unknown
King	55	26	3	1	4	1	1	1	6
Silvers	24	33	20	9	0	0	4	1	9

* One king salmon was recovered dead on the beach at Copalis, Washington.

The following information was extracted from reference no. 11 (Anon., 1957):

"Rivers Inlet Spring Salmon Investigation

"In 1956, the Department of Fisheries continued the spring salmon investigation at Rivers Inlet. The investigation was initiated originally in 1948 to record the sports catch of spring salmon at the head of the inlet. Since that time, in spite of restrictive regulation, the sports catch has increased from 120 to a high of 1,014 in 1955."

Figure 5 represents the timing of the harvest in Rivers Inlet (1955-1956). Figure 8 records the dead recovery of spawned chinook salmon in a tributary stream. The apparent discrepancy in timing should be considered in assessing the timing of tag-recovery programs.

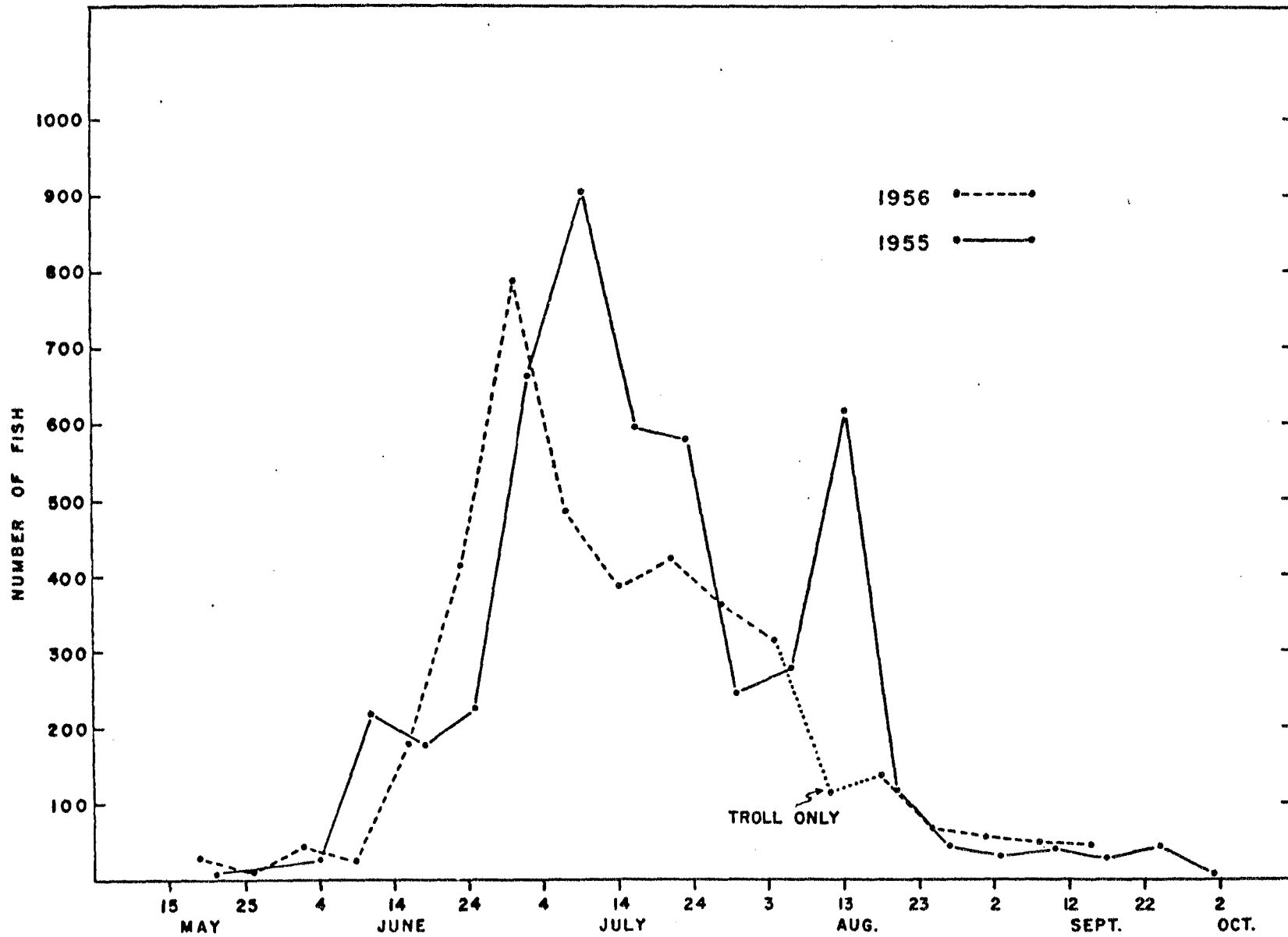


Figure 5. A comparison of the 1955 and 1956 commercial catch of spring salmon in Rivers Inlet.

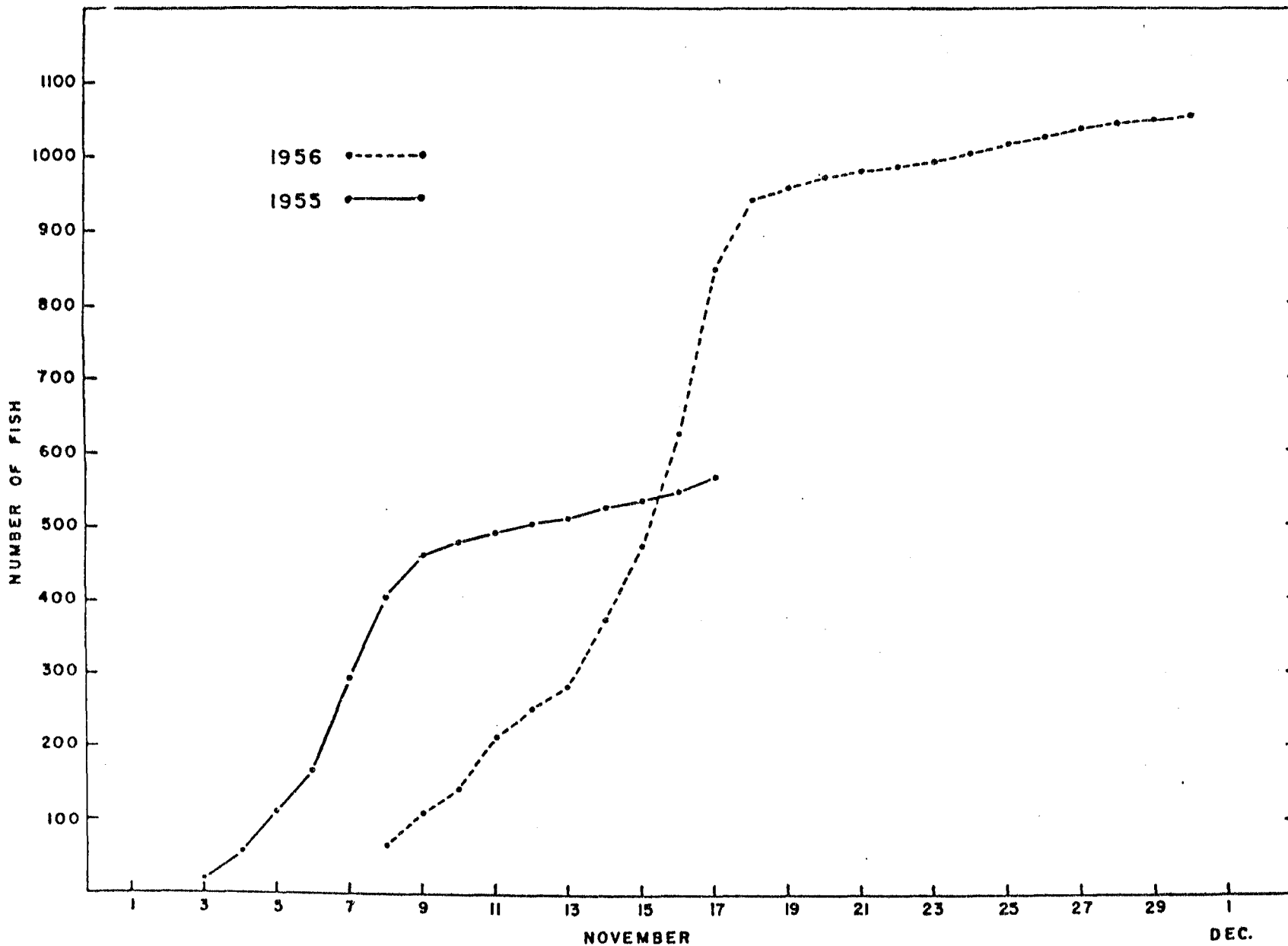


Figure B. Cumulative curves of the dead recovery of spring salmon on the Wannock River in 1955 and 1956.

The following information was extracted from reference no. 60 (Milne, 1957). The paper is an excellent review of recent British Columbia spring and coho salmon tagging experiments (1950-1952), and a comparison with those conducted from 1925 to 1930. Godfrey (1968) has included some of the information in his report, however the full implications of the data can only be understood by reading this paper.

ABSTRACT

From 1949 to 1952 a total of 1,222 spring (chinook) salmon and 2,190 coho salmon were tagged off the coast of British Columbia to demonstrate the ocean migrations and the rivers of origin of fish exploited by the offshore troll fishery. These represent the Canadian part of a coastwide tagging program carried out from Alaska to California through the coordination of the Pacific Marine Fisheries Commission. Most spring salmon were on long spawning migrations, travelling in a southeasterly direction along the continental shelf towards the larger rivers, such as the Columbia and Fraser. Off the southwestern part of Vancouver Island many small immature fish were tagged and recovered from various directions during the next two years. All coho salmon were on shorter spawning migrations, travelling in many directions from offshore waters towards the numerous small coastal streams.

Similar experiments carried out from 1925 to 1930 involved 6,457 spring salmon and 7,126 coho salmon. A comparison between the experiments conducted off the west coast of Vancouver Island in the two periods revealed the following: For spring salmon, the percentages returned were the same (12.9). However small fish appear to provide fewer returns than large fish and more small fish were caught and tagged in recent years. Also more of the tagged fish were recaptured in the recent period off British Columbia (71% compared to 16%) and in the Fraser River (12% compared to 5%) while less were caught in United States waters (29% compared to 82%) and in the Columbia River (16% compared to 60%). This implies that the trollers are now fishing more intensively near the tagging areas and on stocks which spawn in British Columbia rivers rather than on the Columbia River stocks which have decreased greatly in size and importance in recent years. For coho salmon, the percentages returned were higher recently (9.2 compared to 6.1) owing to an increase in the fishing intensity, particularly in United States waters.

The outside troll fishery of British Columbia has been shown to catch a mixture of fish from many streams along the Pacific coast. For this reason certain conservation measures for spring and coho salmon should be considered on an international basis.

INTRODUCTION

In 1948 the Pacific Marine Fisheries Commission resolved to undertake an extensive offshore tagging program along the coast of California, Oregon and Washington to determine the movement of chinook or spring salmon (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) at sea and the rivers of origin of the fish exploited in various areas. Preliminary results of the 1948 and 1949 tagging experiments by the three states have been reported by the Commission in its Bulletin No. 2 (1951). Both Alaska and Canada cooperated to make the program coastwide. It was hoped that by this means the international mixing of stocks could be assessed and, where necessary from a conservational viewpoint, common regulations could be formulated.

Since the Biological Board of Canada had tagged extensively off British Columbia from 1925 to 1930 (Pritchard, 1933) a repetition of these experiments would also afford an opportunity to assess any differences in fishing drain which had occurred over the last twenty years. In recent years the British Columbia troll fleet has increased in size and efficiency and both the fishermen and industry have expressed a growing concern over the conservation of the spring and coho salmon stocks.

In 1949 a commercial trolling vessel was chartered by the Fisheries Research Board of Canada to tag salmon off the west coast of Vancouver Island. Preliminary results have been reported by Neave (1951). A brief summary of the final results will be given, which include a few late returns.

In 1950 tagging operations on a reduced scale were repeated off the west coast of Vancouver Island by purchasing live fish from commercial trollers for tagging purposes. All fish tagged were small, less than 8 pounds in weight, with an average length of 25 inches. Tagging locations were off Barkley Sound in the south and off Kyuquot Sound in the north.

In 1951 two tagging experiments were conducted off each side of the northern end of Vancouver Island and the northern end of Queen Charlotte Islands. Later in the fall, coho salmon were tagged off the southern tip of Vancouver Island from Sooke traps.

In the summer of 1952 spring salmon were tagged from Sooke traps. The results of the experiments from 1950 to 1952 will be discussed in detail.

ACKNOWLEDGMENTS

The success of the tagging program has been due to the excellent cooperation which has been received from the fishermen and those connected with the fishing industry, who conscientiously returned tags and to others who assisted in the actual tagging operations. In particular, sincere thanks are extended to the following trollers: Messrs. L. Ives, S. Olsen, W. Taylor, G. Holden, L. Ochs, A. Oswald, C. Lindrupson, E. Akerley, and J. Stace-Smith; to the Fishermen's Co-operative Association and to J. H. Todd & Sons, Ltd. for assistance rendered. To the taggers, Messrs. W. G. Calderwood (Barkley Sound, 1950), E. A. R. Ball (Kyuquot Sound, 1950 and Sooke, 1951), V. R. Taylor (Quatsino Sound, 1951), W. J. Mitchell (Queen Charlotte Islands, 1951) and D. Denbigh (Sooke, 1952) much appreciation is also due. Mr. E. A. R. Ball and Miss M. Philp were responsible for tabulating many of the data obtained.

METHODS

The majority of the tagged spring and coho salmon were caught by trolling gear; a few of each species were obtained from the traps at Sooke. The former resulted in lower returns than the latter, probably because the former fish were caught by hooks and hauled up from considerable depths by the trolling gear.

Trolling is the only fishing method employed in the ocean, on the feeding grounds and along the migration routes; most net fisheries take place on mature fish either near or on the way to the spawning rivers. The present trolling areas adjacent to British Columbia (Fig. 1) show the places of capture of these two species of salmon. All areas are within 50 miles of shore and 100 fathoms or less in depth, and are either along the continental shelf or in inside waters. Most coho salmon are caught in the top 10 fathoms and within 20 miles from shore, while most spring salmon are taken closer inshore and deeper. Coho salmon are often observed to jump clear of the water surface and are usually found in clear, blue water. Spring salmon seldom jump while feeding in brown, plankton-filled water. The intensity and location of the fisheries affected both

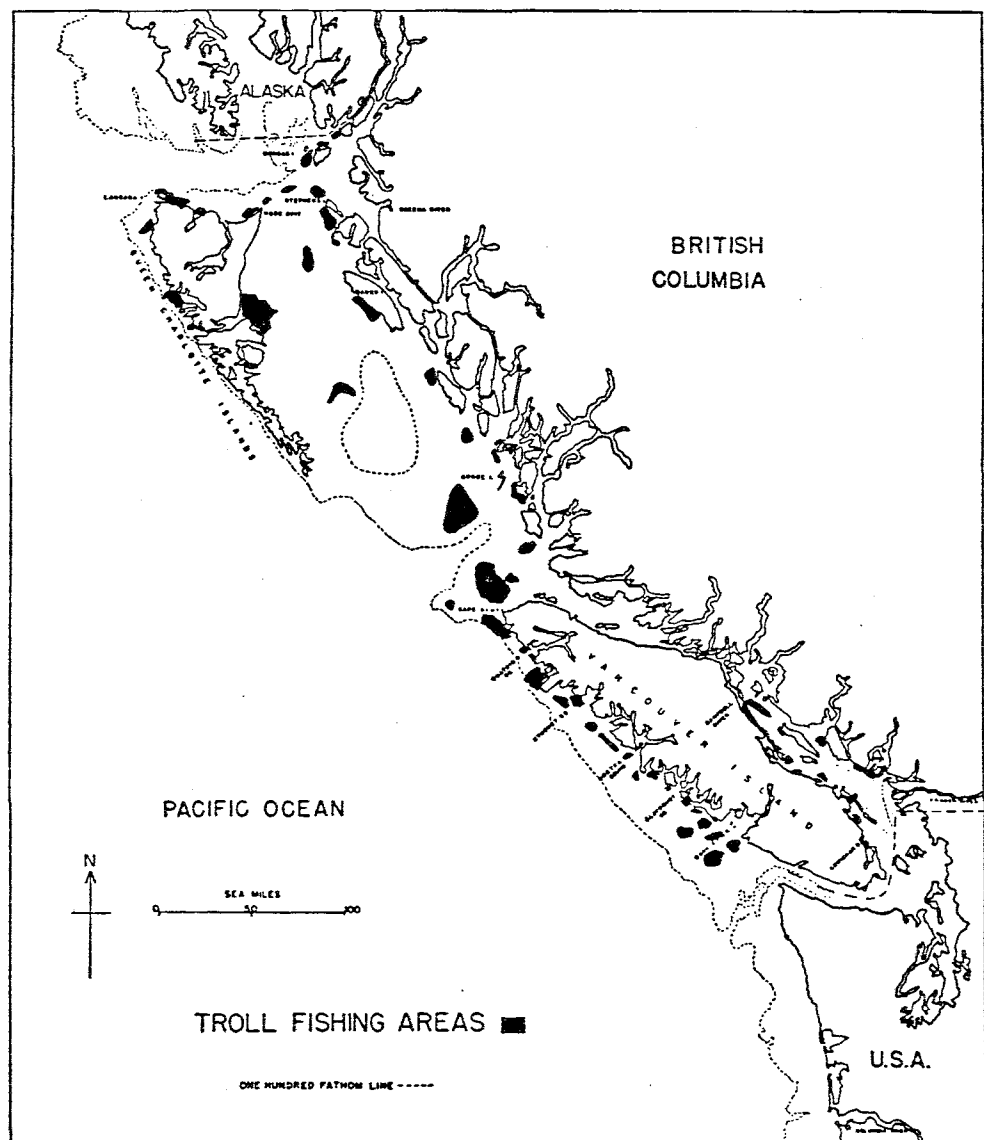


FIGURE 1. The troll salmon fishing areas in British Columbia.

the area of tagging from trolling boats and the distribution of the recoveries by both the troll and net fishing fleets. Thus the recoveries indicate only partial ocean migration routes, minimum rates of travel, and in some cases the final destination to the larger spawning streams.

In the early experiments (1925-30) numbered metal "cattle" tags were attached to the tail of the fish (Williamson, 1927). Recently (1949-52) plastic "button" tags (Peterson discs) were attached to the back of the fish by means of nickel pins (Fig. 2). Some abrasion and mortality occurs (Milne and Ball,

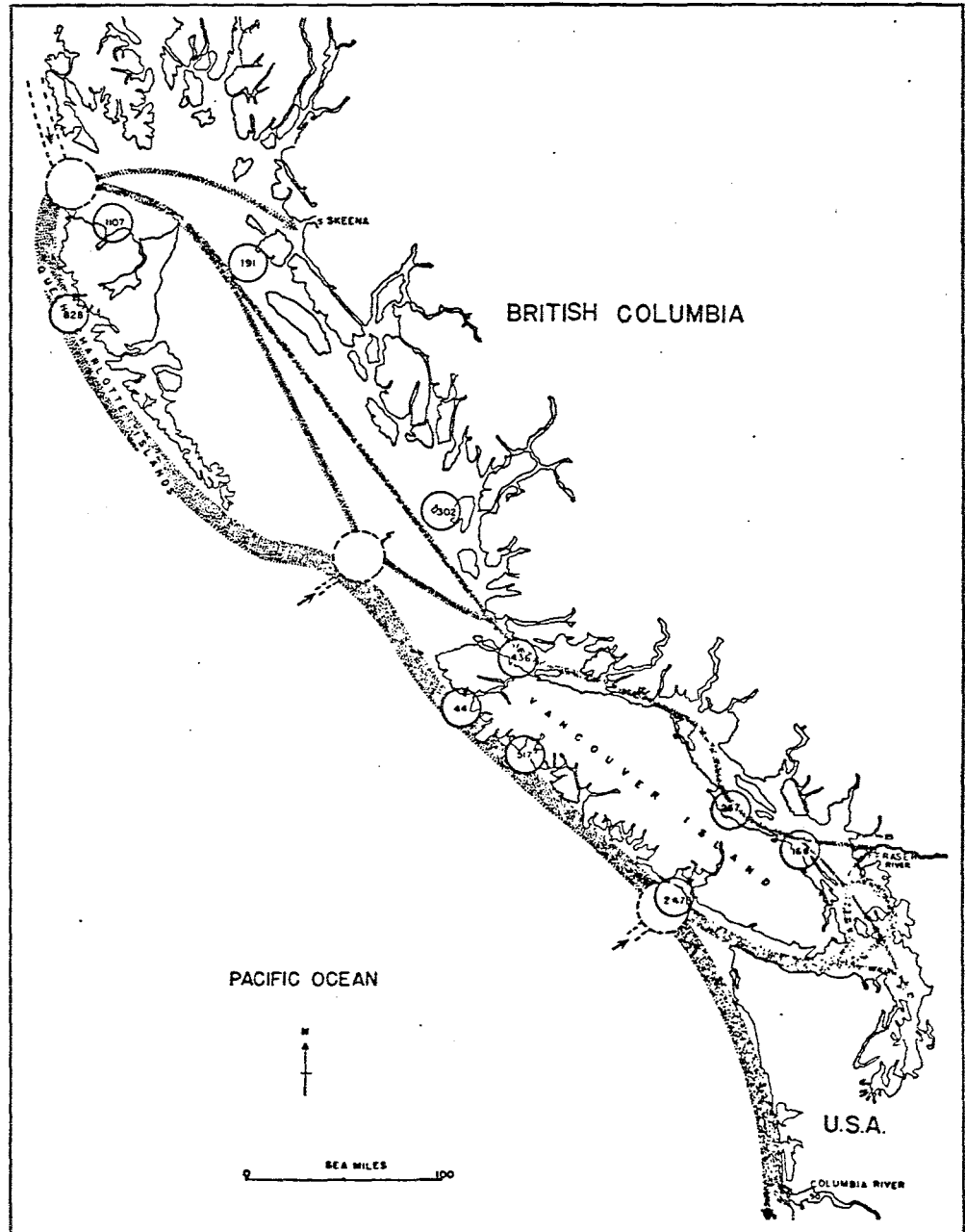


FIGURE 3. The tagging locations showing the number of fish tagged (solid line circles) and the general migration routes of spring salmon tagged from 1925 to 1930.

1956), but fish that were seriously damaged by hooking or handling were not tagged. There is also evidence (Calhoun, Fry and Hughes, 1951) that there is a small loss of tags due to corrosion of the nickel pins near the head. A detailed examination of 88 of the returned pins showed that only three had minor signs of corrosion and none were seriously weakened. The three were in the group of 23 pins which had been out from 200 to 800 days. Despite a reward of 50 cents for each recovery, a few of the tags that are recovered are never returned. For some which are returned complete information is lacking, and in a few instances only the unnumbered tag or "baffle" is recovered. Because of these defects—an unknown mortality, shedding of tags, and incomplete returns—the percentage returned is an inadequate index of the degree of exploitation by the fishery. However, from those returned, a qualitative description of the movements of the fish in the ocean can be made and in some cases the final destination can be determined.

At the time of tagging, the fork length (from the tip of the nose to the fork of the tail) of the fish was recorded and a few scales were obtained for age determination. A summary of the length frequencies of the fish tagged and returned for the experiments conducted from 1949 to 1952 is given in Tables A and B of the Appendix, while ages of the spring salmon tagged and returned in the 1950-52 experiments are given in Table C (Appendix). These data are needed to determine how representative the tagged fish are of the commercial catch, and to explain certain differences in the results of experiments conducted in different seasons and areas.

REVIEW OF THE 1925-30 TAGGING EXPERIMENTS

SPRING SALMON

In 15 separate experiments conducted in 10 areas, a total of 6,457 spring salmon were tagged off British Columbia from 1925 to 1930 inclusive, of which 761 or 11.8% were recovered. The various tagging locations with numbers of fish tagged and the main migration pattern are shown in Figure 3. The width of the probable migration routes are weighted in magnitude. A general summary of the migration of spring salmon based on these experiments is given by Clemens, Foerster and Pritchard (1939).

The majority of the spring salmon travelled long distances in a southeasterly direction along the continental shelf to the larger rivers; many were captured along the way. Columbia River recoveries predominated: for example, from fish tagged off the west coast of Vancouver Island, 60% of the returns were from the Columbia River and 5% of the returns were from the Fraser River. Few fish were recaptured near the tagging areas and 82% were caught in United States waters. Most fish were recovered in the same year as tagged, except for those tagged off Barkley Sound from which numerous returns were recovered in the two years following the tagging year.

Many of the fish tagged off the northeast coast of Vancouver Island were recovered from Georgia Strait (21% of the returns) and Puget Sound (45% of the returns). Those tagged in Georgia Strait showed a more local distribution with 50% of the returns from the Fraser River and only 8% from Puget Sound.

As the tagging locations moved northward the distribution of recoveries also shifted to the north. From fish tagged off the northwest coast of the Queen Charlotte Islands, 58% of the returns were from United States waters to the south (26% from the Columbia River) and 2% were from southeastern Alaska. The fish tagged in Hecate Strait showed a more localized distribution in British Columbia waters with only 35% of the returns being from United States waters, mostly from the Columbia River (26%).

COHO SALMON

In 19 separate experiments conducted in 10 areas, a total of 7,126 coho salmon were tagged off British Columbia from 1925 to 1930 inclusive, of which 632 or 8.7% were recovered. Tagging locations and the main migration pattern are shown in Figure 4. More coho salmon were tagged in inside waters than in the spring salmon operations. No convenient summary is available, but the experiments have been reported by Williamson (1927, 1929), Williamson and Clemens (1932), Clemens (1930) and Pritchard (1934).

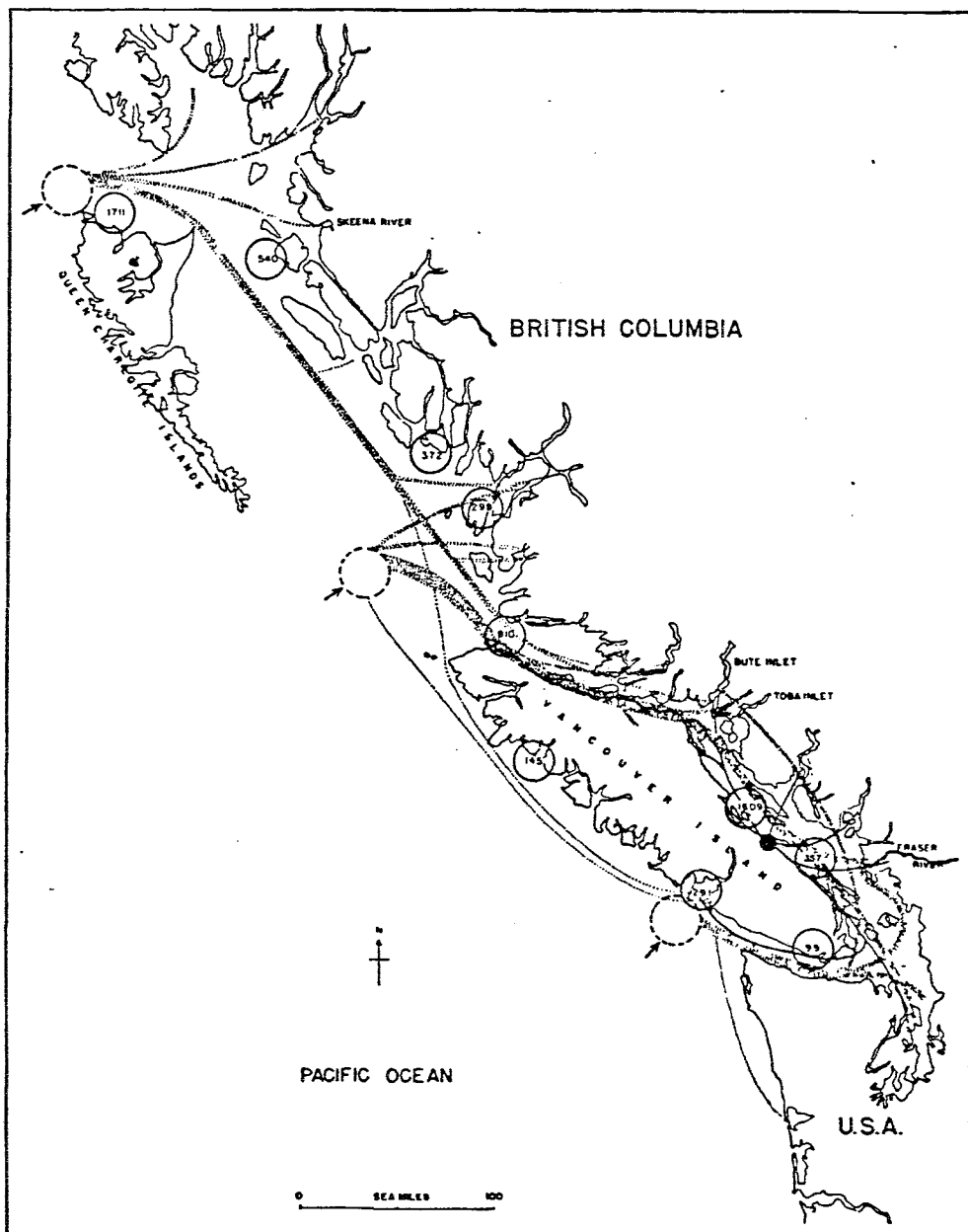


FIGURE 4. - The tagging locations showing the number of fish tagged (solid line circles) and the general migration routes of coho salmon tagged from 1925 to 1930.

The coho salmon radiated in more directions from the tagging areas and migrated shorter distances than the spring salmon. In general they appeared to move in all directions towards numerous small streams along the coast. Many small spawning populations contributed to the fish stock at any tagging locality.

All tagged fish were recovered in the same year as tagged since nearly all coho salmon are either caught or spawn in their third year of life.

From tagging experiments off the west coast of Vancouver Island, the majority of the recoveries were to the south and east from the Fraser River and Puget Sound, with a few from off the Washington coast. From fish tagged off the northeast coast of Vancouver Island most were recovered from Georgia Strait (Fraser River 14% of the returns) with a few from Puget Sound. Less than 10% of the recoveries were from areas north of the point of tagging. Approximately one-quarter of the fish tagged at Sooke traps, on the southern end of Vancouver Island, were recovered in Georgia Strait and Puget Sound, with the majority recaptured in the Fraser River. In Georgia Strait the small cohos, popularly called "bluebacks" radiated from the place of tagging in all directions with one-quarter of the returns from Puget Sound. It appears that they probably spend their entire ocean life in inside waters. The same indication of restricted movement was evident in parts of Hecate Strait where the populations of many small coastal streams intermingle. From the northern coast of the Queen Charlotte Islands, the recoveries were distributed from southeastern Alaska (19% of the returns) to as far south as Vancouver Island.

SUMMARY OF THE 1949 TAGGING EXPERIMENTS

In 1949 both spring and coho salmon were tagged off the west coast of Vancouver Island and the results of the Canadian experiments have been reported by Neave (1951). Since this report there have been 15 returns for spring salmon and 3 for coho. A complete list of the recoveries is given in the Appendix, in Table D for spring salmon and in Table E for cohoes. A summary of the final returns is as follows:

Species	Area	Tags applied	Tags recovered in			Percentage recovered
			1949	1950	1951	
Spring salmon.....	Barkley Sound.....	772	29	37	5	9.2
	Quatsino Sound....	45	11	1	—	26.6
Coho salmon.....	Barkley Sound.....	40	5	—	—	12.5
	Quatsino Sound....	470	41	—	—	8.8

SPRING SALMON

Off Barkley Sound, the size of the fish caught in 1949 was small compared to recent years with the result that 68% of those tagged were less than 67.5 cm. in fork length (about 8 lb.) and 86% were three years of age or less. The large number of recoveries (60% of total returns) in the two years following the tagging

year indicate that many of the fish tagged were immature fish. The returns in both 1949 and 1950 show a wide dispersal in all directions with 30 or 45% of the recaptures in the tagging area. In 1951, four of the five returns were from the Columbia River and the remaining one was captured in the tagging area. Thus the area off Barkley Sound is a feeding area for immature spring salmon.

In 1949 a total of 315 spring salmon were tagged off the southwestern part of Vancouver Island by the Washington State Fisheries Department. Preliminary results (Bulletin 2, 1951) from 58 returns (18%) also indicate that this is a feeding area for immature spring salmon with the main migration towards the Fraser and Columbia Rivers.

Off Quatsino Sound, on the other hand, the fish were larger and a high percentage was recovered in the tagging year. Most were taken at considerable distances to the southeast and one was recovered in 1950 in the Columbia River. Thus almost all of the fish caught off Quatsino Sound are maturing fish on their spawning migration.

COHO SALMON

The coho salmon tagged at both locations in 1949 were maturing fish which migrated in all directions around both ends of Vancouver Island.

In 1949 a total of 35 coho salmon were tagged by Washington State off the southwestern part of Vancouver Island. The return of 11 tags (Bulletin 2, 1951) or 31% was higher than that in the Canadian experiments but a similar migration in all directions indicates that this is a common feeding ground for coho salmon from many river systems.

SPRING SALMON EXPERIMENTS FROM 1950 TO 1952

A summary of the numbers of spring salmon tagged in the five experiments from 1950 to 1952 together with the numbers and percentages of the returns is given in Table I. For comparison the results of the two Canadian experiments conducted in 1949 are also shown in the table.

The areas have been arranged in geographical order from north to south. Following this order each area is discussed in greater detail in the text. Complete data for the recoveries are given in Tables F to J in the Appendix. These are arranged in each area in the order of the date of tagging for each recovery year.

The international aspect of the migrations is apparent but, in the 1949-52 experiments, the number of returns from United States waters and the Columbia River are much less than they were in the 1925 to 1930 experiments. For the experiments off Vancouver Island the recoveries in United States waters have dropped from over 80% to under 40% and the Columbia River recoveries have dropped from over 50% to 25% or under for the two periods. This is an indication of both an increased fishery drain by trolling boats in the tagging areas and a reduction in the stocks of the Columbia River.

QUEEN CHARLOTTE ISLANDS

In 1951 a total of 64 spring salmon were tagged from commercial trollers operating off the northwestern end of the Queen Charlotte Islands; 41 off the west coast and 23 off the north coast. In this area most of the fish are large, averaging over 15 lbs., and are 4 or 5 years of age. The 7 recoveries were all from the 42 fish tagged at a length of over 75 cms. (30 in.). They were all recovered from 11 to 60 days later after migrating from 350 to 600 miles in a southeastern direction (Fig. 5). The fish which was recaptured closest to the tagging area, also gave the fastest rate of travel; approximately 350 miles in 11 days or over 30 miles per day.

It appears that the majority of the fish in this area are maturing fish that are migrating around both sides of the Queen Charlotte Islands to spawn in rivers far to the southeast.

TABLE I.—Summary of spring salmon tagged in British Columbia waters in 1949 to 1952.

Tagging area	Year	Number tagged	Number returned	Percentage return	Geographical distribution of returns ^a			
					Canadian waters	U.S. waters exclusive of Alaska	Fraser River	Columbia River
QUEEN CHARLOTTE ISLANDS				%	%	%	%	%
N.W. COAST.....	1951	64	7	11.0	57	43	14	—
VANCOUVER ISLAND								
N.W. COAST								
Quatsino Sd.....	1949	45	12	26.6	75	25	25	25
Quatsino Sd.....	1951	54	8	15.0	62	38	12	25
Kyuquot Sd.....	1950	22	4	18.2	100	—	25	—
S.W. COAST								
Barkley Sd.....	1949	772	71	9.2	75	25	8	14
Barkley Sd.....	1950	140	38	27.2	61	39	16	16
S. COAST								
Sooke traps.....	1952	125	28	22.4	72	28	57	4
Total.....	—	1,222	168	13.7	—	—	—	—

^a As percentage of the total tags returned.

WEST COAST OF VANCOUVER ISLAND

NORTHERN PART.—In 1951 the operations were similar to those off the Queen Charlotte Islands. A total of 54 fish were tagged off Quatsino Sound. Most of the fish in this area are large and 3 to 5 years of age. The 8 recoveries

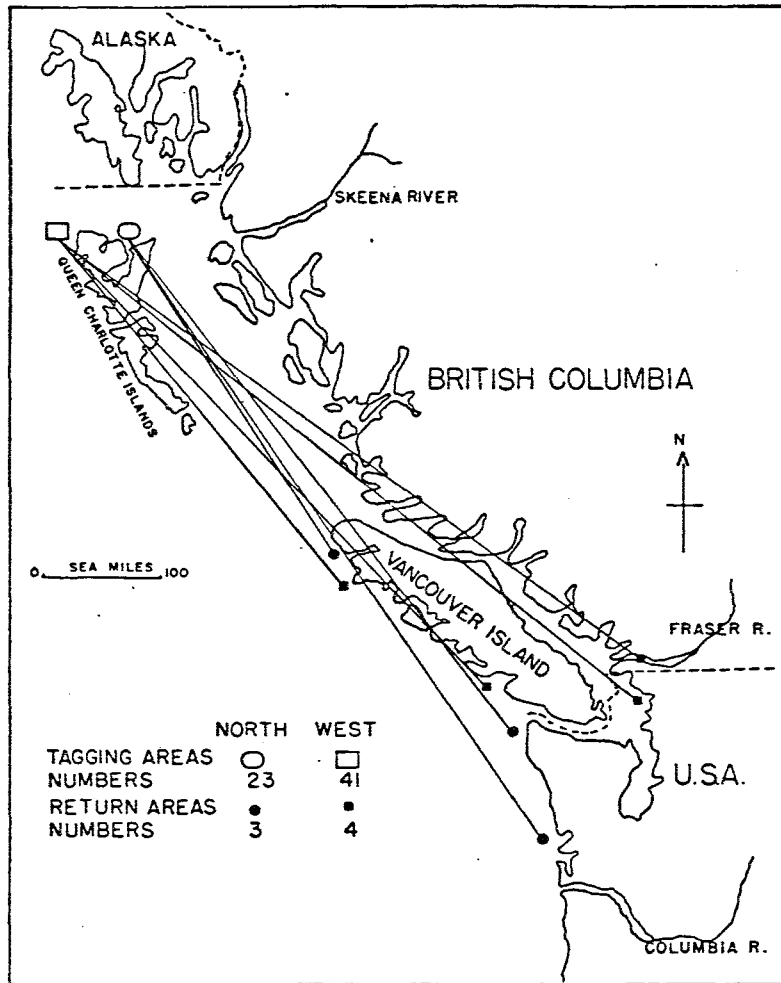


FIGURE 5. Distribution of recaptured spring salmon tagged off the west and north coasts of the Queen Charlotte Islands in 1951.

are shown in Figure 6. The four fish over 80 cm. (32 in.) in length were recaptured the same year, three smaller fish were caught the next year, and one fish of 52 cm. (20 in.) was retaken two years after the tagging year.

The majority of these fish were not maturing fish when tagged and the final movement was towards the Columbia and Fraser Rivers. The smallest fish grew from about 4 lbs. to 20 lbs. during the two years in the ocean. This is in contrast to the result in 1949 for this area, when all but one of the recoveries were made in the same year as tagged.

In 1950 off *Kyuquot Sound* only 22 small fish, less than 8 lbs. in weight, were tagged. This is a select sample of 2- and 3-year-old fish since most of the fish caught in this area were 3 and 4 years old. The four recoveries are shown in Figure 7. All of the fish had moved in a southeasterly direction along the west coast of Vancouver Island. One fish was recovered the next year and another fish was recovered two years after tagging, both about 100 miles from the tagging area. The latter fish had grown from 52 to 85 cm. (20 to 33 in.) in the two years.

In summary, the majority of the fish off the northwestern part of Vancouver Island are large maturing fish but a portion of those less than 15 lbs. are immature feeding fish that will spawn in subsequent years. The direction of movement is southeasterly along the west coast of Vancouver Island.

SOUTHERN PART.—The 1950 tagging off *Barkley Sound* was similar to that off *Kyuquot Sound* in that only small fish less than 8 lbs. were tagged. Since more small fish in their third year are available in this area, 140 fish were tagged from commercial trolling boats. The majority were tagged in June and ranged from 39 to 67 cm. in length (16-26 in.). The distribution of the 38 recoveries is shown in Figure 7. The percentage return of 27.2 was almost three times as large as that in 1949 (Table I). Fifty-five percent of the returns were made in the next year after tagging and 23% were recovered in the second year following the tagging. Each year a marked radiation from the tagging area was demonstrated. Most of the returns in the year of tagging were from areas north of the tagging area and from the Fraser River, while in the later years more returns were from the south in the Columbia River.

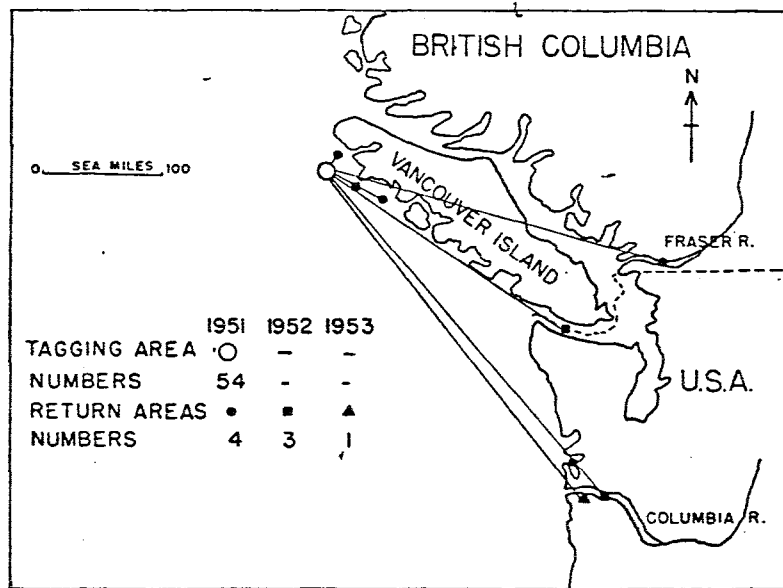


FIGURE 6. Distribution of recaptured spring salmon tagged off Quatsino Sound, Vancouver Island, in 1951.

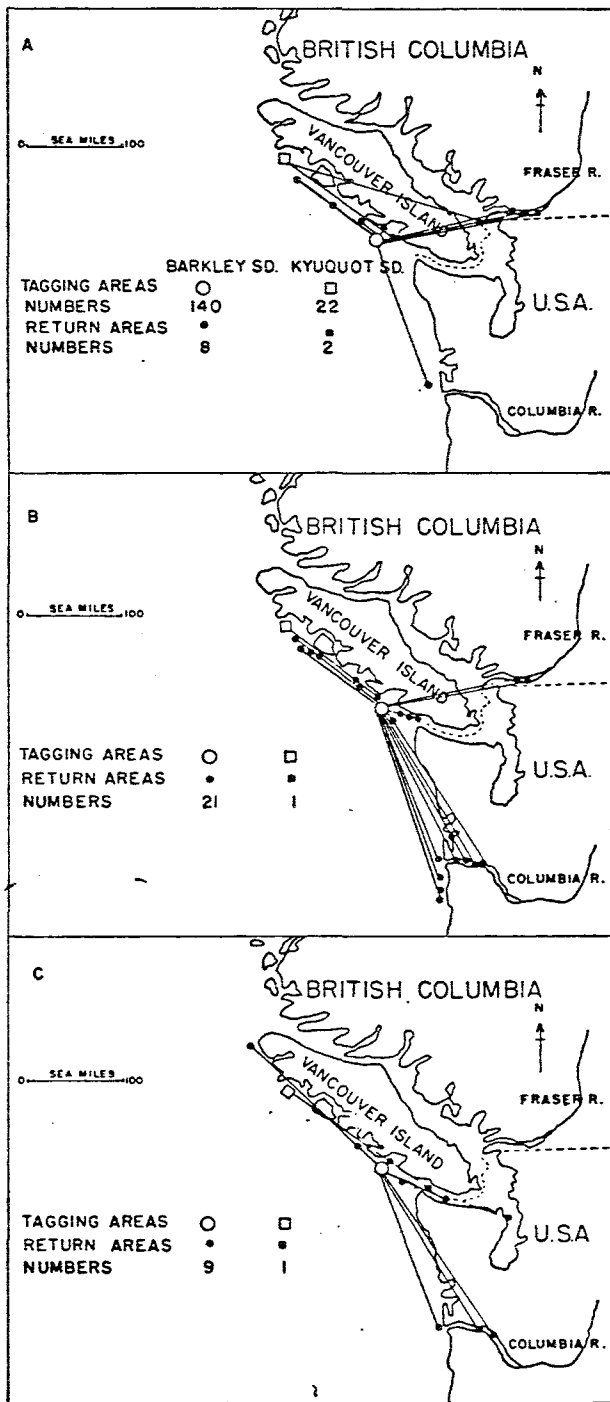


FIGURE 7. Distribution of recaptured spring salmon tagged off Kyuquot and Barkley Sounds, Vancouver Island, in 1950. A—Shows the returns in 1950; B—Shows the returns in 1951; C—Shows the returns in 1952.

In summary, nine (24% of the returns) were taken by trollers off the west coast of Vancouver Island north of the tagging area; nine (24%) were recaptured in the tagging area; seven (18%) had moved east through the Strait of Juan de Fuca towards the Fraser River and thirteen (34%) had moved south towards the Columbia River. The first two groups were mostly feeding fish caught by trollers while the latter two groups were all maturing fish taken by gill-netters. These facts indicate a feeding or nursery area of immature fish off Barkley Sound which is followed by a spawning migration to the south or east.

From the length and age of the tagged fish and from the lengths supplied by some of the fishermen when the fish were recaptured, the average ocean growth of the fish is as follows:

	Fork length		Dressed weight	Age
	cm.	in.	lb.	
When tagged or recovered in 1950.....	60	24	6	3
When recovered in 1951.....	80	31	14	4
When recovered in 1952.....	90	35	23	5

This is in close agreement with the growth rate calculated from scale measurements, and confirms the contention that the scale annuli represent true annual increments.

During July and August, 1952, a total of 125 spring salmon were tagged from the *Sooke traps*. These were a selected group of small fish, averaging about 9 lbs., much smaller than the average size of fish caught in the traps. The 28 recoveries were maturing fish from 2 to 4 years old and they were all recaptured later in the same season, mostly by the inside net fisheries (Fig. 8). In detail, sixteen (57%) were taken in the Fraser River area, usually about a week later; six were recaptured in parts of Puget Sound, and four were recaptured again in the traps. Only two moved to the west; one was taken off the Washington coast; the other in the Columbia River. The latter was tagged in a group of nine fish from the most westward trap, three of which were later recovered from the Fraser River; yet it was recovered 39 days later up the Columbia River at Bonneville hatchery.

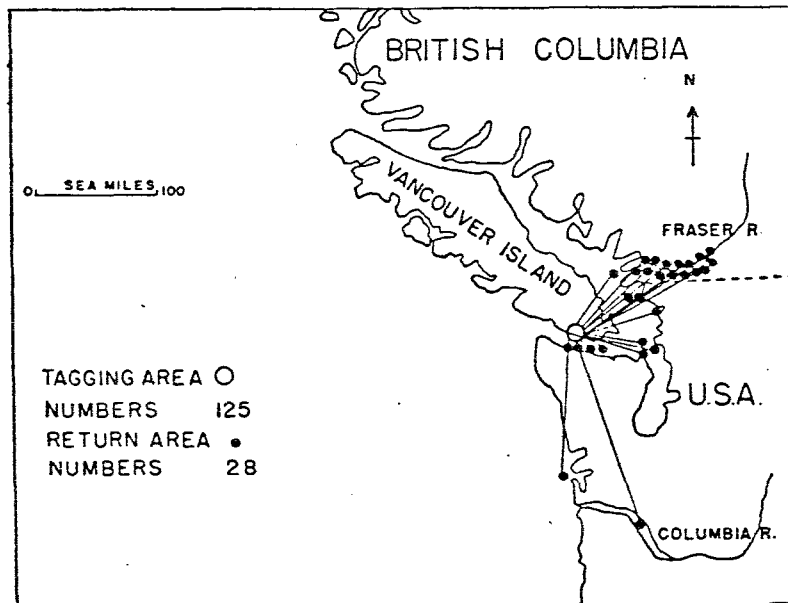


FIGURE 8. Distribution of recaptured spring salmon tagged at Sooke traps, Vancouver Island, in 1952.

COHO SALMON EXPERIMENTS IN 1950 AND 1951

A summary of the numbers tagged in the seven experiments in 1950 and 1951 together with the numbers and percentages of returns is given in Table II. The results of the two Canadian experiments conducted in 1949 are also included in the table. Complete data for the 1950-51 recoveries are given in Tables K to O in the Appendix.

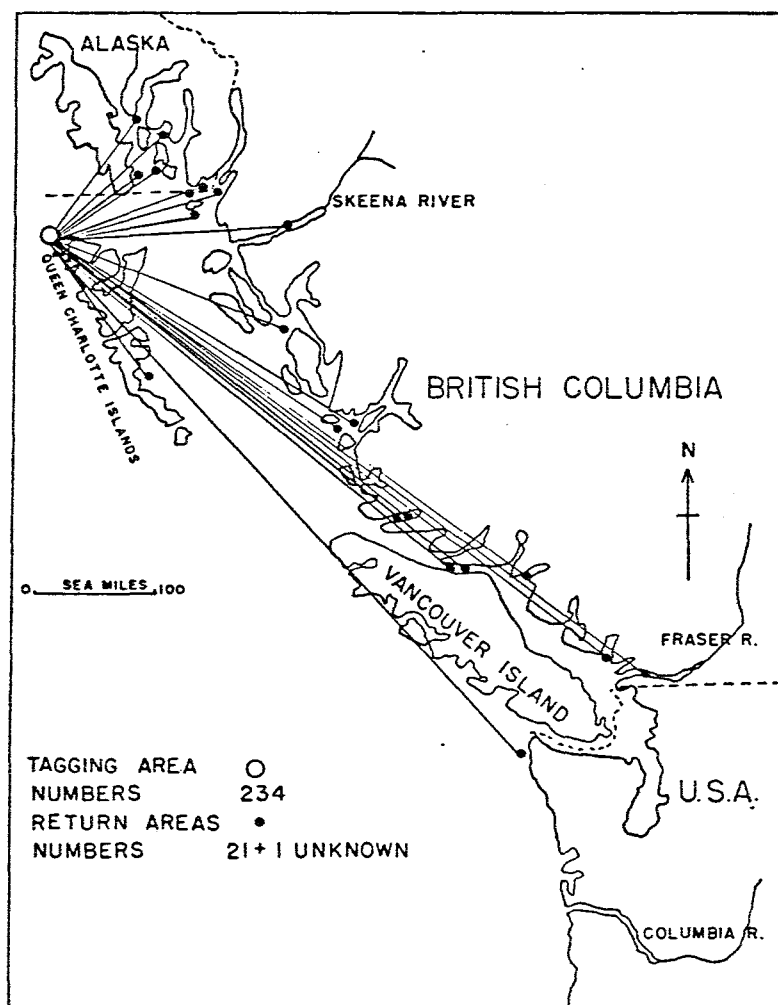


FIGURE 9A. Distribution of recaptured coho salmon tagged off the west coast of the Queen Charlotte Islands in 1951.

TABLE II.—Summary of coho salmon tagged in British Columbia waters in 1949 to 1951.

Tagging area	Year	Number tagged	Number returned	Percentage return	Geographical distribution of returns ^a		
					Canadian waters	U.S. waters exclusive of Alaska	Alaska
QUEEN CHARLOTTE ISLANDS				%	%	%	%
N. coast.....	1951	380	27	7.1	70	0	30
W. coast.....	1951	234	22	9.4	72	5	23
VANCOUVER ISLAND							
N.W. coast							
Cape Scott.....	1951	178	12	6.8	66	34	—
Quatsino Sd.....	1951	366	28	7.7	61	39	—
Quatsino Sd.....	1949	470	41	8.7	85	15	—
Kyuquot Sd.....	1950	110	5	4.5	80	20	—
S.W. coast							
Barkley Sd.....	1949	40	5	12.5	40	60	—
Barkley Sd.....	1950	262	41	15.6	57	43	—
S. coast							
Sooke traps.....	1951	150	32	21.3	56	44	—
Total.....	—	2,190	213	9.7	—	—	—

^a As percentage of the total tags returned.

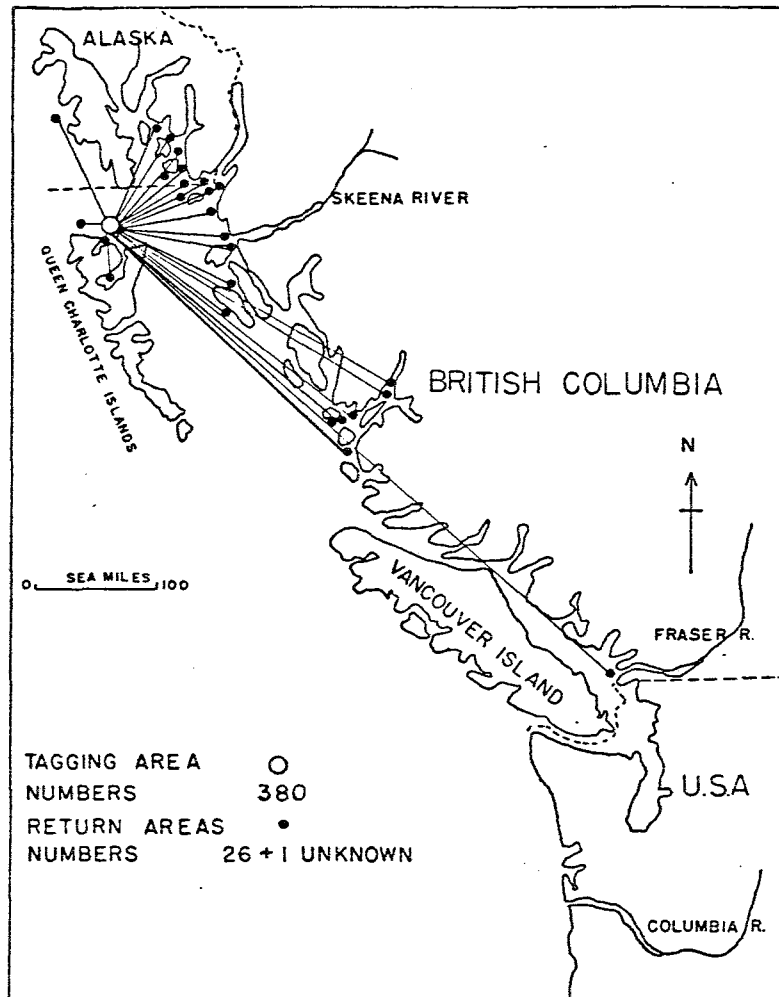


FIGURE 9B. Distribution of recaptured coho salmon tagged off the north coast of the Queen Charlotte Islands in 1951.

The international aspect of the migrations is apparent, particularly in the areas adjacent to Washington and Alaska. In the 1949-51 experiments the number of returns from outside British Columbia waters is greater than in the early experiments twenty years ago. For example, from experiments conducted during the two periods off the Queen Charlotte Islands the percentage of the returns from Alaska has increased from 19% to 27%; from experiments off the west coast of Vancouver Island, the returns from Washington have increased from 22% to 30%; and from Sooke trap tags, returns have increased from 27% to 44%. This is probably because the fishing effort by the United States fishermen, both commercial and sport, has increased more in recent years than the effort in waters off British Columbia.

QUEEN CHARLOTTE ISLANDS

In 1951, a total of 614 coho salmon were tagged off the northwestern end of Queen Charlotte Islands; 234 off the west coast and 380 off the north coast. All fish were maturing fish in their third year. The 27 (7.1%) recoveries for the west and the 22 (9.4%) recoveries for the north are shown in Figures 9A and 9B. From both locations the fish moved northeast and south towards many streams along the coast from Alaska to the Fraser River. Only 4 or 8% of the total returns were recaptured near the Queen Charlotte Islands. Thirteen or 27% of the total returns were recovered in southeastern Alaska.

The majority probably spawned in the coastal streams of central and northern British Columbia. Only one fish tagged on the west coast was recovered off the coast of Washington. The fish appear to have migrated to the east from these tagging areas, and then radiate in all directions along the coast of British Columbia.

The condition of the fish after tagging was recorded but no marked difference is apparent in the numbers recovered. The majority of the fish were released in good condition and the few released in poor condition gave a relatively high return.

Condition of fish:	Good	Fair	Poor	Not recorded
No. tagged.....	536	57	19	2
No. returned.....	43	4	2	—
Percent returned.....	8.1	7.0	10.5	—

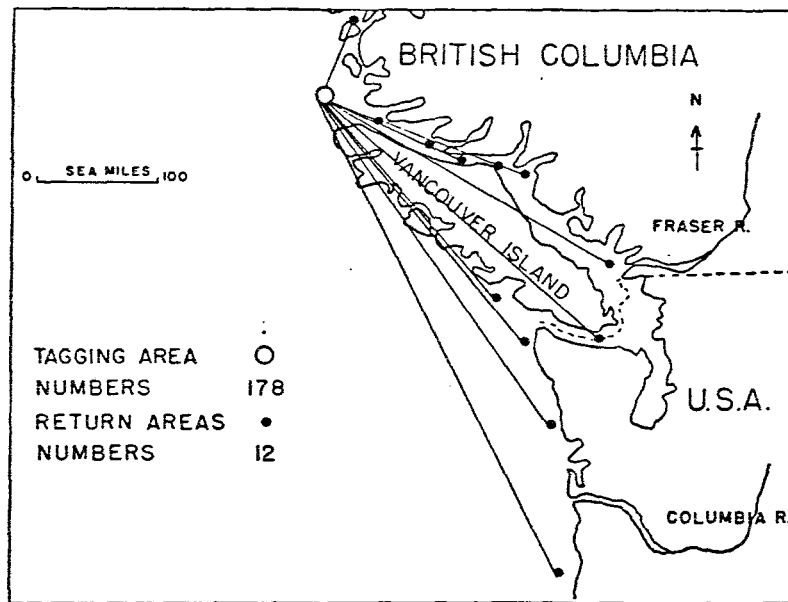


FIGURE 10A. Distribution of recaptured coho salmon tagged off Cape Scott, Vancouver Island, in 1951.

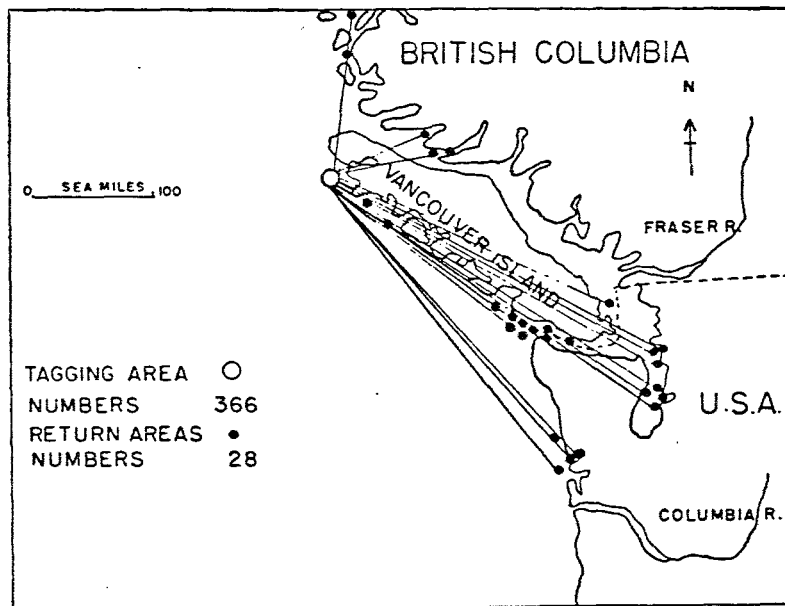


FIGURE 10B. Distribution of recaptured coho salmon tagged off Quatsino Sound, Vancouver Island, in 1951.

WEST COAST OF VANCOUVER ISLAND

NORTHERN PART.—In 1951 the operations were similar to those conducted off the Queen Charlotte Islands; that is, fish were tagged in two locations near the northern tip of Vancouver Island. At Cape Scott, 178 fish were tagged and off Quatsino Sound 366 fish were tagged. The 40 recoveries are shown in Figures 10A and 10B. The results of this experiment in relation to the heavy catch made in this area in 1951 have been reported by Milne (1952). For those tagged off the northwestern tip of the island, 8 or 67% of the returns showed an eastward movement (Fig. 10A). For those tagged off the west coast, only 5 or 18% went around the north end of the island; the remainder migrated down the west coast of Vancouver Island (Fig. 10B). Thus the fish appear to segregate in this region and travel around both ends of the island.

Estimates based on the time of tag returns, showed that the fish moved at an average rate of 5 miles per day and took about a month to migrate the length of Vancouver Island. At the entrance to the Strait of Juan de Fuca the fish appear to segregate with some going along the Washington coast as far south as Oregon while others migrate eastward into Puget Sound. Almost one-half of the returns were recovered in United States waters which is much higher than in 1949 (11% of the returns).

In 1950 off *Kyuquot Sound* 110 fish of small size, less than 8 lbs. in weight, were tagged and a low return of 5 fish was obtained. The majority probably migrated southeast along the west coast of Vancouver Island, but some fish below Cape Cook apparently migrated around the north end of the island (Fig. 11).

SOUTHERN PART.—The 1950 tagging off *Barkley Sound* was also of small fish under 8 lbs. in weight, varying in length from 42 to 70 cm. (17 to 27 in.). The recovery from the 262 fish tagged was the highest (15.6%) of the experiments using troll-caught fish. It was higher than the 12.5% returned from the smaller Canadian experiment conducted in this area in 1949 but much lower than the 31% returned from the small 1949 experiment conducted by the State of Washington (P.M.F.C., 1951). The 41 recoveries are shown in Figure 12. The fish radiated in all directions and demonstrated that coho salmon from this area migrate around both ends of Vancouver Island. Similarly to spring salmon, this region appears to provide a common feeding ground for many different populations. One-quarter of the recoveries were from Puget Sound and a total of over 40% were from United States waters. Since all fish were maturing, over $\frac{2}{3}$ were recaptured by the net fisheries as they migrated towards their spawning streams.

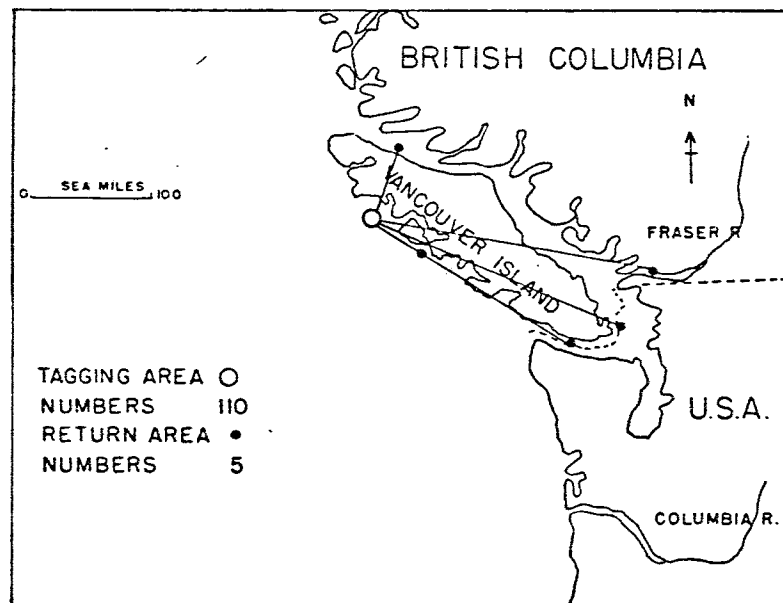


FIGURE 11. Distribution of recaptured coho salmon tagged off *Kyuquot Sound*, Vancouver Island, in 1950.

In 1951, during September, 150 fish varying in length from 39 to 78 cm. (15 to 31 in.) were tagged at the southern end of Vancouver Island at *Sooke traps*. The recovery of 32 or 21.8% is high. This is probably because the fish caught in the traps are in better condition than those caught by troll gear. Six fish were recaptured in the series of five traps at Sooke (Fig. 13). Only two had travelled westward, the remainder going to Puget Sound and the Fraser River. Almost half were recovered in United States waters.

In summary, the coho salmon move in many directions off the west coast of Vancouver Island and travel around both ends of the island. This is in contrast to the marked southeast migration of spring salmon.

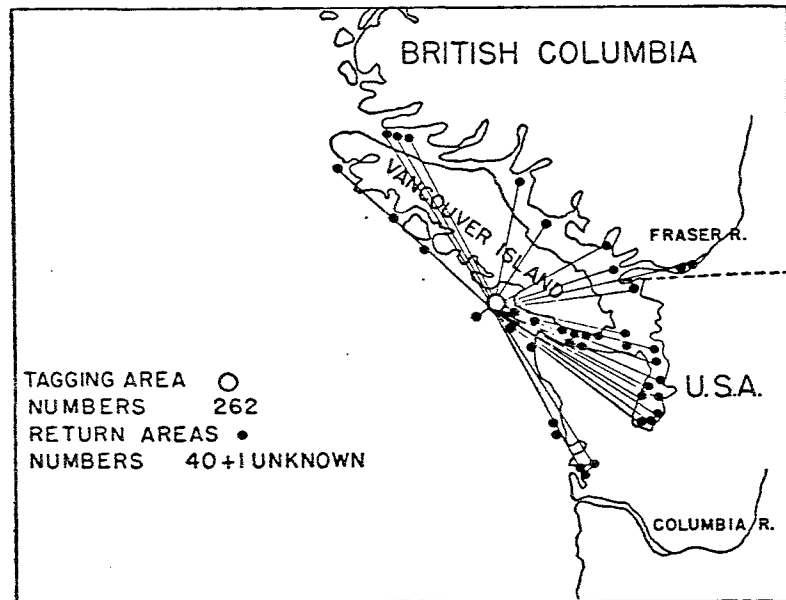


FIGURE 12. Distribution of recaptured coho salmon tagged off Barkley Sound, Vancouver Island, in 1950.

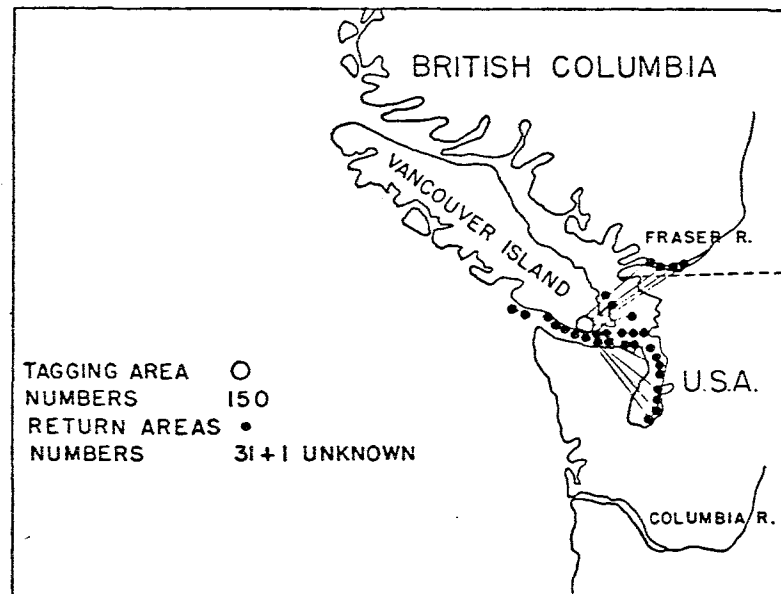


FIGURE 13. Distribution of recaptured coho salmon tagged at Sooke traps, Vancouver Island, in 1951.

COMPARISON OF THE EARLY AND RECENT TAGGING EXPERIMENTS

SPRING SALMON

The total numbers of spring salmon tagged in outside waters during the two periods, 1925 to 1927 and 1949 to 1951, are given in Table III along with the distribution of the recoveries from the main regions of the coast.

In the Canadian experiments conducted off the *west coast of Vancouver Island* the percentage return of 12.9 for the early period is the same as that for the recent period despite the fact that different types of tags were used and that changes in the trolling effort have occurred. However, the distribution of the recoveries differs between the two periods. In the recent experiments only 16% of the recaptures were from the Columbia River and 29% were from United States waters, compared to 60% and 82% respectively in the earlier experiments. The recent recoveries from the Fraser River amounted to 12% of the recaptures, compared to 5% twenty years earlier; and the total recovered in British Columbia waters was 71% of all recaptures, compared to only 16% in the early experiments. These differences indicate a decrease in the size and importance of the Columbia River stock, a greater intensity of trolling near the tagging areas, and an increase in the catch of British Columbia stocks such as that of the Fraser River.

In the Washington State experiments conducted in this region in 1948 and 1949 the percentage return of 17.2 is higher than that in the Canadian experiments (12.9%). Moreover the percentages returned from the Columbia River (10%) and in United States waters (19%) are lower than the returns of 16% and 29% in the 1949 to 1951 Canadian experiments. The 81% recovered in Canadian waters, mostly near tagging areas, is higher than that in the 1949-51 Canadian experiments (71%). Although the 10% that were returned from the Fraser River is lower than the 12% recovered in the 1949 and 1951 Canadian experiments, it is the same percentage as was returned from the Columbia River. Consequently the Washington State experiments tend to confirm more strongly the conclusions drawn from the Canadian experiments.

In evaluating the previously mentioned changes in the fishery, it should be stressed that more small immature fish are now caught, and were tagged in the years 1949 to 1951, than in the earlier period. For example, the weights of the fish tagged off Barkley Sound differ between the two periods as follows:

TABLE III.—Comparison of recoveries from tagging experiments on spring salmon for the periods 1925-30 and 1948-51.

Recovery areas	West coast of Vancouver Island						Queen Charlotte Islands				S.E. Alaska ^b (outside areas)	
	1925-27		1949-51		1948-49 ^a		1929-30		1951		1950-51	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
California coast.....	2	(.5)	1	(.7)	..	..	..	..	..	..	..	..
Oregon coast.....	4	(1)	4	(3)	..	..	37	(14)	..	..	5	(5)
Columbia River.....	235	(60)	21	(16)	7	(10)	69	(26)	..	..	31	(29)
Washington coast.....	26	(7)	12	(9)	4	(6)	12	(5)	2	(29)	10	(10)
Puget Sound.....	55	(14)	1	(.7)	2	(3)	35	(13)	1	(14)	..	..
U.S. (except Alaska).....	322	(82)	39	(29)	13	(19)	153	(58)	3	(43)	46	(44)
Alaska.....	..	..	..	..	..	..	4	(2)	..	..	15	(14)
Fraser River.....	19	(5)	16	(12)	7	(10)	50	(19)	1	(14)	13	(12)
B.C. coast.....	46	(11)	78	(59)	49	(71)	52	(20)	3	(43)	31	(30)
British Columbia total.....	65	(16)	94	(71)	56	(81)	102	(39)	4	(57)	44	(42)
Miscellaneous.....	7	(2)	..	..	..	..	3	(1)	..	..	..	..
Total recoveries.....	394	(100)	133	(100)	69	(100)	262	(100)	7	(100)	105	(100)
Total number tagged.....	3049	..	1033	..	403	..	1935	..	64	..	710	..
Percentage recovery.....	12.9	..	12.9	..	17.2	..	13.5	..	11.0	..	14.8	..

^a Compiled from Pacific Marine Fisheries Commission Bulletin No. 2, 1951.

^b Compiled from Alaska Department of Fisheries Annual Reports No. 2 and 3, 1950-51.

		Weight in pounds					
		1-9	10-19	20-29	30-39	40-49	50-59
1925	No. tagged.....	330	498	206	72	11	8
1926	No. tagged.....	337	433	378	158	41	6
1949	No. tagged.....	670	98	4			
	No. returned.....	57	12				
	% returned.....	8.8	12.3				
1950	No. tagged.....	140					
	No. returned.....	38					
	% returned.....	27.0					

In the 1949 experiment the percentage that was returned from tagging small fish was lower than that from tagging larger fish. Based on the length measurements shown in Table A (Appendix) 21 fish or 6.1% were returned from the 344 fish that were smaller than 62.5 cm. whereas 50 fish or 11.7% were returned from the 428 fish that were tagged at a larger size. The difference in return probably results from both a higher mortality involved in catching and tagging small fish and the higher natural mortality that would occur during the longer period that the small fish remain in the ocean.

In the 1950 experiment all the fish were small but the relatively high return suggests that an intensive fishery must have exploited these immature fish throughout much of their ocean life. Unfortunately the sizes or ages of the recaptured fish are not available for the 1925 and 1926 experiments as recorded by Williamson and Clemens (1932). However a comparison can be made of the ages of the spring salmon tagged in 1926, whose ages are given by Mottley (1929); those tagged in 1949, reported by Neave (1951), and those tagged in 1950, given in Table C (Appendix):

Year	Year of life				
	Second	Third	Fourth	Fifth	Sixth
1926.....	3%	28%	50%	18%	1%
1949.....	3%	84%	13%	—	—
1950.....	17%	78%	5%	—	—

Obviously there was a great difference in the age of the fish being caught and tagged in the two periods.

The difference in size and age of fish tagged probably accounts for the return of only 12.9% (Table III) in recent years when smaller and younger fish were tagged and a higher fishing intensity operated, compared to the same return from tagging larger and older fish when the fishing intensity was much lower during the early years of the outside fishery.

The tagging of smaller and younger fish has also resulted in relatively more fish being recaptured in the years following the tagging year and in the vicinity of the tagging area, if it is a feeding area. An increase in fishing effort in the tagging area would also increase the number taken near the point of release and reduce the number that could be taken elsewhere at a later time. For the Barkley Sound experiments, the distribution of the returns in percentages is as follows:

Year		Year after tagging			
		1st	2nd	3rd	4th
1925	Total return.....	61	35	3	1
	Return off Vancouver Island.....	1	6	—	—
1926	Total return.....	77	18	4	1
	Return off Vancouver Island.....	3	1	—	—
1949	Total return.....	41	52	7	—
	Return off Vancouver Island.....	24	34	1	—
1950	Total return.....	21	55	24	—
	Return off Vancouver Island.....	11	26	11	—

Because of the difference in recapture near the tagging area, the returns in Table III of 16% from the Columbia River and 12% from the Fraser River are relatively low in comparison with the percentage of 60 and 5 obtained in the early experiments. Furthermore, the tagging of more immature fish implies that a higher ocean mortality is involved. This would result in a lower return from the rivers in comparison with the ocean returns, since some fish would be recaptured before all the mortality had occurred. For these reasons, the present contribution from the Columbia River is higher than that indicated by the tagging results, probably about 30%, and the contribution from the Fraser River is probably about 20%. If this is true, then in the period between the two experiments the contribution of fish from the Columbia River to the troll fishery off the west coast of Vancouver Island has decreased by about half while that from the Fraser River has increased by about 4 times.

In the experiments conducted off the *northwest coast of the Queen Charlotte Islands* the return of 11.0% in 1951 (Table III) is lower than the return of 13.5% in the earlier period. This may also be related to the difference in size and age of the fish tagged or to changes in the season and intensity of the fisheries. The percentage of the returns that were found in United States waters decreased from 58 to 43 between the two periods and no recoveries were made in the Columbia River itself in the recent experiment in contrast to a return of 26% of the recoveries in the early period. The percentage of the total returns that were found in British Columbia waters increased from 39 to 57 in the two periods although the portion recovered from the Fraser River decreased from 19% to 14%. Because the number of fish tagged in 1951 is so small it is of interest to note the results of some larger experiments conducted off southeastern Alaska by the Alaska Department of Fisheries in 1950 and 1951. Larger fish were tagged in these experiments and a larger recovery of 14.8% was obtained. The percentages of the total returns that were made in United States waters (44) and in the Fraser River (12) are similar to those from the 1951 tagging off the Queen Charlotte Islands. When the recoveries in Alaskan waters (14%) are added to those recovered in British Columbia waters (42%) the total is similar to the 57% recovered in British Columbia waters in the recent tagging off the Queen Charlotte Islands. Apparently few of these large mature fish were recap-

tured near the tagging area with the majority being recaptured while migrating along the coast to the southeast. Since 29% were recovered in the Columbia River, this stock is probably still an important contributor to the outside troll fishery operating off northern British Columbia even though the small experiment in 1951 off the Queen Charlotte Islands did not disclose it.

Parker and Kirkness (1951) in summing up all of the southeastern Alaska experiments conducted in outside waters from 1950 to 1952 concluded that the Columbia River was probably the largest single source of salmon and that the Fraser River was the second largest. In the area north of Cape Spencer 37% of the returns were from the Columbia River and 5% were from the Fraser River, while in the area south to the Alaskan boundary 24% were from the Columbia River and 16% were from the Fraser River. Also the majority of the returns from the Columbia River belonged to the fall run, especially the races that spawn above Bonneville dam.

The spring or chinook salmon of the Columbia River are commonly classified into three groups, called spring, summer and fall runs, depending on the times when the fish migrate up the river. Since 1949 the large fall chinook stock has declined sharply to record lows in both 1954 and 1955. Because of this recent decline, it is important to know which segment of the stock is fished by the trollers off the British Columbia coast. The peak of the fishing off the Queen Charlotte Islands occurs in June and that off the west coast of Vancouver Island takes place in July. If another month is allowed for the fish to reach the Columbia River then it would appear that most of the maturing fish caught off British Columbia probably belong to the fall chinook stock. However, in recent years many immature fish have also been caught, particularly off the southwestern part of Vancouver Island. The times, when the tagged fish were

recovered in the Columbia River, should indicate the group to which these small fish belong. The numbers of tags recovered in the Columbia River during the three spawning migration periods are as follows:

	Spring run April-May		Summer run June-July		Fall run Aug.-Oct.		Total
	No.	%	No.	%	No.	%	No.
1925-30—							
Queen Charlotte Islands.....	3	6	10	22	33	72	46
West coast of Vancouver Island..	7	3	52	24	157	73	216
1949-51—							
West coast of Vancouver Island...	2	10	—	—	17	90	19

Both in the past and at present, it appears that the British Columbia trollers have exploited the fall chinook run to the Columbia River more heavily than the early runs, although in the past when the troll-fishing season was earlier than at present and the Columbia River gillnet fishery was less restricted during the summer period, many summer chinook salmon were also tagged and recaptured. Few spring chinook salmon were caught at any time. Thus since 1925 the fall chinook run has provided the majority of the Columbia River fish that are caught by the trollers off British Columbia and the recent decline in this stock is no doubt affecting the outside catch at the seasonal peak of the fishing.

In conclusion, the theory of a northwestward feeding migration of young fish coupled with a southeastward spawning migration of adults has now been firmly established for spring salmon caught in the waters along the continental shelf off British Columbia. Fish from the larger rivers predominate in the catches made in a northwesterly direction from their mouths. Because of these long migrations, the intermixing of spring salmon stocks along the Pacific coast gives rise to regulations and problems which are international in scope and which require mutual co-operation between Canada and United States for their solution.

TABLE IV.—Comparison of recoveries from tagging experiments on coho salmon for the periods 1925-40 and 1948-51.

Recovery areas	West coast of Vancouver Island						Queen Charlotte Islands				S.E. Alaska ^b (outside areas)		Sooke traps Vancouver Island			
	1925-27		1949-51		1948-49*		1929-30		1951		1950-51		1928-29		1951	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Oregon coast.....	..	..	1	(1)	..	..	..	..	..	..	..	..	..	..	..	..
Washington coast.....	3	(13)	14	(10)	4	(13)	..	..	1	(2)	..	..	1	(3)	..	..
Puget Sound.....	2	(9)	25	(19)	2	(27)	1	(1)	..	..	..	..	8	(24)	14	(44)
U.S. (except Alaska).....	5	(22)	40	(30)	6	(40)	1	(1)	1	(2)	..	..	9	(27)	14	(44)
Alaska.....	..	..	..	..	..	..	22	(19)	13	(27)	61	(80)	..	..	..	..
British Columbia total.....	18	(78)	86	(65)	9	(60)	93	(80)	33	(67)	15	(20)	24	(73)	18	(56)
Miscellaneous.....	..	..	6	(5)	..	..	..	..	2	(4)	..	..	..	..	..	..
Total recoveries.....	23	(100)	132	(100)	15	(100)	116	(100)	49	(100)	76	(100)	33	(100)	32	(100)
Number tagged—total.....	376	..	1426	..	59	..	1828	..	614	..	848	..	157	..	150	..
Percentage recovery.....	6.1	..	9.2	..	25.4	..	6.3	..	8.0	..	9.0	..	21.0	..	21.8	..

* Compiled from Pacific Marine Fisheries Commission, Bulletin No. 2, 1951.

^b Compiled from Alaska Department of Fisheries Annual Reports No. 2 and 3, 1950-51.

COHO SALMON

The total numbers of coho salmon tagged and the recoveries from the main regions along the coast are summarized in Table IV for the two periods 1925 to 1930 and 1949 to 1951. The number of recoveries in the recent period is higher than that in the earlier period. In the Canadian experiments off the west coast of Vancouver Island the percentages have increased from 6.1 to 9.2 in the two periods and off the northwest coast of the Queen Charlotte Islands from 6.3 to 8.0. Since most of the coho salmon in the two periods were caught in their third year as maturing fish of the same size, the difference in percentage return is probably an indication of the heavier exploitation in recent years. Judging from the changes in the distribution of the recoveries in the two periods it would appear that much of the increase in exploitation occurred in United States waters. From taggings off the west coast of Vancouver Island, recoveries from Puget Sound increased from 9% to 19% between the two periods. Smaller experiments conducted in 1948 and 1949 in this region by the Washington State Department of Fisheries further confirm that in recent years the rate of recovery is higher than formerly, and that more tagged fish are recovered in United States waters, particularly in Puget Sound. The returns from fish tagged at Sooke traps suggest the same conclusion, since 44% of the recent returns were from Puget Sound, compared to only 24% in the early period. Similarly for the Queen Charlotte Islands experiments, the returns from southeastern Alaska were 27% of the total returning in 1951 compared to 19% in the 1929 to 1930 period. The tagging in the outside waters off southeastern Alaska in 1950 and 1951 showed a marked radiation from the tagging area with 20% recovered in northern British Columbia waters.

As compared with spring salmon, the coho salmon migrated shorter distances in all directions from the point of tagging towards the numerous small streams along the coast. They travel more slowly and appear to wander more during both their feeding and spawning migrations. The result is that the ocean distribution of coho salmon from any one river is more restricted along the coast and probably extends farther offshore than that of spring salmon. Nevertheless, fish recovered in the Fraser River have been tagged as far south as Oregon and as far north as Alaska. The great overlapping and mixing of many small stocks makes regulation difficult but the fish caught by the trollers of British Columbia are primarily a local management problem, except for the area adjacent to either Alaska or Washington state.

SUMMARY

By tagging fish caught by commercial trollers off the coast of British Columbia the ocean movements of adult spring and coho salmon have been demonstrated and in some cases the final destinations determined. The results from tagging 1,222 spring salmon and 2,190 coho salmon during the period from 1949 to 1952 are presented in detail. Similar experiments involving 6,457 spring salmon and 7,127 coho salmon which were conducted from 1925 to 1930 are reviewed and the results compared with those from the recent tagging operations.

For spring salmon caught in the outside waters of British Columbia the majority are on long spawning migrations, travelling in a southeasterly direction along the continental shelf towards the larger rivers, such as the Columbia and Fraser. Off the southwestern part of Vancouver Island many small immature fish are also captured while they are foraging in the ocean a year or two prior to the spawning migration.

In the case of coho salmon, all the fish are on shorter spawning migrations, travelling in many directions from offshore waters towards numerous small coastal streams as well as larger rivers.

A comparison between the results of the experiments conducted off the west coast of Vancouver Island about twenty years apart disclosed the following changes. For spring salmon the percentages recovered were the same despite an increase in the fishing intensity in recent years. This may be accounted for by the lower returns that result from tagging the smaller and younger fish which are being caught more heavily in recent years. Also more fish were recovered in recent years in waters off British Columbia and in the Fraser River than formerly while fewer fish were recovered in United States waters and in the Columbia River. This implies that the stocks of the Columbia River have decreased in size and importance while the stocks from British Columbia rivers are being harvested more heavily now than in former years. For coho salmon the percentage recovered was higher in the recent period than in the early one probably because of the increase in fishing intensity, particularly in United States waters.

Since the outside troll fishery operates on a mixture of stocks from many rivers and streams along the Pacific coast, local regulations are often inadequate and conservation measures should be co-ordinated throughout the whole stream and ocean range of each stock. For spring salmon taken along the Pacific coast from California to southeastern Alaska and for coho salmon taken in areas adjacent to Alaska and Washington state, these problems become international in scope.

The following information was extracted from reference no. 61 (Milne, 1964). The full implications of the data represented in tag-recovery programs can only be gained by reading the paper.

ABSTRACT

Chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) in coastal waters of British Columbia are fished mainly by trollers, but also by purse seine and gill net. Ocean sport fishing for these two species has also reached considerable importance. Concern over the present status of chinook and coho stocks has prompted this study of recent trends in the fisheries up to 1960. Fishing has become highly automated and competitive. Tagging experiments have indicated that the troll fisheries exploit a mixture of chinook salmon from the Fraser River, of late-returning ("fall") fish chiefly from the Columbia River, and of stocks from small coastal rivers in the Province. Coho salmon on the fishing grounds come from numerous small coastal streams from Alaska to California. After World War II troll fishing for chinook and coho increased along the entire Pacific coast. Commercial troll catches of chinook salmon rose to the highest levels in history, except in Alaska. Since 1953 both the Alaskan and Washington State catches declined, as did also the Oregon and California catches after 1956. This is doubtless related to recent declines in the fall runs of chinook to the Columbia River since 1950, and to declines in the Sacramento River stocks since 1957. The British Columbia troll catch of chinooks dropped in 1954 and 1955, as it did in Alaska and Washington, but since then it has remained at a high level. Possibly Fraser River stocks are now being exploited more heavily than in the past. The gill-net fishing effort on chinook salmon has greatly decreased in the Columbia and Sacramento Rivers, and is being severely restricted in the Fraser River. The sport fisheries along the entire coast are expanding. Troll catches of coho salmon all along the Pacific coast increased markedly after the war up to 1951. They have since declined, particularly in Southeast Alaska. Since 1951 the British Columbia troll catch of coho salmon has been the largest along the coast. Fishing for coho salmon is presently at a very high level of intensity. Fortunately, many stocks receive a measure of protection by way of regulations in effect to conserve the more abundant sockeye, pink and chum salmon.

SPAWNING STREAMS AND ESCAPEMENTS

The following general description of the spawning streams and escapements of chinook and coho salmon in British Columbia was derived from a detailed examination of Fishery Officers' spawning reports (Form B.C. 16) for the years 1945-1954.

There are over 1500 streams in which salmon spawn in British Columbia, and more than 200 linear miles of spawning area. Spawning observations of chinook and coho salmon are conducted less intensively than for the other species, mainly because of the physical difficulties involved. For example, chinook salmon spawn in main rivers and their larger tributaries where usually, because of the depth and colour of the water, they are difficult to observe. Coho salmon spawn mainly late in the year, during inclement weather, and in numerous small coastal streams and the smaller tributaries of larger rivers. The spawning estimates must therefore be considered approximations only of the sizes of the runs to the various streams.

Of the 150 or more chinook salmon rivers in British Columbia, about one-half have over 1000 spawners and contribute more than 90% of the total annual escapement of about 500,000. Fifteen of these rivers, or 10%, contribute about three-quarters of the total spawning escapement of chinook salmon.

The Fraser River is the major chinook salmon producer in British Columbia. Above Hope it has about a dozen important streams which contribute about 25,000. The total number of spawning chinook salmon on the Fraser is about 100,000 fish, or 20% of the total chinook salmon escapement in British Columbia. About two-thirds of the Fraser River chinooks spawn in the upper reaches of the system where power dams have been contemplated. The important Fraser tributaries where chinook salmon spawn include the Harrison, Upper Fraser, Thompson and Shushwap Rivers.

The Squamish River in District 1 is also one of the most important chinook salmon producers in the Province, and on occasions it has accounted for possibly more than one-quarter of the total escapement. In the north the Skeena River is of major importance, its principal chinook salmon tributaries being the Bear, Morice, Babine and Kispiox Rivers. These, together with the Bella Coola and other chinook salmon rivers in District 2, account for a little less than a quarter of the total annual escapement. The remainder of the total escapement occurs in many rivers of District 3, including the Cowichan, Nimpkish, Somass, Puntledge and Campbell Rivers on Vancouver Island, and the Homathko and the Kleena Kleene Rivers on the lower mainland.

The following information was extracted from reference no. 17 (Anon., 1965);

"A Progress Summary of the Strait of Georgia Chinook and Coho Investigation

"During the fall of 1962 the Department of Fisheries of Canada initiated a biological investigation of the chinook and coho salmon stocks of the Strait of Georgia-Juan de Fuca region. This investigation has included to date three tagging programs and an intensive analysis of the statistical catch data available for the region. The basic objective in initiating the present investigation was one of acquiring the type of knowledge on which a sound management program could be developed to ensure optimum utilization of the stocks in view of the prospect of increasing future demands by both the sport and commercial fishing interests. The present study, therefore, represents the first stage in the development of a more active management program; a program which will require the continuing re-assessment of all factors associated with managing these stocks in the face of changing requirements. The management activities in the Strait of Georgia are, and will continue to be, closely integrated with the overall Departmental program and future studies which are being developed for areas adjacent to the Strait of Georgia will also provide knowledge applicable to this region.

"As a result of the studies conducted to date, considerable additional knowledge has been gained on the movements and exploitation of these species within the region. With regard to exploitation, the studies have revealed that a trend is developing in both the commercial troll and sport fisheries to the harvest of immature chinook and coho salmon and certain regulatory proposals have been developed to correct this situation.

"The following presentation has been prepared to describe the progress to date of the coho and chinook salmon investigation as well as to describe the basis for the proposed regulation changes mentioned above.

"Results of the Tagging Studies

"1. Chinook Salmon

"A total of 344 immature chinook salmon were tagged in the Strait of Georgia area during May and June of 1963, and

69 of these tags have been returned to date. Sixty-four tags were recovered in the Strait of Georgia, one was recovered in Loughborough Inlet, three were recovered from spawning streams in Puget Sound and one was returned from an unknown location. During May and June of 1964 an additional 551 chinook salmon were tagged in the Strait of Georgia area and 78 of these tags have been returned to date. A total of 73 tags was recovered in the Strait of Georgia, four were recovered in Juan de Fuca Strait and one in Johnstone Strait.

"Although returns from the chinook salmon tagging are not yet complete the results have corroborated reports of previous tagging that chinook salmon demonstrate a high degree of residency by the time they reach the commercial minimum legal size."

The following information was extracted from reference no. 4 (Alaska Department of Fish and Game, 1968):

"Summary Southeastern Alaska Inside King Salmon Tagging Program

"The Alaska inside troll king salmon tagging program was conducted during the years 1950 through 1955. The study is separated into three separate phases, depending on the area and time of tagging. These are as follows:

- (1) Southern District - Clarence Strait, Behm Canal, Bradfield Canal and Ketchikan - 9/27 to 6/28, 1950, '51, '53 and '54 - chiefly conducted on immature fish;
- (2) Northern District - Stephens Passage, Funter Bay, Taku Inlet - May and June 1950, 1951, 1952, 1953 and 1955 - conducted on mature Taku River fish as well as on immatures;
- and (3) Northern District - Stephens Passage, Chatham Strait and Inner Icy Strait - 6/25 to 11/5, 1950, 1951, 1952 and 1953 - largely conducted on immatures.

"The results given below are listed by these separate programs. Lengths and ages are only given for fish tagged and then recovered.

"All fish tagged late in the fall in the Southern District that were recovered the following year are classified as 'year of tagging'. All fish tagged after July 31 and recovered the next year in the Northern District were also considered as 'year of tagging'. Justification for the above arbitrary grouping is the small size of the fish late in the year (chiefly under 26" when tagged) and the limited fishing effort after September.

"Fish ages are given as number of marine annuli, e.g., 0.1, 0.2, 0.3, etc.

"I. Southern District

No. fish tagged = 732 - Behm Canal (318), Bradfield Canal (59), Ketchikan (91) and Clarence Strait (264).

No. fish recovered = 99 (one for second time) - Alaska (84)
- British Columbia (15).

% Recovery = 13.5%.

The British Columbia recaptures were located in:

- (1) Hecate Straits (5)
- (2) Naden Harbour
- (3) Whole Channel
- (4) Knight Inlet
- (5) Squamish River
- (6) Dala River
- (7) Tahsis River
- (8) Rivers Inlet (2)
- (9) Bute Inlet (10) and Gardner Bay.

The Alaska recaptures (84) included some fish collected in the Taku River system.

"II. Northern District (May-June, Taku River, etc.)

No. fish tagged = 1,258

No. fish recovered = 212 (one for second time)

- Alaska (103)

- British Columbia (9)

Recovery = 17%."

The British Columbia recaptures were located in:

- (1) Rivers Inlet
- (2) Crowler Cove
- (3) Skeena
- (4) Knight Inlet (3)
- (5) Bute Inlet (3)

The Alaska recaptures (103) included some fish collected in the Taku and Stikine River systems.

"III. Northern District (6/25 to 11/6)

No. fish tagged = 1,052

No. fish recovered = 109 - Alaska (101), British Columbia
(7), Columbia River (1)

% Recovery = 10.4%."

The British Columbia recaptures were located in:

- (1) Rose Spit
- (2) Cape Cook
- (3) Johnstone Strait
- (4) Knight Inlet (2)
- (5) Bute Inlet
- (6) Smith Inlet.

The Alaska recaptures (101) included some fish collected in the Taku and Stikine River systems.

"In general, all of the larger mainland rivers have small runs of kings, but only three streams (Taku, Stikine and Alsek) have large enough runs to support gill net fisheries. The escapement as well as the number of king rivers is unknown except for some counts on a few of the rivers."

The following information was extracted from reference no. 54 (Informal Committee on Chinook and Coho, 1969, Vol. I., United States Section):

In 1963, Canada and the United States formed an Informal Committee on Chinook and Coho. The terms of reference published at the Committee's inaugural meeting of November 20, 1963 were:

- (a) an informal committee composed of two representatives from each country be established;
- (b) the immediate purpose be to arrange for reviews of available information on migration and exploitation of chinook and coho salmon along the Pacific Coast of North America pertaining to mutual management problems. These reviews would provide the basis for possible future research programs;
- (c) specifically the reviews should summarize information on the migratory movements of chinook and coho salmon to determine where and when fish bound for United States streams intermingle with those bound for Canadian streams and to determine the extent of such intermingling in areas where fishing occurs;
- (d) each country prepare its own review for submission to the committee, and to include recommendations for research.

To accomplish the terms of reference outlined above, it was agreed that there should be a full exchange of pertinent information on the following:

- (a) results of tagging and marking experiments;
- (b) catch statistics;
- (c) related fishing regulations;
- (d) distribution and abundance of spawners; and
- (e) other background information as required.

It was also agreed that a technical working group composed of two members from each country be appointed.

Between 1963 and 1969 each country prepared its own review aimed at meeting the requirements of the Committee's terms of reference.

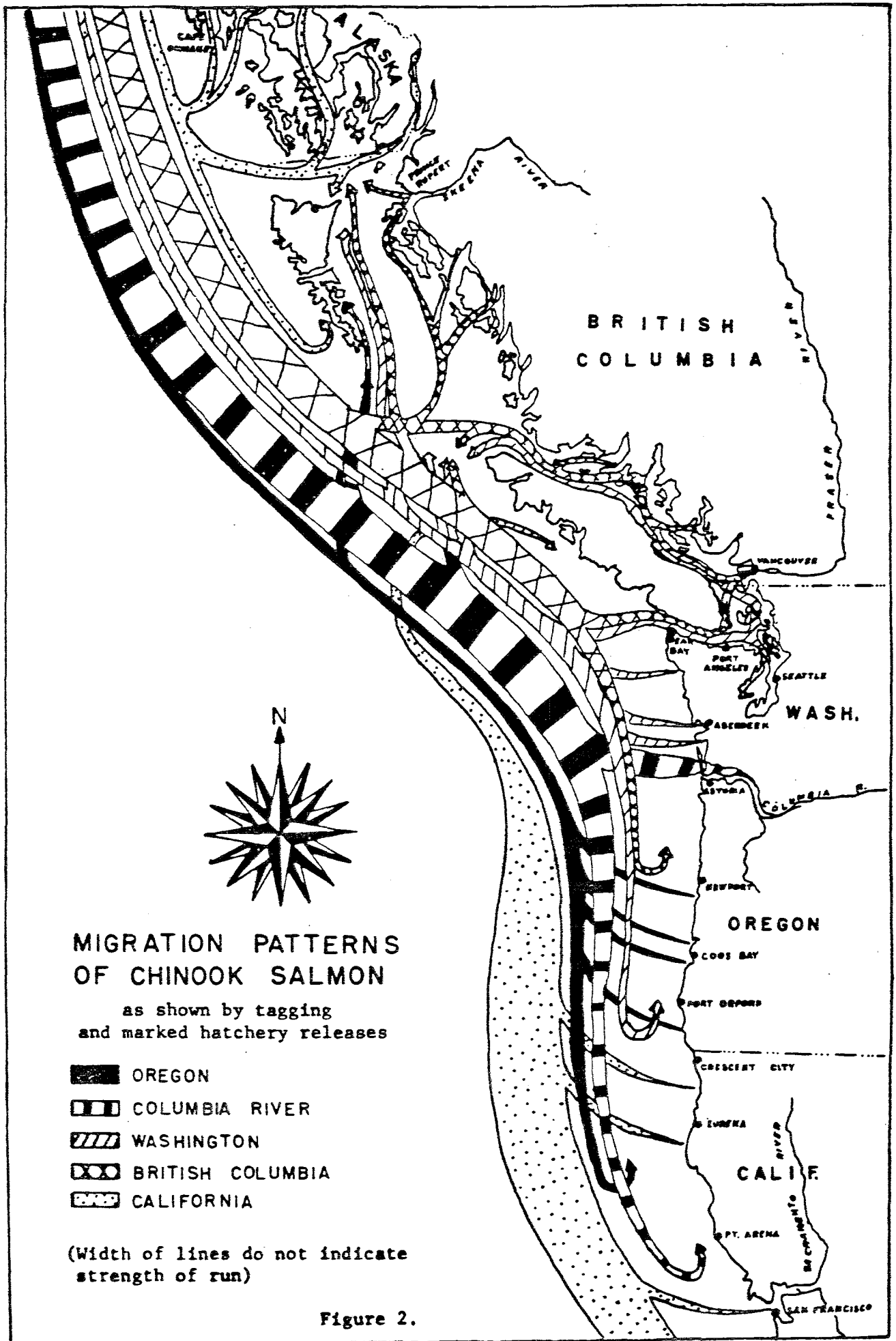
The enclosed reviews or reports were submitted to the Informal Committee on Chinook and Coho at a meeting in Seattle on April 30, 1969. These are two independent reports. The interpretations, conclusions and recommendations in each are those of the national section preparing the report and are not necessarily agreed to by the other section. The reports contain

duplications and differences of opinion; also they have shortcomings, resulting, in part, from the 1964 cut-off date agreed upon at the commencement of the reviews.

Since 1964, much additional data has been obtained on the distribution of various stocks of chinook and coho and the contributions of those stocks to the fisheries of Canada and the United States. It is therefore the intention to fill in the gaps, when possible, for those situations where incomplete data are involved and to exchange the more recent data.






Canadian Section
W. R. Hourston
K. Radway Allen

United States Section
Donald R. Johnson
Leon A. Verhoeven



**MIGRATION PATTERNS
OF CHINOOK SALMON**

as shown by tagging
and marked hatchery releases

-  OREGON
-  COLUMBIA RIVER
-  WASHINGTON
-  BRITISH COLUMBIA
-  CALIFORNIA

(Width of lines do not indicate
strength of run)

Figure 2.

Distribution of Chinook

A review of the published literature with respect to movements of chinook salmon has demonstrated the international character of the fishery. Although the pattern of a northwesterly feeding migration of young and a southeasterly migration of adult chinook has been firmly established from the results of tagging experiments conducted in Southeastern Alaska, British Columbia, Washington, and Oregon, some chinook migrate in a converse pattern. Although the various tagging and fin-marking experiments conducted by United States and Canadian agencies have shown the fresh-water areas from which salmon in the offshore commercial and sport fisheries have originated, the total contribution by watershed or locality has not been adequately determined.

From tagging conducted in Southeastern Alaskan waters in 1950 through 1952, Parker and Kirkness (1956) showed the importance of the Columbia and Fraser rivers to the outside Alaskan troll fishery. These investigators also found that other major river systems north of the California-Oregon boundary and as far north as Alaska contributed to the Alaskan fishery but as individual systems to a lesser degree than the Columbia or Fraser.

Milne (1957) reported on tagging studies conducted off the coast of British Columbia from 1949 through 1952 and compared these results with earlier experiments. In each case it was found that maturing chinook were present that were headed for larger watersheds such as the Columbia and Fraser rivers. Those chinook tagged off the southwestern part of Vancouver Island included many immatures whose migratory routes radiated in several directions but a significant portion (24%) of the recovered tagged fish were taken north off the tagging area. Milne and Godfrey (1964) compared time of appearance of red- and white-fleshed chinook in the troll and river fisheries. They concluded that the outside troll catches consist primarily of a mixture of chinook from the Fraser River, fall-run chinook from the Columbia River, and chinook from smaller coastal streams of both countries.

Estimates of the contribution of the Columbia River to the ocean-troll fishery from ocean tagging experiments by Silliman (1950), Milne (1957) and Heyamoto^{1/} have ranged from 30% to 78% depending on the time and area in which

^{1/} Heyamoto, H. A review of ocean tagging experiments utilized to estimate Columbia River chinook contribution to offshore trolling areas. Unpub. ms. March, 1961; Olympia, Washington.

the experiments were performed.

Milne (1957) tagged a selected group of small chinook from the Sooke traps at the eastern end of the Juan de Fuca Strait in 1952. The majority of the recoveries occurred in the Fraser River or in the Puget Sound net fisheries. Only two fish were recovered in areas westward (and southward) of the tagging area: one was recaptured off the Washington Coast and the other in the Columbia River.

Migration patterns of chinook salmon originating in the various watersheds of California, Oregon, Washington, Southeastern Alaska, and British Columbia are shown in Figure 2. These patterns are based on composite tagging and marking experiments conducted over a period of many years. The width of the diagrammatic migration routes does not imply the strength of the stocks originating in the watersheds but is intended to demonstrate only generally the distance and geographical area applying to the movements of chinook. High-seas catches have shown chinook and coho to migrate far offshore and considerably beyond the ranges indicated by Figure 2.

A present-day experiment designed to determine contribution of hatchery-reared chinook from the Columbia River is known as "Operation Fin Clip". This program has been in effect since 1961 and presently is being conducted cooperatively by the U. S. Bureau of Commercial Fisheries and State and Canadian fishery agencies on the Pacific Coast. In this program about 10% of the chinook released from Federally-financed hatcheries in the Columbia River system were fin-marked. Recoveries of 2-year-old fish were made in 1963 in the sport and Columbia River gill-net fisheries and of 3-year-old fish in 1964 in the troll fisheries from California to Alaska. The international aspects of the marking program are shown by the unweighted recoveries in political areas along confirmed migration routes of the species (Figure 3). The substantial contribution of Columbia River fall-chinook salmon to the troll fisheries of British Columbia, Washington, and Oregon is demonstrated by the extremely high marked to unmarked ratio observed in each of the fisheries (mean value near 1:30). Mark returns from the Alaskan troll fishery have neither corroborated nor refuted the findings of Parker and Kirkness (1956). Only three widely-spaced recoveries occurred in the Alaskan troll fishery and these are not shown in the figure. Marked 4-year-old fish will not be available until 1965. However, Parker and Kirkness found that the Alaskan fishery for chinook takes primarily 4-year-old fish from natural stocks originating in the Columbia River upstream from the many hatcheries partaking in the present marking program. Information on oceanic distribution of most Alaskan chinook stocks is presently unavailable.

Conclusions

An ocean-troll fishery for chinook by nationals of both countries occurs off the Pacific Coast states and the province of British Columbia. United States fishermen who range north from Washington and south from Alaska operate on grounds commonly fished by Canadian nationals in the vicinity of Hecate Strait, Queen Charlotte Sound, and off the west coast of Vancouver Island. United States fishermen also fish in common with Canadian trollers off Washington.

The pattern of chinook salmon migration has been established from tagging experiments as predominantly northwestward for feeding and southeastward for maturing adults, although a number of feeding chinook move to the south as indicated by recoveries off Oregon and, even occasionally off California, of marked fish from the Columbia River. The Columbia and Fraser rivers are the two largest supply sources of chinook to the international ocean fisheries, but the proportional contribution of each is unknown and probably varies considerably from year to year.

Escapements

Reliable estimates of chinook and coho escapements are available for relatively few streams and, for the most part, are inadequate for measuring the true magnitude of salmon in the streams. Measurement of spawning escapement varies between areas and streams within areas. Counts are all based on visual observations, either of entire stream systems or of stream areas of sufficient length to give a relative index of annual escapement, or at dams and hatchery racks.

Chinook

The island streams of Southeastern Alaska generally do not support large stocks of chinook salmon. Spawning ground surveys and catch records of the net fisheries off large mainland rivers have shown that only three rivers in Southeastern Alaska produce chinook salmon in quantity. These rivers are the Alsek, Taku, and Stikine. There are many small streams in Southeastern Alaska in which chinook are known to spawn, but for which quantitative escapement data are unavailable.

The major chinook stocks in Alaska are associated with large rivers to the north and westward of Southeastern Alaska, e.g., Copper, Nushagak, Kuskokwin and Yukon rivers. The Yukon River in western Alaska supports a chinook fishery in the magnitude of 100,000 fish annually but corresponding escapement information is unavailable.

Escapement values to British Columbia streams are derived from a detailed examination of Fishery Officer's reports (Milne, 1964). There are nearly 200 chinook spawning streams in Canada with a total annual average escapement of nearly 200,000 fish according to stream escapement summaries. Major streams containing spawning runs of more than 10,000 fish annually are the Fraser and tributaries, Bella Coola - Atnarko, Squamish, and Skeena. A summary of relative escapement counts in all districts of British Columbia is shown in Figure 6.

In Washington and Oregon, the Columbia River is one of several major streams in which a total count of certain stocks of salmon is made, but this is only for the portions of the runs which migrate above Bonneville Dam. These upriver stocks spawn in tributaries in Washington, Oregon, and Idaho. Columbia River chinook salmon are designated as "spring", "summer", and "fall" depending on their timing through the lower Columbia River. The spring run is that segment occurring in the fishing area from January through May while the summer run is that portion fished commercially during June and July. Columbia River commercial fishing seasons and regulations are set to achieve an escapement goal of 80,000 to 90,000 chinook each for the upriver spring and summer runs. Significant numbers of spring chinook also ascend the Cowlitz and Willamette rivers which are tributary to the Columbia River below Bonneville. The fall run has been arbitrarily separated into an early portion that enters the river in August and a late portion that enters in late August, September and October. The early segment passes over Bonneville Dam in late August and early September to spawn in the main river and tributaries and hatcheries in Washington, Oregon, and Idaho. The major above-Bonneville spawning areas are the complex of hatcheries adjacent to the Bonneville pool, the Wind and Klickitat rivers, and the main river upstream from John Day Dam. The escapement level for the early segment of fall-run chinook is maintained at between 100,000 and 125,000 fish counted over Bonneville Dam. The late segment spawns mainly in tributaries below Bonneville such as the Cowlitz, Kalama, and Lewis rivers. Figure 6 shows only those portions of the chinook runs that are counted over Bonneville Dam, therefore, the values should be considered minimal. Trends only are available for chinook in other watersheds in the State of Washington - the reader is referred to the 1963 Annual Report of the Washington Department of Fisheries, p. 100-101. Because of the difficulties associated with conducting complete surveys, index areas are established in many rivers and total

escapement is approximated by employing a conversion factor. Streams containing over 10,000 chinook spawners annually include the Duwamish-Green, Skagit, Snohomish, Deschutes, and the complex of streams flowing into Grays Harbor and Willapa Bay.

The spawning abundance in Oregon streams is based on the number of fish per mile observed on index areas in coastal streams, except the Umpqua and Rogue rivers, and in tributaries of the Columbia River below Bonneville Dam except the Willamette River. In the Willamette, the escapement is essentially the total count over the fish ladder at Willamette Falls. For spring chinook entering the Willamette River, the total escapement has ranged from 14,400 to over 76,000 fish for the years 1946 through 1963 (PSIAC Report, 1964). The fish-per-mile index in Oregon's coastal rivers has ranged from 12 to 60 fish during the years 1953 through 1962. Umpqua and Rogue rivers' spring-chinook counts (at dams) reached modern highs in 1963 of 10,000 and 41,000 fish, respectively.

Based on the PSIAC Report (1964) the Sacramento-San Joaquin chinook spawning populations have ranged from less than 100,000 to nearly 600,000 fish (Figure 6). Estimated escapements for other important chinook streams are the Klamath (150,000), Eel (50,000), and Smith (15,000).

The following information was extracted from reference no. 55 (Informal Committee on Chinook and Coho, 1969, Vol. II, Canadian Section):

"In 1963, Canada and the United States formed the Informal Committee. The terms of reference published at the Committee's inaugural meeting of November 20, 1963 were:" (See chinook section, reference no. 54, for details.)

This report (includes Godfrey, MS 1968, reference no. 45) summarizes the results of chinook and coho tagging programs to 1964. Figures on the average annual (1957-64) commercial catch of chinook salmon for the west coast of North America and Statistical Areas (1-29) in British Columbia are included as general information.

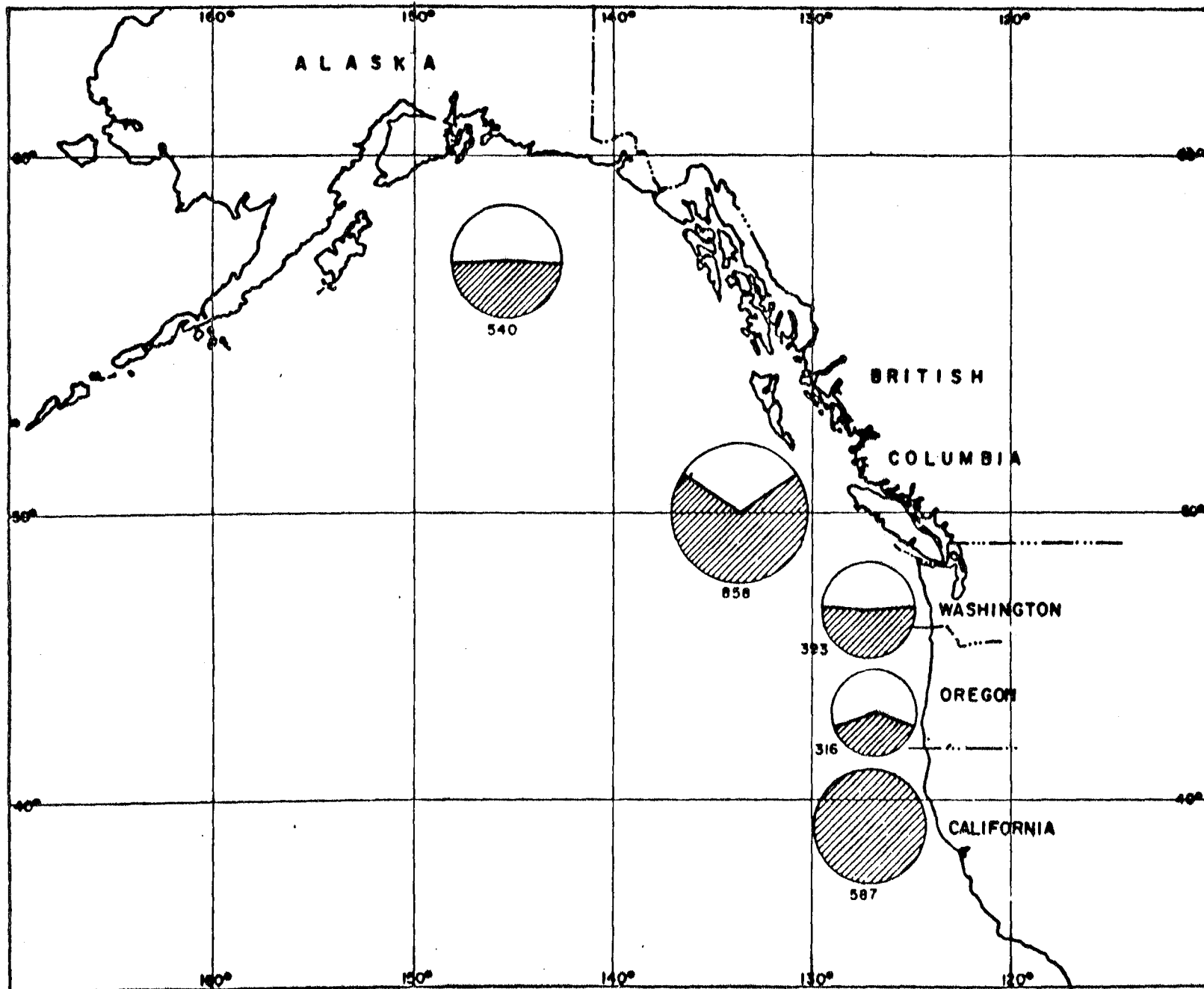


Figure 1. Average annual (1957-64) commercial catch of chinook salmon by region in thousands of fish. Troll catch shaded.

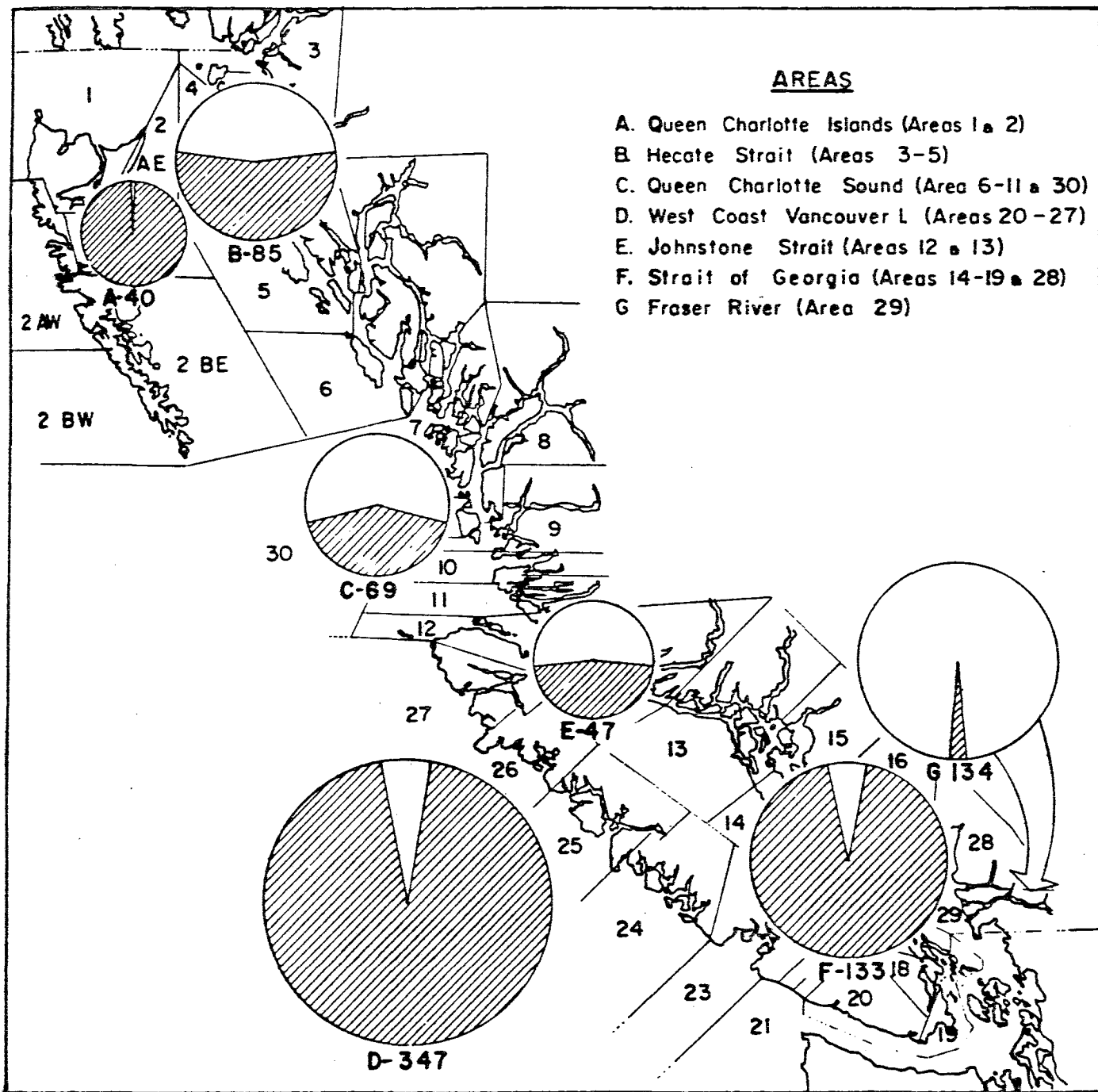


Figure 3. Average annual (1957-64) commercial chinook salmon catch in British Columbia by area (grouped statistical areas) in thousands of fish. Troll catch shaded.

REVIEW OF INFORMATION OBTAINED FROM THE TAGGING AND MARKING OF
CHINOOK AND COHO SALMON IN COASTAL WATERS OF CANADA
AND THE UNITED STATES

(from Godfrey, 1968 MS)

INTRODUCTION

In 1963 the Governments of Canada and the United States authorized the formation of the Informal International Chinook and Coho Salmon Committee to study and advise upon certain problems relating to chinook and coho salmon that were of mutual concern to the two countries. This Committee, which consists of two Canadian and two United States members, met in November of the same year, at which time they agreed upon terms of reference. At that time, also, the Committee appointed a Canadian and a United States working group (each being composed of two members) to prepare, independently, reviews for submission to the Committee that "specifically", would "... summarize information on the migratory movements of chinook and coho salmon to determine where and when fish bound for United States streams intermingle with those bound for Canadian streams and to determine the extent of such intermingling in areas where fishing occurs."

The working groups were instructed to implement "a full exchange of pertinent information on the following:

- (i) Results of tagging and marking experiments
- (ii) Catch statistics
- (iii) Related fishing regulations
- (iv) Distribution and abundance of spawners
- (v) Other background information as required."

This Manuscript Report was originally prepared by the writer as a reference document to be used by the Canadian working group (of which the writer is one of the two members) in the preparation of its review. In its present form the document is "factual" in the sense that it is limited to amassing and illustrating the available and pertinent information that has resulted from past (1924-1964) Canadian and United States tagging and marking experiments. No attempt is made at this time to draw conclusions regarding the intermingling in fishing areas between Canadian and United States stocks of the two salmon species.

The sources from which the data contained in this document were drawn varied considerably in their nature and original purposes. Partly because of this at least, it is very likely that some errors have occurred. The writer would be most grateful for information by which they could be corrected.

The writer acknowledges with thanks the technical assistance of Mr. E.A.R. Ball and Mrs. Fran Newman in the compilation of data and the preparation of illustrations.

LIMITATIONS OF TAGGING AND MARKING EXPERIMENTS

It is not the intent in this section to review in detail all the limitations of tagging and marking experiments as they pertain to the objectives of this report. However, as methods for determining the migrations of United States and Canadian salmon, and of the timing, location and extent of their intermingling, the tagging and marking experiments which the two countries have conducted in the past have some particular deficiencies which should be mentioned.

With the exception of a few releases made more than 20 years ago with fish of the Cowichan River on Vancouver Island, Canada has never marked seaward-migrating chinook and coho salmon for the purposes listed above. In contrast, the United States has done so - in large numbers and over many years. Thus, although these experiments had serious shortcomings (see later section), the recoveries that were made subsequently in Canadian fishing waters have provided information on the occurrence there of United States fish, and of their catch by Canadian fishermen, which has not been paralleled by similar information about fish of Canadian origin.

The tagging of fish in the ocean has also been out of balance in terms of the effort expended by the two countries - that is, in terms of the numbers and kinds of fish tagged, and of the times and locations of the experiments. It is important to realize, for example, that of all the chinook and coho salmon tagged by Canada since 1925 to the present time, over 80% of the chinooks and 75% of the coho¹ were tagged over 30 years ago, during 1925-1930. In contrast, the tagging of these two species by the United States, at least in waters adjacent to British Columbia (i.e., Washington coast, Puget Sound, United States waters of Georgia Strait and the Strait of Juan de Fuca, and in the outside coastal and inside waters of Southeast Alaska) has been done almost entirely within the last 10 years.

Furthermore, the actual total numbers of the two species that have been tagged by the two countries have not been great, even over the span of more than 30 years. For example, the total numbers of chinook and coho salmon that Canada has tagged since 1925 have been roughly only 8000 and 13,000² respectively. Comparable figures for the United States, excluding taggings south of the Columbia River, and those of small, immature fish within Puget Sound, would be roughly 7500 chinook and 16,000² coho salmon. Thus the total fund of tagging information that is useful for this report is limited in this respect also.

The most serious limitation to the use of tagging and marking experimental data for the purpose of determining the extent of intermingling is, of course, the deficiencies inherent in the recovery of tags within the territories (including the fishing grounds) of the two countries. Differences in recovery efficiency have resulted from differences in fishing intensity and from differences in the opportunity to recapture tagged fish in fresh water. In the latter case these are especially related to the presence of dams or hatchery weirs on numerous streams in the United States, in contrast with only a very few "counting fences" on Canadian streams.

¹Excluding the coho tagged in Juan de Fuca Strait in 1957-1958 in the joint U.S.-Canadian project.

²Including the coho tagged in the Strait of Juan de Fuca in 1957-1958.

There have been attempts in the past to make use of tag recovery data to estimate the contributions of a particular river system to a particular fishery. For example, Silliman (1948), Parker and Kirkness (1956), and Milne (1957) made tentative estimates of the catch of Columbia River chinook salmon in fisheries at several locations. When such an estimate was made for the year of the experiment, a major assumption was that the opportunity to recover tags on all other streams was equal to that of recovering them on the Columbia River. This assumption could not, of course, be upheld nor was it possible to correct for differences in recovery efficiency. Parker and Kirkness merely concluded, "but with reservations on the relative importance of the Fraser and the Columbia River", that the Columbia River followed by the Fraser River were probably the most important single contributors to the troll catch of chinook salmon in Southeast Alaska (i.e., during 1950-1952). Silliman and Milne computed estimates, but the errors inherent in their methods render these questionable.

When the results of past tagging experiments are applied to later years the situation becomes even more complicated, since the assumption must be made that the actual abundance of each of the stocks contributing to a particular fishery has not changed; and this is neither known nor likely.

With these reservations noted, the following summarization of information obtained from past tagging and marking experiments conducted by the United States and Canada is presented as a reference document to the review that is being prepared by the Canadian working group of the International Chinook and Coho Salmon Committee. The attempt has been made to summarize and to illustrate as much of the available information as possible. The review terminates with information obtained from experiments conducted during 1964. Since then Canada has tagged large numbers of chinook and coho "grilse" in the Strait of Georgia and adjacent bays and inlets, and the United States has initiated an extensive program for the detection of marked "fall" chinook and coho salmon from Columbia River and Washington State hatcheries in sport and commercial fisheries from California to Southeast Alaska. Useful information from these and other operations will no doubt be available in the very near future.

INFORMATION FROM TAGGING EXPERIMENTS

Chinook salmon

1. Southeast Alaska; inside waters (Table I*and Fig. 1)

During 1950-1955 the United States tagged 3098 chinook salmon in the inside waters of Southeast Alaska at the locations noted in Table I. There were, of course, many recoveries in both inside (mainly) and outside waters of Southeast Alaska, but these could have included both immature and mature fish of British Columbia origin, or even farther south, since there was also one recovery from the Columbia River. Table I lists only the recoveries made in British Columbia fisheries and streams. They extended from the Skeena River to the Fraser River, and were made predominantly in inside coastal waters. The data do not give any clear evidence that a single British Columbia river system or region was a major contributor to the fish present in the tagging areas. The absence of recoveries farther south than the Fraser (with the exception of that to the Columbia River) is in marked contrast

*Tabled data not extracted for this report

with the results of tagging in the outside coastal waters of Southeast Alaska (see Table II and Fig. 2).

Roughly 25% of the British Columbia recoveries were made one or more years after tagging.

2. Southeast Alaska; outside coastal waters (Table II and Fig. 2)

A total of 918 chinook salmon were tagged by the United States in the outside coastal waters of Southeast Alaska during 1950-1952 in three major regions - Cape Spencer to Cape Fairweather, Sitka to Cross Sound, and Warren Island to Cape Felix. The recoveries extended from both inside and outside coastal waters of Southeast Alaska southwards as far as along the coast of Oregon. From the results of these experiments Parker and Kirkness (1956) concluded, "but with reservations on the relative importance of the Fraser and Columbia Rivers", that the Columbia River followed by the Fraser River were the major contributors of chinook salmon to the Southeast Alaska troll fisheries, and that "all major streams from southern Oregon northward to Southeastern Alaska contribute, but to a lesser degree". The exact meaning of "to a lesser degree" is not clear. The combined contribution from such streams might have equalled that of the Columbia River plus the Fraser River. In any event, with probably considerably less likelihood or opportunity of recovering tags, the recoveries from these streams amounted to one-half of those to the two principal rivers.

Approximately 30% of the recoveries were made one or more years after the fish had been tagged. The most northern tagging area, that between Cape Spencer and Cape Fairweather, appeared to have the greatest proportion of immature fish. The great majority of the Columbia River recoveries were, according to Parker and Kirkness, fish of the "fall" run; primarily from locations above Bonneville dam.

3. Northern Queen Charlotte Islands (Tables III-VI and Fig. 3-5)

During 1925-1930 Canada tagged 1935 chinook salmon off the northwest and north coasts of the Queen Charlotte Islands, and an additional 64 in 1951. There were 4 recoveries to the north in Southeast Alaska, but these could have originated in streams to the south. Besides these, the distribution of the recaptures extended from Nass River in northern British Columbia to streams along the Oregon coast. These latter recoveries were a significant feature of the results of the early experiments in 1925 and in 1929-1930 (see Fig. 3 and 4). The results of the 1951 experiment (Fig. 5) are in marked contrast as there were no recoveries any farther south than off the Washington coast north of the Columbia River. This could be merely because so few fish were tagged in that year. However, they might also reflect both the decline in stocks and the closures of fisheries in Oregon coastal streams during the intervening years.

As in the waters off Southeast Alaska, the Columbia and Fraser Rivers again appear to have been the major single contributors.

In contrast to the taggings in Southeast Alaska, only just over 10% of the recoveries from the Queen Charlotte Islands were fish that were taken one or more years after being tagged. This difference could indicate the presence in those more southern waters of relatively fewer immature fish, the

proportion of positively immature fish (when tagged) among the recoveries being relatively low in each of the six operations, viz., 16.2, 7.3, 17.5, 0.0, 8.2, and 0.0. However, it should not be overlooked that in the Queen Charlotte Islands operations over 97% of the fish were tagged more than 30 years ago, whereas the Southeast Alaska experiments were done in more recent years, during 1950-1952. The differences noted, if at all real, might therefore reflect a temporal change in the composition of the stocks rather than geographical variation.

4. Hecate Strait (Table VII and Fig. 6)

In 1930 Canada tagged 182 chinook salmon in Hecate Strait off Stephens, Porcher and Banks Islands, and an additional 302 farther south in Milbanke and Fitzhugh Sounds. From the former operations, although the total number of recoveries was small (15), they extended from the Nass River in northern British Columbia southwards to the Columbia River. Similarly from the Milbanke-Fitzhugh Sounds operations the recoveries (numbering 16) ranged from the Skeena River to the Columbia River. The taggings off Stephens-Banks-Porcher Islands gave four returns of fish that were immature when they were tagged - all to the Columbia River. All of the recaptures from Milbanke and Fitzhugh Sounds were made in the year they were tagged.

The two recoveries to the Nass and Skeena Rivers, both of which were maturing fish, are the first instances given in this report of fish being recaptured in streams located distinctly to the north of where they were tagged.

In 1956, 1957 and 1958 Canada tagged a total of 151 chinook salmon in the vicinity of Dundas Island (Table VIIA and Fig. 6A). Almost 30% of these

fish were recovered, all in more or less adjacent waters and streams, with the exception of one taken in or off the Columbia River. All other freshwater recoveries were made in the Nass and Skeena rivers, and with three exceptions (see Table VIIA) all recoveries were made in the year of tagging.

5. West coast of Vancouver Island (Tables VIII-XV and Fig. 7-14)

Canada tagged a total of 3049 chinook salmon off the west coast of Vancouver Island during 1925-1927, and another 1158 during 1949-1952. In addition to these the United States tagged 315 off Barkley Sound (the Swiftsure Bank-Lennard Island area) in 1949.

From all these releases only two fish were recaptured at locations well to the north of the Island. One of these, tagged off Kyuquot Sound in 1927, was taken on halibut gear off Goose Island, Queen Charlotte Sound, in the following year. The other, tagged off Barkley Sound in 1949, was taken off the west coast of the Queen Charlotte Islands, also a year later. However, there were many recoveries made on the west coast of Vancouver Island to the north of the tagging locations. The majority of these were immature fish at the time they were tagged.

From both the taggings in the earlier years (1925-1927) and in the later period (1949-1952) there were many recoveries in the inside waters of the Strait of Juan de Fuca, Georgia Strait and Puget Sound. The Fraser River in particular provided many returns.

The principal differences between the results of the early and later experiments were the proportions of the total recoveries that were made off the west coast of the Island, and the proportions that were made in the Columbia and Fraser rivers. These may be summarized as follows:

<u>Percentages of total recoveries made</u>		
<u>Location</u>	<u>1925-1927</u>	<u>1949-1952</u>
West coast Vancouver Island	7.1	53.0
Columbia River	59.6	11.4
Fraser River	4.8	17.4

As Milne (1957) pointed out, the change in the recovery rate off the west coast of the Island (that is, in or near the tagging areas) must have resulted from changes in fishing intensity and efficiency. Also, in the more recent period relatively more smaller, immature fish were tagged and recaptured in or near the tagging areas, and because of their higher ocean mortality, there were relatively fewer stream recoveries. Milne concluded that these changes implied that the stocks of the Columbia River have decreased in size and importance while those of the Fraser and other British Columbia streams were then making a greater contribution to the west coast troll fisheries.

The actual distributions of the recoveries by locations are not so very different between the two periods, and in this connection it may be noted that the early taggings provided two recaptures from the Sacramento River, while from the 1949 operation off Barkley Sound one fish was recovered off Point Ano Nuévo on the California coast.

Finally, it may be noted that the fish tagged at Sooke were predominantly (or possibly all) maturing fish. Most were en route to the Fraser River and other streams in Georgia Strait and Puget Sound. There were, however, also two recoveries to the south from the experiment of 1952 - one taken off Westport, and one in the Columbia River.

6. Northeast and east coasts of Vancouver Island (Tables XVI, XVII and Fig. 15-18)

In 1928-1930 Canada tagged 553 chinook salmon off the northeast coast of Vancouver Island and at the northern extremity of Queen Charlotte Strait, and in 1927-1928 a further 435 in the waters extending from Deep Bay to Nanaimo.

From the more northern area there was one recovery well to the north in Fisher Channel (Fitzhugh Sound). The remaining recoveries indicated that some fish from the north end of the Island probably migrated southwards along the west coast of the Island, while others moved to the south by way of Johnstone and Georgia Straits. Recoveries in the Fraser River and Puget Sound predominated. The most southern recoveries were made in the Columbia River (3 fish; see Table XVII).

The tagging in the Deep Bay-Nanaimo area also gave one return at a point far to the north, in Smith Inlet. Again the remaining recoveries were made either in or near the tagging areas or to the south, predominantly in the Fraser River, but extending also into Puget Sound and as far south as the Columbia River (one fish from the Nanaimo area; Table XVI B).

7. West Beach, Whidbey Island and San Juan Island (Table XVIII and Fig. 19-22)

In 1960 the United States conducted an experiment to compare hooking mortality between single and treble hooks by tagging 346 chinook salmon near the southern tip of Whidbey Island. The recoveries are illustrated in Fig. 19. They were widespread and indicated considerable mixing of Canadian with United States fish even at this location within Puget Sound. Two of the Canadian recoveries were taken as far north as in Fitzhugh Sound. These recoveries may be summarized as follows.³

	%
Fitzhugh Sound, B.C.	3.4
Fraser River - Howe Sound, B.C.	17.2
Cowichan Bay - Saanich Inlet, B.C.	6.9
Others in Georgia Strait, B.C.	13.8
Near Sooke, B.C.	1.7
West coast Vancouver Island, B.C.	5.2
Swiftsure-Cape Flattery area	6.9
Puget Sound streams	8.6
Puget Sound; saltwater recoveries	36.2
	99.9

Although the report (see footnote, p. 7) that describes this operation does not give details, it does indicate that some of the tagged fish must have been small, immatures. The range in fork length was from 19 to 60 cm (average 36.6 cm).

In 1962 and again in 1964 the United States tagged chinook salmon off West Beach, Whidbey Island - 1029, and 494, respectively. These were predominantly maturing fish. In this area, too, there was a high degree of intermingling of Canadian with United States fish. In particular, there were numerous recoveries from the Fraser River and its approaches (in both Canadian and United States waters), and in such United States streams as the Nooksack and Skagit Rivers. Only four fish were recaptured from points to the west - two in the Strait of Juan de Fuca, one off the Washington coast and one from the Columbia River. The most northerly recovery was that of a fish taken in the Big Qualicum River on the east coast of Vancouver Island.

The results of the United States tagging in 1964 at San Juan Island indicated a considerable preponderance in that area of chinook salmon en route to the Fraser River. There was only one recovery in a Puget Sound stream, none elsewhere in British Columbia other than in the Fraser River and its immediate vicinity, and none from outside waters or to the west of the tagging area.

³These figures were derived by counting the recoveries illustrated in figure 15 of Haw, 1963.

8. Puget Sound (Table XXII)

As the table indicates, the experiments that were conducted in Puget Sound, for which information is available, were concerned mainly with the movements of immature fish, particularly coho salmon. The importance of immature Fraser River fish contributing to the inside stocks is emphasized by Bayliff (Item 3 in Table XXII). Even immature chinook salmon from the Columbia River were found at Bush Point on the southern tip of Whidbey Island.

9. Strait of Juan de Fuca (No tables or figures)

During the course of a joint study of coho salmon in the Strait of Juan de Fuca and adjacent outside waters in 1957 and 1958, Canada and the United States also tagged a number of chinook salmon. Some of the chinook salmon data appear to have been lost or misplaced but there is information on the numbers tagged by Canada in 1957 and on the recoveries from these.

In 1957 Canada tagged the following numbers of chinook salmon in the areas indicated: (a) outside the Bonilla-Tatoosh line, 158; (b) Canadian waters of the Strait of Juan de Fuca, 16; (c) United States waters of the Strait of Juan de Fuca, 92.

Apart from recoveries within or near the tagging area, the outside tagging gave only one additional recovery, at the mouth of the Fraser River. The recoveries from fish tagged in United States waters of the Strait were almost all local or in Georgia Strait, but there were also several of fish that had migrated to the outside: west coast of Vancouver Island, three; Washington coast, one; the Columbia River, three; and one near Eureka, California. From Canadian waters of the Strait there were three recoveries in United States waters off Georgia Strait, and one to the Fraser River.

10. Umatilla Reef (Table XIX and Fig. 23)

The United States tagged 166 chinook salmon in this area in 1949. Two fish were recovered to the north off the west coast of Vancouver Island, both of them having been immature when tagged. In addition, four fish were recovered in Puget Sound, three off the Washington coast, five in the Columbia River, and one in the Sacramento River. The Columbia and Sacramento fish were all taken in the year they were tagged.

11. Washington coast and off the Columbia River (Table XX, XXII and Fig. 24)

Sixty chinook salmon were tagged by the United States in the vicinity of the Columbia River in 1948. There were two recoveries in the same year from the Columbia River, and in the following year(s) one each from the west coast of Vancouver Island, the coast of Washington, and near the Farallon Islands off the coast of northern California.

During 1959 and 1960, respectively, 422 and 343 chinook salmon were tagged in the area just north of Grays Harbor on the Washington coast to just south of the mouth of the Columbia River (Table XXII, Item 6). Most of the recoveries were made in or near the mouth of the Columbia River, but the remainder extended over a very wide range - from the west coast of Vancouver Island and the Fraser River to the north, as far south as off the Farallon

Islands. Besides the Columbia River and Fraser River recoveries, other stream recoveries were made in the Umpqua River on the Oregon coast and the Sacramento-San Joaquin system. The Fraser River recoveries included maturing fish (from both years of tagging), but the source document (see Table XXII) does not make it clear whether they were exclusively so.

11. Off the coast of Oregon (Table XX and Fig. 24)

In 1948-1949 the United States tagged 138 chinook salmon in the general area of Coos Bay. There were six recaptures - four off the Oregon coast, and two off the coast of California (one of which was probably of Sacramento-San Joaquin origin).

12. Off the coast of California (Table XXI and Fig. 25-27)

During 1939-1949 the United States tagged chinook salmon in two general areas off the northern coast of California - 3132 north of Point Arena and 3010 south of Point Arena. Most of the recoveries were relatively local either in the California ocean fisheries or in northern California streams, particularly the Sacramento-San Joaquin system. However, there were a number of exceptions, of fish that were recaptured in more northern waters: the west coast of Vancouver Island, three; the coast of Washington, four; the coast of Oregon, 15; the Columbia River, two; Oregon coastal streams, six. Details of individual recoveries are not given in the source document (see Table XXI), so that it is not possible to say which of these northern recoveries were maturing fish when tagged and which were immature.

Note: The coho salmon section of this report (reference no. 45, Godfrey, MS 1968) has been removed and put in the coho section of the report (6 pages plus figures).

INFORMATION FROM MARKING EXPERIMENTS

1. In Canada

The only experiments carried out in British Columbia that have involved the marking (by the excision of fins) of juvenile seaward-migrating chinook and coho salmon were done more than 20 years ago during 1937-1945, with fish of the Cowichan River. These experiments were valuable at that time because they demonstrated that fish from the Cowichan River made long migrations to outside coastal waters, and that they contributed to the catches in distant fisheries. Recoveries of these marked fish were made along both coasts of Vancouver Island, as well as in nearer United States waters and in Cowichan Bay and adjacent areas.

However, the information gained from these operations is of little value to this report, nor does it add anything of particular significance to what has been learned of Cowichan River fish from the tagging experiments which have been described above.

2. In the United States

Over the years various agencies in Washington, Oregon, and California (and to a considerably less extent in Southeast Alaska) have released large numbers of marked juvenile chinook and coho salmon, mainly fish that had been reared in hatcheries. However, the amount of information resulting from these operations which this technical group has obtained, and which is useful for the purposes of this report, is very limited. It does not add greatly to what has already been determined from tagging experiments about the migrations of the two species, and in particular it cannot presently be used to compute the contributions of particular stocks to particular fisheries with a desirable degree of confidence.

There are a number of reasons for this (see also Kiemle, 1962), including confusion and error in release data (the numbers, dates, and locations of releases), frequent usage of single marks (which could be duplicated by naturally-occurring "marks"), duplication of marks (that is, use of the same mark at the same time at two or more locations), regeneration of the excised parts, and other factors. This situation, together with the lack of more precise information on most of the release and recovery projects themselves, prevents this group from making a sufficiently sound and useful analysis of the data.

This is not to say, of course, that valuable information has not been gained from these efforts or that they have not contributed to the knowledge of the occurrence of fish of known origin in particular fisheries. What must be judged as valid marks of known origin have been found at numerous locations in the sports and commercial fisheries along the coast from California to Southeast Alaska. Some examples may be given. In 1964 agencies in both the United States and Canada made an intensive search for marked chinook and coho salmon. The recovery information for some of these marks which indicates where these fish were found is summarized in Tables XLVI-XLVIII. These tables also make it apparent that certain fisheries must have received quite important contributions from some of the releases.

Canada is presently cooperating with the United States in a program designed to evaluate the production of "fall" chinook salmon from a number of hatcheries on the Columbia River. It is clearly evident from Table XLVI that considerable numbers of the first releases (in 1962) of these fish must have been taken in several fisheries in 1964. That many must have been taken by Canadian fishermen off the west coast of Vancouver Island is also evident, especially in view of the fact that only about 10% of the releases were marked, and that there must also have been a differential survival between the marked and the unmarked fish. This program, including the analysis of the release and recovery data, is being directed by the United States Bureau of Commercial Fisheries. Because of this, and also because the program is continuing at this time, it is felt that further discussion of the results in this report would be both inappropriate and untimely.

As mentioned in the Introduction, Canada is now also participating in the recovery of marked coho salmon released from Columbia River hatcheries, and hatcheries in Washington State.

INFORMATION ON THE TIMES OF INTERMINGLING

There are several reasons why it is virtually impossible to describe accurately and meaningfully the timing of the presence of the fish of one country on the fishing grounds of another, or on the grounds fished by the nationals of the two countries. If identification of the origins of fish depends upon recoveries from ocean tagging, then limits to determining the timing of intermingling will be established at the outset by the period over which the tagging operation was conducted, and by the numbers of fish belonging to the different stocks present in the area that were successfully tagged and subsequently recovered in home streams (or in areas where the home stream can be assigned with certainty). If the marking of seaward-migrating juvenile fish is employed, then the principal requirements of this method for determining "timing" are that reliable, unduplicated marks are used, and that an adequate search is made for marked fish in the catches in the area of concern.

No past experiments with chinook and coho salmon have fulfilled these requirements satisfactorily.

In the case of tagging, the best that has been achieved in a few instances has been that, in an important fishing area, moderate numbers of fish were tagged throughout most of the fishing season. More commonly, only small numbers of fish were tagged during part of the seasons. Although these experiments certainly provided much valuable information, they nevertheless did lack the requirement by which the timing of intermingling could be determined in detail.

In the case of marking experiments there have been deficiencies in the programming for marking and releasing the fish, and the effort to search for marked fish in the Canadian catches has only been meagre (that is, prior to 1964).

However, despite these limitations, some information on the timing of intermingling can be given, and this will be based on recoveries that were made in streams, against a background of information on the seasonal progression of the catch in areas where intermingling between United States and Canadian fish is known to occur.

Information given earlier in this report has indicated that the more important areas of intermingling between United States and Canadian chinook and coho salmon are:

- (1) the outside coastal waters of Southeast Alaska
- (2) the inside waters of Southeast Alaska
- (3) Dixon Entrance, and off the northwest coast of Graham Island
- (4) off the west coast of Vancouver Island
- (5) Canadian waters in the Strait of Juan de Fuca
- (6) United States waters in the Strait of Juan de Fuca
- (7) United States waters in Georgia Strait

In addition to these, however, there are also other areas where intermingling has been demonstrated, although these are almost certainly of less importance, because of the probability that considerably fewer foreign fish

were involved. In the case of United States fish in Canadian waters, these areas include inside coastal waters of British Columbia from Dundas Island in the north to the United States-Canada boundary in Georgia Strait. In the case of Canadian fish in United States waters (or in international waters fished almost exclusively by United States fishermen), they would include inside Puget Sound, and off the coast of Washington to at least as far south as the Columbia River.

(It may be appropriate to mention at this point that some waters may be more important as areas of intermingling than is presently realized. These are certain localities close to international boundaries where appreciable numbers of juvenile fish, or "grilse", are commonly taken in the sport fisheries. Three examples are Georgia Strait, Puget Sound and the Strait of Juan de Fuca.)

Tables XLIX-LXIII list the earliest and the latest dates on which chinook and coho salmon of "positively" known origin (that is, they were recovered in streams) were tagged in various areas in past years. These data indicate where and when individuals of particular stocks are definitely known to have been present. Of course, the locations are actually those of the

tagging operations, and it is not known how precisely, either in space or in time, they paralleled those of the fishing. It can be seen from the footnotes to these tables, and by referring to Fig. 55-64, that some of the tagging experiments extended over much of the fishing season, whereas others were of only very short duration, or at best were only intermittent over a longer period.

Figures 55-64 have been prepared to show average seasonal catches, by week or by day according to the data available, as a means of indicating the usual duration of a fishery in a particular area, and the period during which the fish were probably present there in their greatest numbers. (It is hardly necessary to mention that several factors, particularly the effects of regulatory closures and strikes, detract from the reliability of this method for demonstrating the true changes in seasonal abundance.)

Before attempting to use these figures and tables to give detailed descriptions of the timing of intermingling in specific areas, some more general conclusions may be drawn from their consideration.

(1) Almost certainly some Canadian and some United States fish, either as matures, immatures or both, are present in all of the more important areas of intermingling throughout the whole of the fishing period at least.

(2) The same is probably also true of the less important areas of intermingling; however, in these locations fewer stocks and considerably smaller numbers of foreign fish would be involved.

(3) The best information on the timing of intermingling has been obtained from the results of tagging individuals of the major stocks (such as those of the Columbia and Fraser rivers). Much less information has been gained in the case of the many smaller stocks, even though their combined contribution to the fisheries in an area might be of comparable magnitude, or at any rate, of considerable importance.

In more detail, the times during which intermingling between United States and Canadian chinook and coho salmon occur, and are important, may be summarized as follows:

1. Outside coastal waters of Southeast Alaska (Table XLIX and Fig. 55,56)

The troll fisheries in this area extend into international waters, and to a small extent at least the stocks present are exploited by Canadian (e.g., on the Cape Fairweather grounds) as well as United States fishermen.

Trolling in these waters lasts from about mid-May to early October. Large catches of chinook salmon continue to be made from at least late May to late June; and of coho salmon mainly through July and August.

Stream recoveries of chinook salmon tagged in these waters have been made in the Taku, Nass, Skeena, Bella Coola, Fraser and Columbia rivers, and in several coastal streams of Washington and Oregon. From the same operations coho salmon were recovered in the Taku, Stikine and Skeena rivers, and in an unnamed stream in Smeaton Bay, Southeast Alaska.

2. Inside coastal waters of Southeast Alaska (Fig. 55, 56)

In more recent years the principal fisheries in these waters have been by purse seines, gillnets and trolling gear. (Prior to 1959 numerous traps accounted for a large fraction of the total salmon catch.) The relative importance of these three types of gear varies among the different locations and during the season. Troll catches have been used to illustrate the duration of the fishing season throughout the area as a whole, but in any event it may be said that chinook and coho salmon are taken from mid-May to mid-October. Important catches of chinook salmon continue roughly from early June to mid-August; and of coho salmon from mid-July to mid-September. As mentioned earlier, Canadian chinook and coho salmon, either as mature or immature fish, or both, are probably present in these waters during the entire fishing period at least.

Chinook salmon tagged in these waters have been recovered in the Taku, Chilkat and Stikine rivers (Southeast Alaska), in the Skeena, Dala, Tahsis and Fraser rivers (British Columbia), and in unrecorded streams in Burroughs Bay and Pyramid Harbor (Southeast Alaska), and Gardner Bay, Smith, Knight and Bute inlets (British Columbia). The source document that lists these recoveries does not distinguish between saltwater and freshwater recoveries for coho salmon, but merely shows the British Columbia recoveries by fisheries statistical area.

3. Dixon Entrance and vicinity (Tables L and LVII; Fig. 57-60)

In this region, also, the troll fishery extends into international waters. The season lasts from about mid-May to the end of August, at least. On the average, highest catches are made throughout June and into the first half of July. Intermingling between United States and Canadian fish no doubt occurs during all of this period at least, and has been demonstrated by the following stream recoveries: (a) chinook salmon in the Nass, Skeena, Fraser

and Columbia rivers, and in streams on the coasts of Washington and Oregon; (b) coho salmon in the Ahrnklin River (Southeast Alaska), and in the Quinimass, Nass, Bear, Skeena, Sangun, Cowan, Ketlope, Kimsquit, Kitimat, Asklum, Big Qualicum, Squamish, and Fraser rivers (British Columbia).

4. Inside coastal waters of northern and central British Columbia
(Tables LI and LVIII; Fig. 57-60)

In Fisheries Statistical Areas 3 to 11, catches of chinook salmon by the troll fishery last from about mid-May to late September, with relatively high catches persisting throughout June. Relatively high coho catches are made later in the season, mainly throughout June by trolling gear, and throughout June to early September by purse seines and gill nets.

Tagging in these waters (from in the vicinity of Dundas Island in the north, southwards to Fitzhugh Sound) has resulted in stream recoveries of chinook salmon in the Nass, Skeena, Fraser, Somass (Alberni Canal) and Columbia rivers; and of coho salmon in the Nass, Skeena, Oona, Kitimat, Big (Bella Coola), Koeve and Fraser rivers, and in two unnamed streams - one near Cape Fox, Southeast Alaska, and one in Kumelon Inlet, British Columbia.

5. Off the west coast of Vancouver Island (Tables LII, LIII, LIV and LXI;
Fig. 57-60)

United States as well as Canadian trollers fish in international waters in this area, but although the United States effort is considerable, the catches actually made off the coast are not known, since they are merely recorded among the port landings, and these include fish taken farther to the south.

In the Canadian troll fishery important catches of chinook salmon begin to be made early in May, and persist until towards the end of August. Relatively high coho catches continue to be made usually from about mid-June to late August.

Taggings in this area (by both the United States and Canada) have provided recoveries of chinook salmon from the Fraser, Columbia and Sacramento rivers, from streams in Puget Sound, from the Dungeness River in the Strait of Juan de Fuca (in Washington), and from coastal streams of Washington and Oregon States. Stream recoveries of coho salmon have been made in Nitinat Lake and Russian River (both on the southwest coast of Vancouver Island), in the Fraser, Squamish and Nicomekl rivers of southern British Columbia, and in a number of streams in Puget Sound and on the Washington and Oregon coasts.

It is probable, as Milne (1957) has stated, that although the catches in these waters of Columbia River chinook salmon include fish of the "spring", "summer", and "fall" runs, those of the last are of major importance, particularly among the maturing categories.

6. The Strait of Juan de Fuca (Tables LXI and LXII; Fig. 57-60)

Suitable data are not available by which the seasonal progression of the catches of chinook and coho salmon in United States waters of the Strait might be described. To describe the seasonal trends in Canadian waters, the catches in Statistical Area 20 have been used.

Relatively important catches of chinook salmon are made by Canadian trollers from about mid-May to mid-June, and much later by the purse seiners, mainly during most of August. Important catches of coho salmon by purse seine and gill net continue to be made from about mid-August to late September or early October. It is important to recall that in this area much annual variation in the net fishing effort occurs as a result of the restrictions that are imposed in order to effect the management of the runs of Fraser River sockeye and pink salmon.

Tagging by Canada off Sooke, which lies within Area 20, has given stream recoveries of chinook salmon from the Fraser and Columbia rivers, and from streams in Puget Sound. Coho salmon recoveries from the same operations have been made in Nitinat Lake, and the Fraser and Skykomish (Puget Sound) rivers.

From the United States-Canadian taggings in the Strait in 1957 and 1958 (in the territorial waters of both countries) chinook salmon stream recoveries were made in the Fraser and Columbia rivers (and possibly others for which presently available data appear to be incomplete). Coho salmon were recovered in the Fraser, Capilano and Campbell (near White Rock) rivers in British Columbia, and in a number of streams in Puget Sound and on the Washington coast, as well as in the Columbia River.

7. United States waters of Georgia Strait (Fig. 59 and 60)

In the San Juan Islands area the average (1950-1960) daily catch of chinook salmon increased steadily from early July to reach a peak during early August, after which it declined at a fairly uniform rate until late September. The period during which relatively important catches were made was, on the average, from mid-July to early September. The average coho salmon catch (also for 1950-1960) increased from early August and reached peaks during middle to late September, after which it declined quite rapidly. Relatively large catches were made from mid-August to early October.

In the West Beach (Whidbey Island) area the average (1950-1960) catch of chinook salmon was relatively constant from early to late in the season - that is, from early July to early September. The source document (Jewell and Piscus, 1962/63) does not illustrate the average daily coho salmon catch in the West Beach area, but combines it with the Skagit Bay catch. This showed a fairly steadily increasing catch from early August to late September, after which the decline to mid-October was quite rapid.

In the Point Roberts fishery the average (1950-1960) daily chinook salmon catches showed one minor and two major periods of peak catches. In that order these occurred at approximately mid-July, mid-August and mid-September. In each case these peaks were reached by rather rapidly increasing daily catches and were followed by almost equally rapid declining daily catches. The average daily coho catch for the same period increased gradually and fairly steadily over a prolonged period from early August to about mid-September. After this, relatively high, though declining, catches were maintained until early October, following which they fell fairly steadily until the end of October.

The United States tagged chinook salmon in the West Beach area in 1962, and both chinook and coho salmon in the San Juan Islands and West Beach areas in 1964. Because the data provided do not list the tagging dates of recovered fish, it is not possible to prepare tables corresponding to Tables XLIV-LXIII, which give the earliest and latest dates on which fish that were later recovered in streams were tagged in these areas. The actual stream recoveries were as follows: (a) West Beach tagging, chinook salmon - Cowichan and Big Qualicum rivers (on Vancouver Island), Fraser River, Columbia River (Astoria), and several streams in Puget Sound; (b) West Beach tagging, coho salmon - French Creek, Cowichan and Fraser rivers (British Columbia), Nooksack River, several rivers inside Puget Sound and the Hoko River in the Strait of Juan de Fuca near Neah Bay; (c) San Juan Islands tagging, chinook salmon - the Fraser River and the Samish River (Puget Sound); (d) coho salmon - 13 different streams on Vancouver Island, the Fraser River and eight streams on the lower British Columbia mainland; and in Washington State, two streams in Georgia Strait, two in the Strait of Juan de Fuca and several streams (or hatcheries) in Puget Sound.

8. The east coast of Vancouver Island (Tables LV, LIX and LX; Fig. 57-60)

In Canadian waters of the Strait of Georgia (Fisheries Statistical Areas 14-19) the average troll catch of chinook salmon has remained relatively high and constant for almost the full fishing season, roughly from mid-May to mid-October. However, during this period the highest average catches were made late in the season, during September. The average troll catch of coho salmon rose rapidly to a peak shortly after the fishing season opened (June 15), after which it declined quite rapidly until late in July, following which the decrease was more gradual until the end of the season. Thus, relatively important coho catches were made from mid-June to middle or late September.

Taggings in Queen Charlotte Strait to the north, and in Georgia Strait at several locations off the east coast of Vancouver Island, gave stream recoveries of chinook salmon to the Cowichan River (Vancouver Island), to the Fraser and Columbia rivers and to several streams in Puget Sound. Coho stream recoveries from these operations were made in the Puntledge River (Vancouver Island), in the Fraser River and in six other streams of the lower British Columbia mainland, and in the Nooksack and Samish rivers of Washington State.

9. Off the coast of Washington (Tables LVI and LXIII)

Available catch statistics for the troll fisheries off the coast of Washington are not by area of catch, but by port of landing. Therefore it is not possible to illustrate and describe the seasonal change in the average catches of chinook and coho salmon in these waters in the same way as has been done for the fisheries to the north. However, information on the troll fisheries does indicate that chinook catches are relatively large from roughly late April to late August, and coho catches from throughout June to mid-September.

Stream recoveries of chinook salmon tagged by the United States off Umatilla Reef (in 1949) were made in the Columbia and Sacramento rivers and in streams of Puget Sound. From taggings farther south, off the Columbia River and along the Oregon coast, chinook stream recoveries were made in the Columbia River and in coastal streams of Oregon and California; and coho stream recoveries in the Fraser, Nooksack and Columbia rivers, in Puget Sound streams, and in Washington and Oregon coastal streams.

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- Table XXII (this document) - additional miscellaneous references on chinook salmon taggings are given in this table.
- Table XXXIX (this document) - additional miscellaneous references on coho salmon taggings are given in this table.

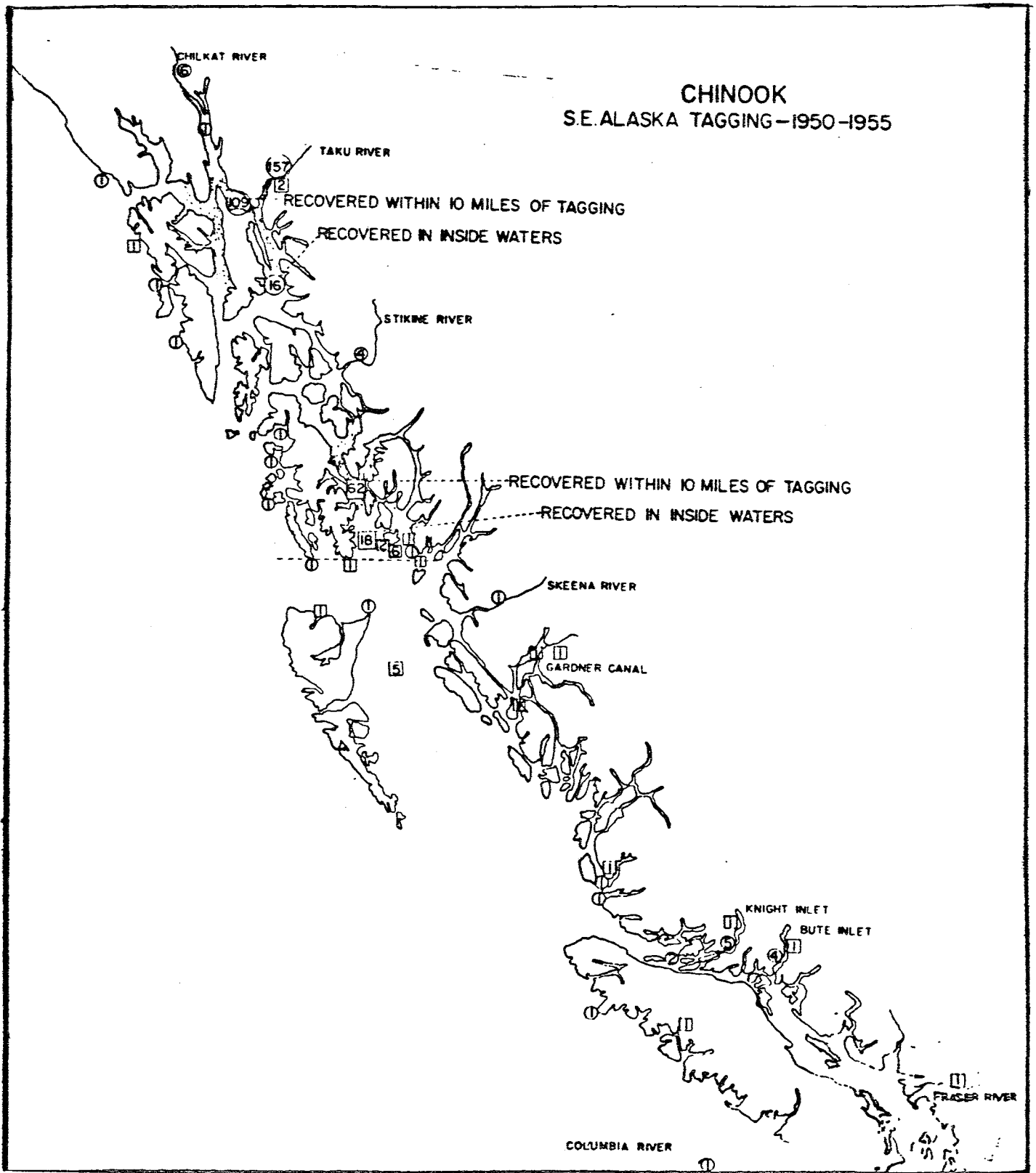


Figure Recoveries of chinook salmon tagged by the United States in inside waters of Southeast Alaska in 1950-1955. Drawn from data provided by the Alaska Department of Fish and Game. (From Godfrey, 1968, Fig. 1.)

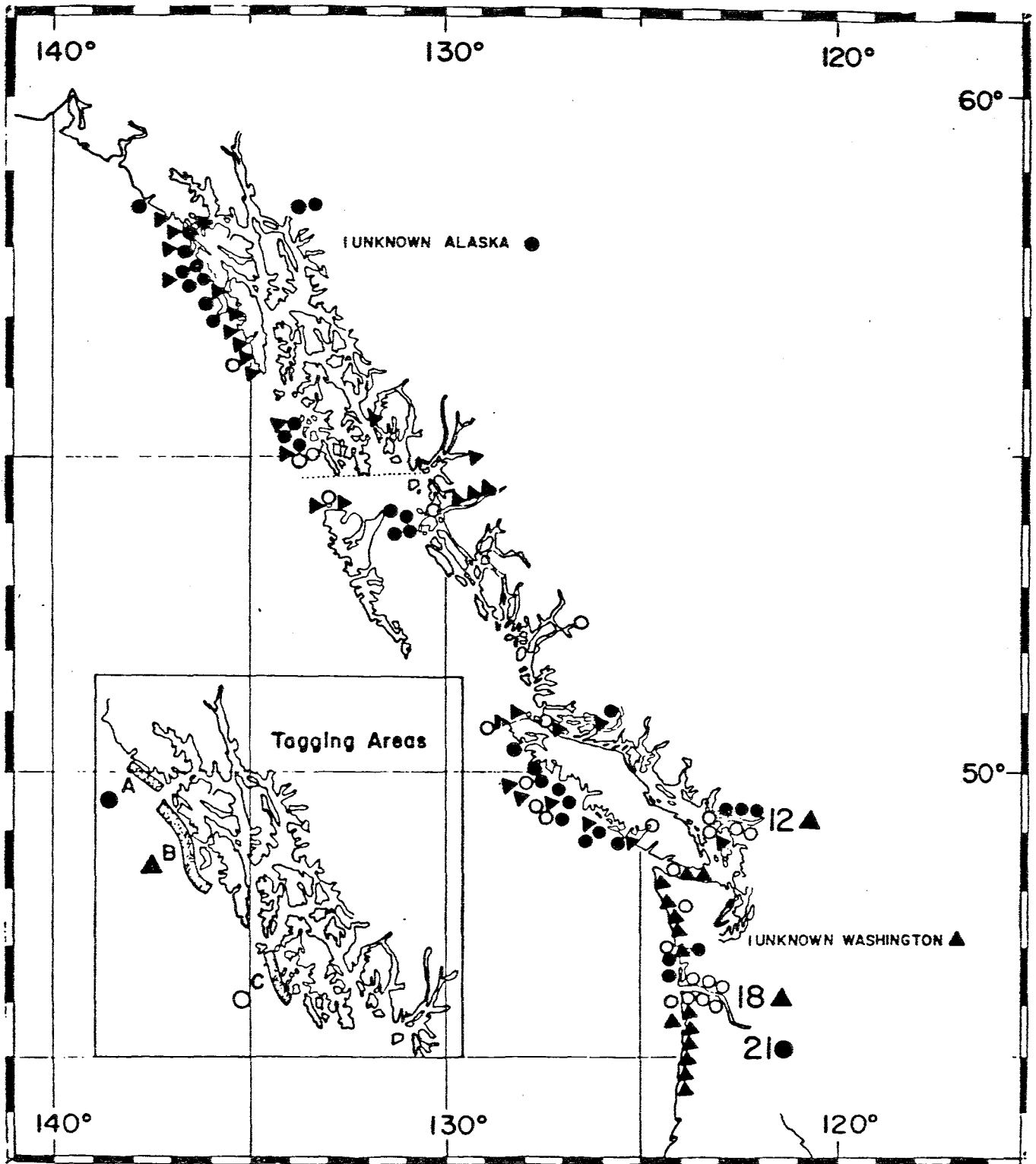


Figure Recoveries of chinook salmon tagged by the United States off the west coast of Southeast Alaska in 1950-1952. Redrawn from Parker and Kirkness, 1956. (From Godfrey, 1968, Fig. 2.)

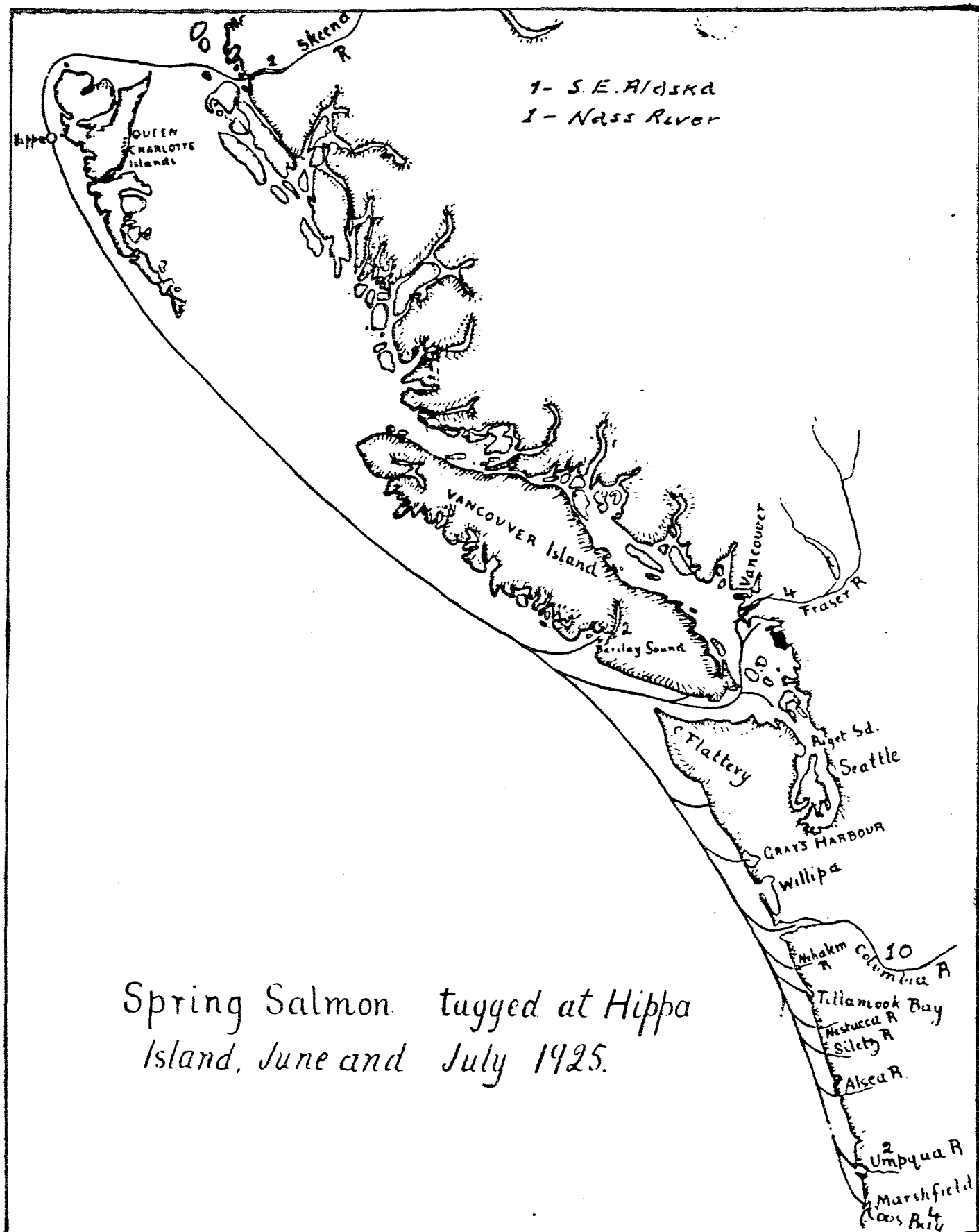


Figure Recoveries of chinook salmon tagged by Canada off Hippa Island, Queen Charlotte Islands, in 1925. Reproduced from Williamson, 1927, with later recoveries added (Williamson, 1929, and Clemens, 1932). (From Godfrey, 1968, Fig. 3.)

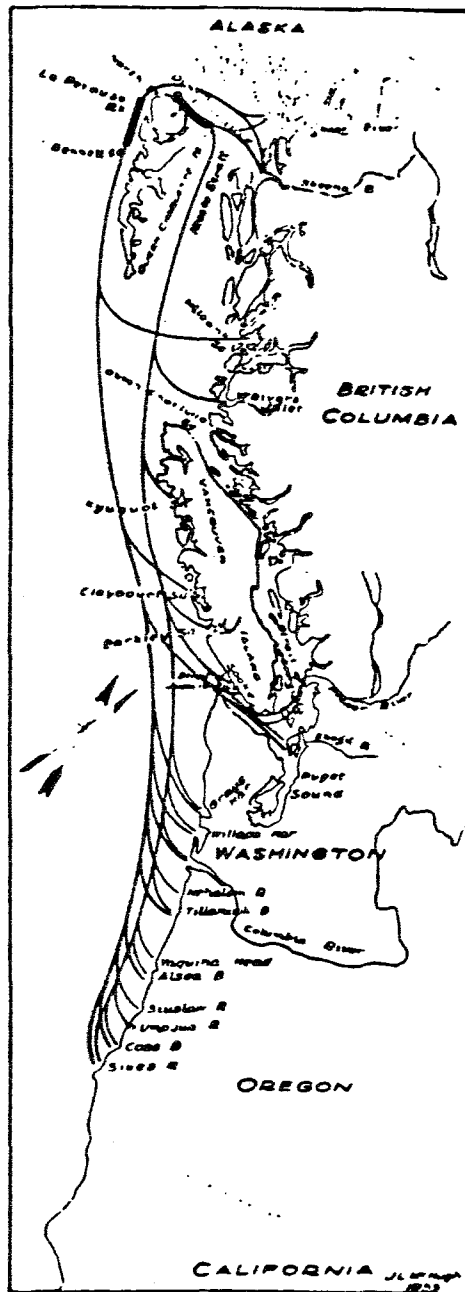


Figure Recoveries of chinook salmon tagged by Canada off the north and north-west coasts of the Queen Charlotte Islands in 1929 and 1930. Reproduced from Pritchard, 1934a. (From Godfrey, 1968.)

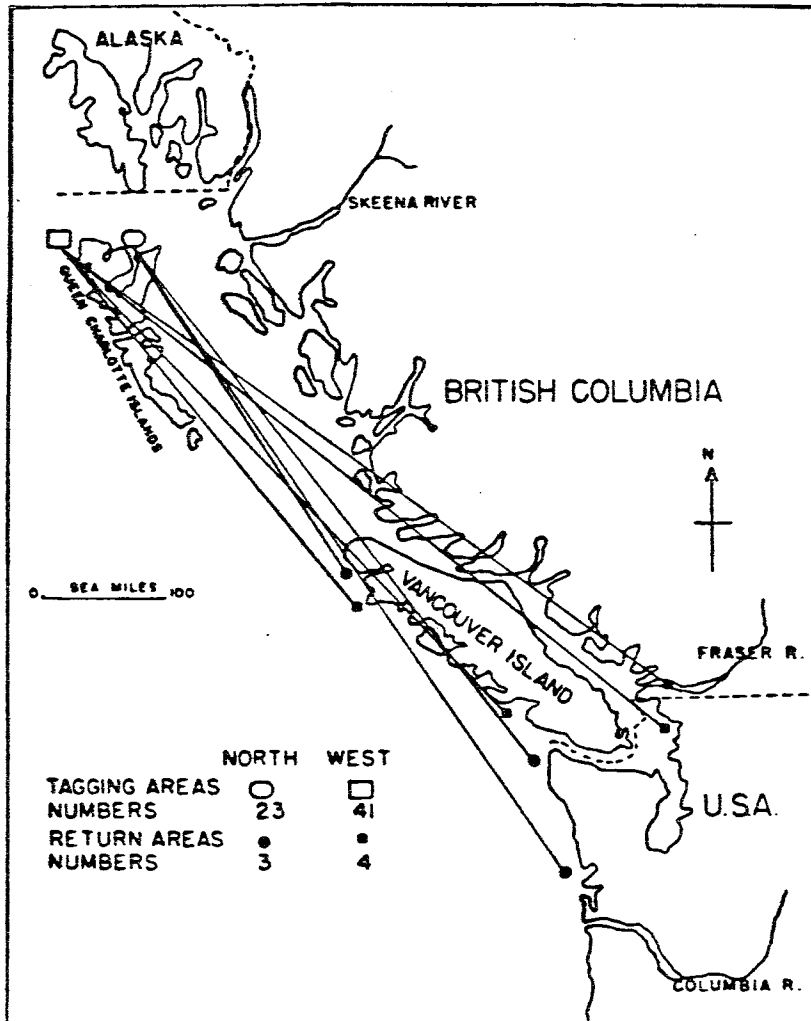


Figure Recoveries of chinook salmon tagged by Canada off the north and northwest coasts of the Queen Charlotte Islands in 1951. Reproduced from Milne, 1957. (From Godfrey, 1968, Fig. 5.)

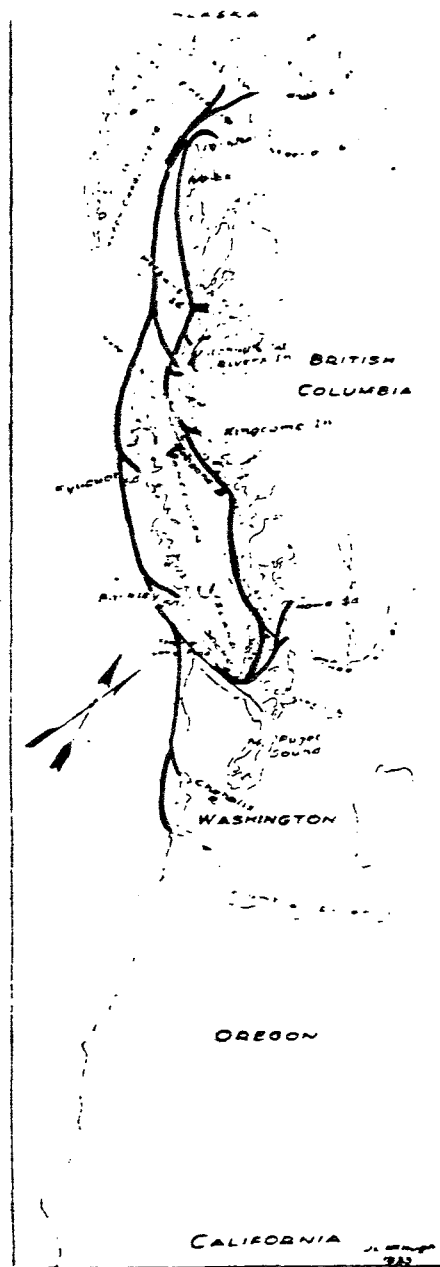


Figure Recoveries of chinook salmon tagged by Canada in north and central Hecate Strait in 1930. Reproduced from Pritchard, 1934a. (From Godfrey, 1968, Figure 6.)

(Quality of mechanical reproduction poor - refer to original)

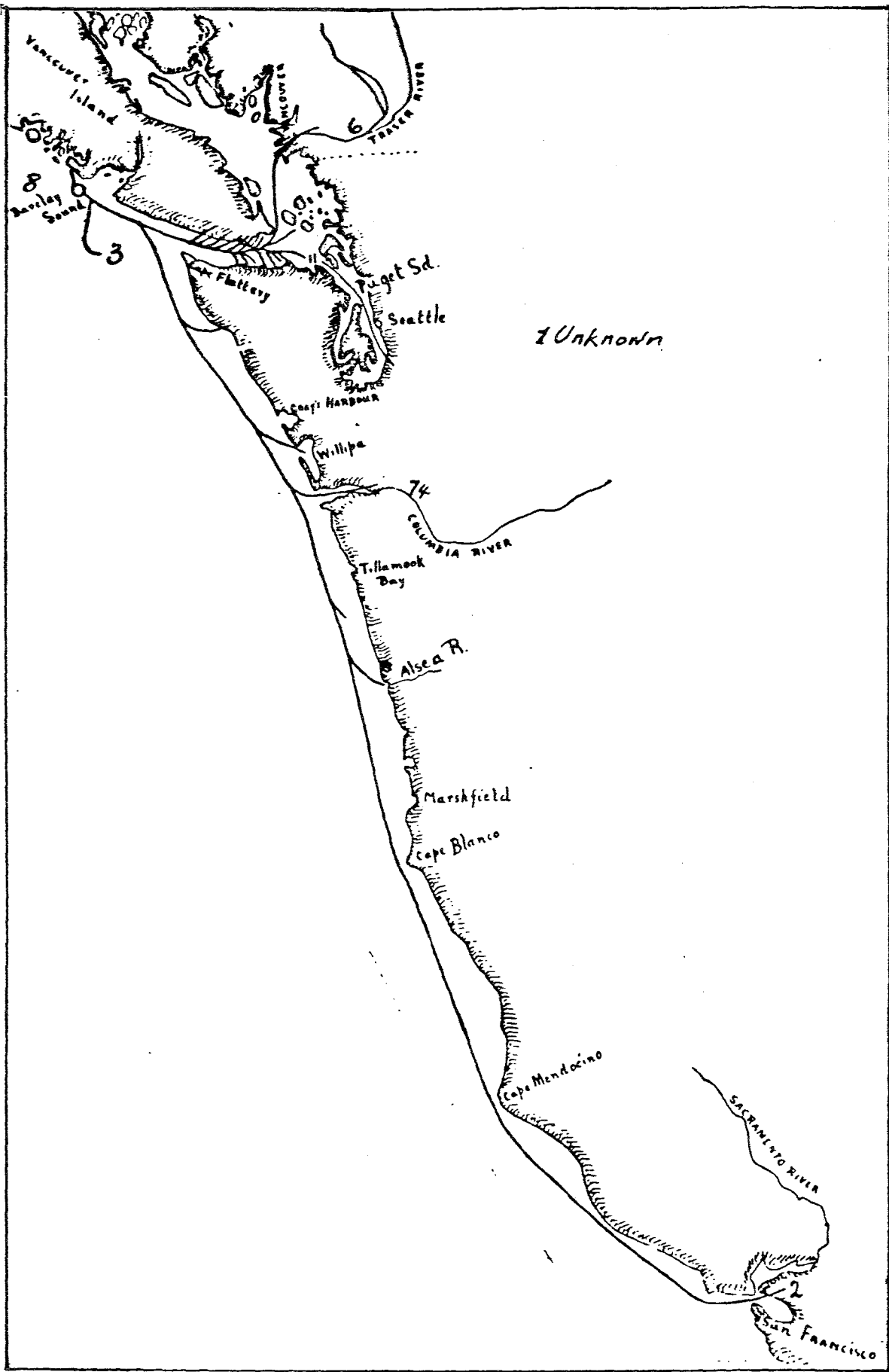


Figure Recoveries of chinook salmon tagged by Canada off Barclay Sound in 1925. Reproduced from Williamson, 1927, with later recoveries added (Williamson, 1929, and Clemens, 1932). (From Godfrey, 1968, Fig. 7.)

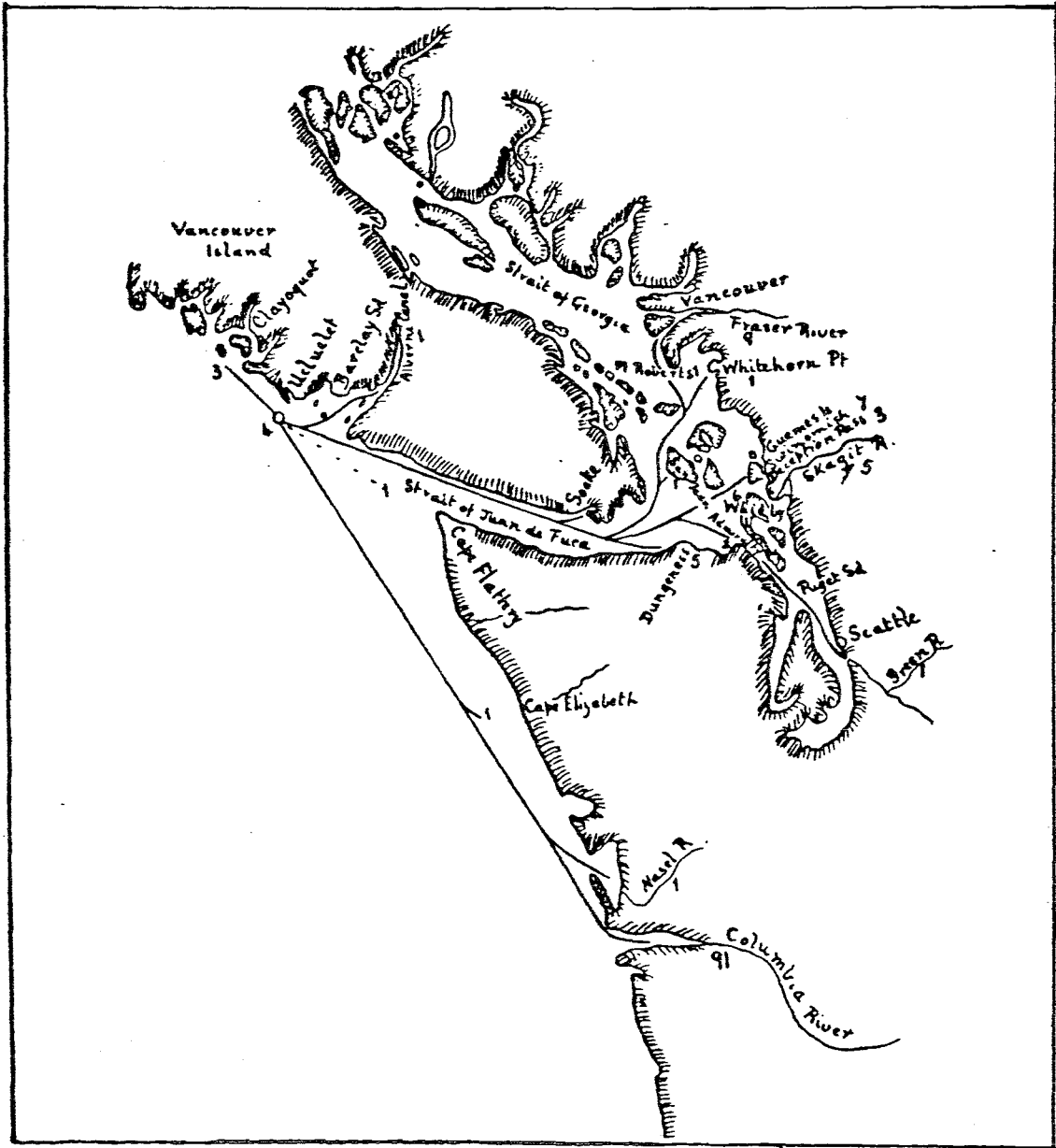


Figure Recoveries of chinook salmon tagged by Canada off Barclay Sound in 1926. Reproduced from Williamson, 1929, with later recoveries added (Williamson and Clemens, 1932). (From Godfrey, 1968, Fig. 8.)

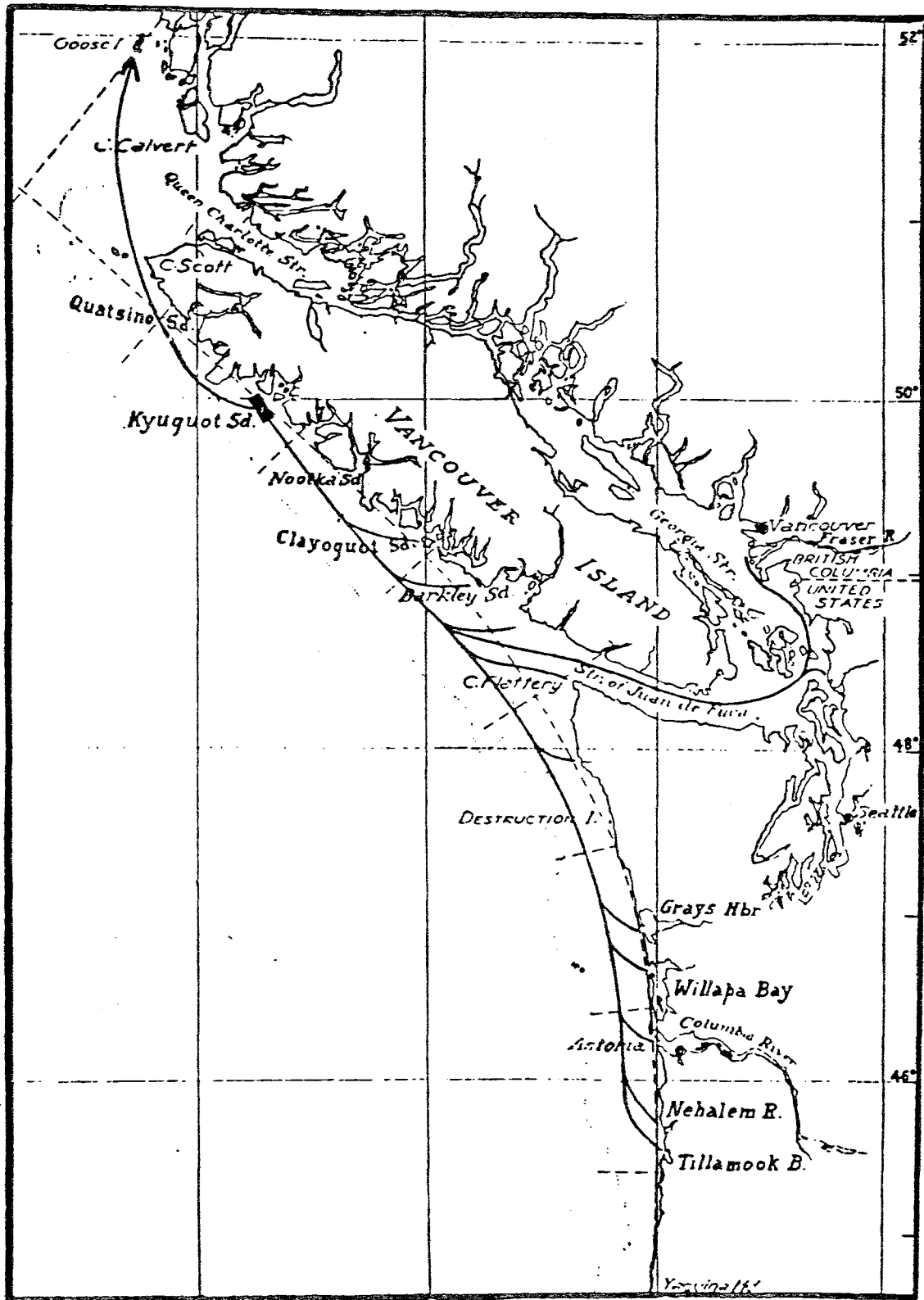


Figure Recoveries of chinook salmon tagged by Canada off Kyuquot Sound in 1927. Reproduced from Williamson and Clemens, 1932. (From Godfrey, 1968, Fig. 9.)

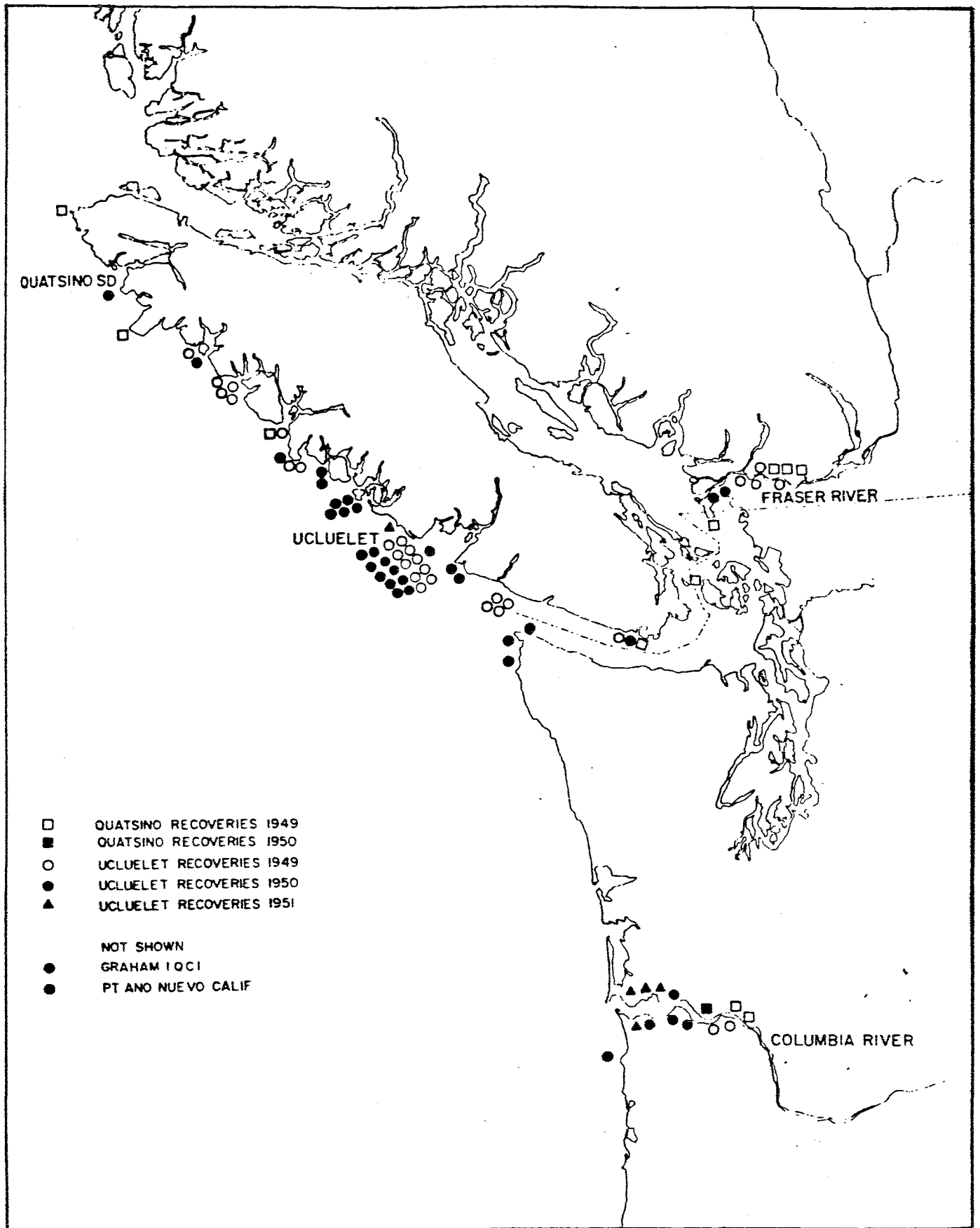


Figure Recoveries of chinook salmon tagged by Canada off Quatsino and Barclay Sounds in 1949. Redrawn from Neave, 1951, with later recoveries added (Milne, 1957). (From Godfrey, 1968, Fig. 10.)

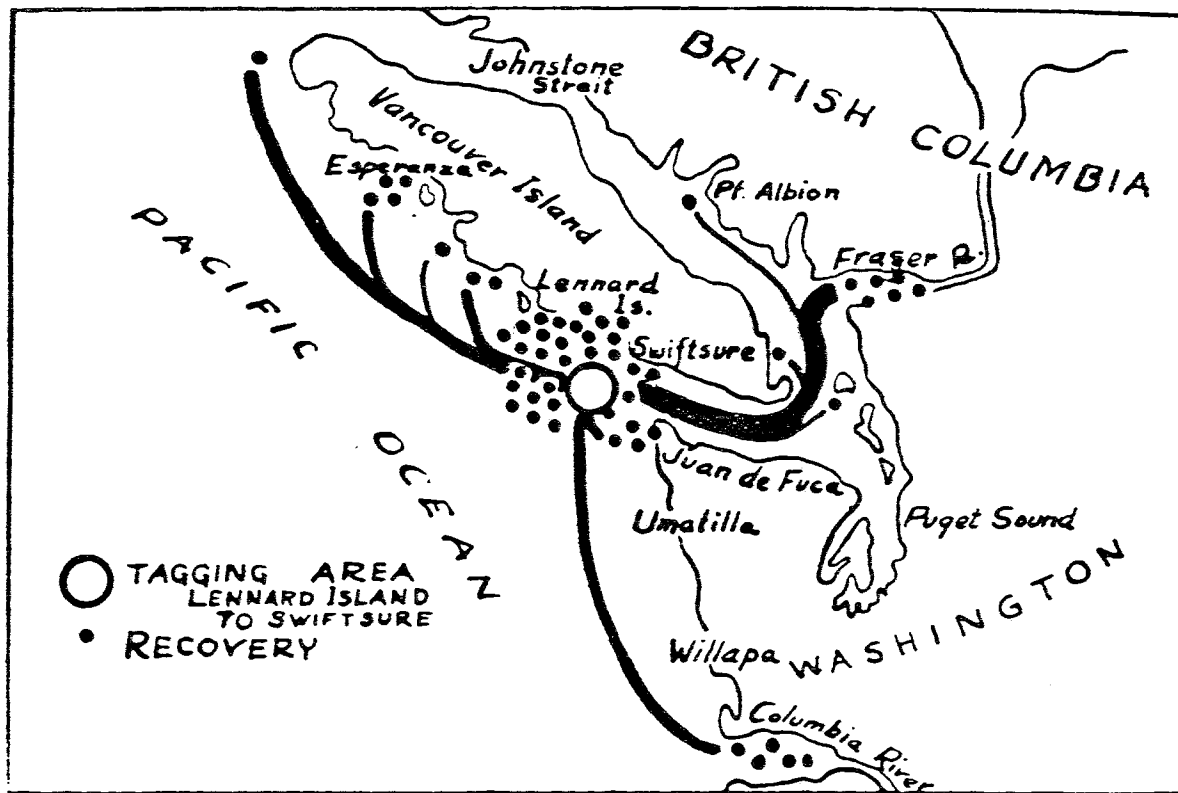


Figure Recoveries of chinook salmon tagged by the United States in the Swiftsure-Lennard Island area in 1949. Reproduced from Kauffman, 1951. (From Godfrey, 1968, Fig. 11.)

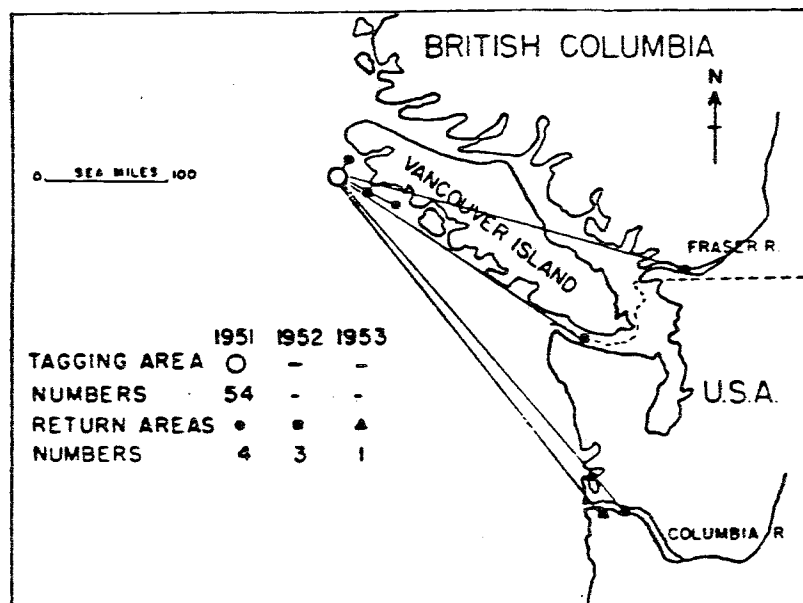


Figure Recoveries of chinook salmon tagged by Canada off Quatsino Sound in 1951. Reproduced from Milne, 1957. (From Godfrey, 1968, Fig. 12.)

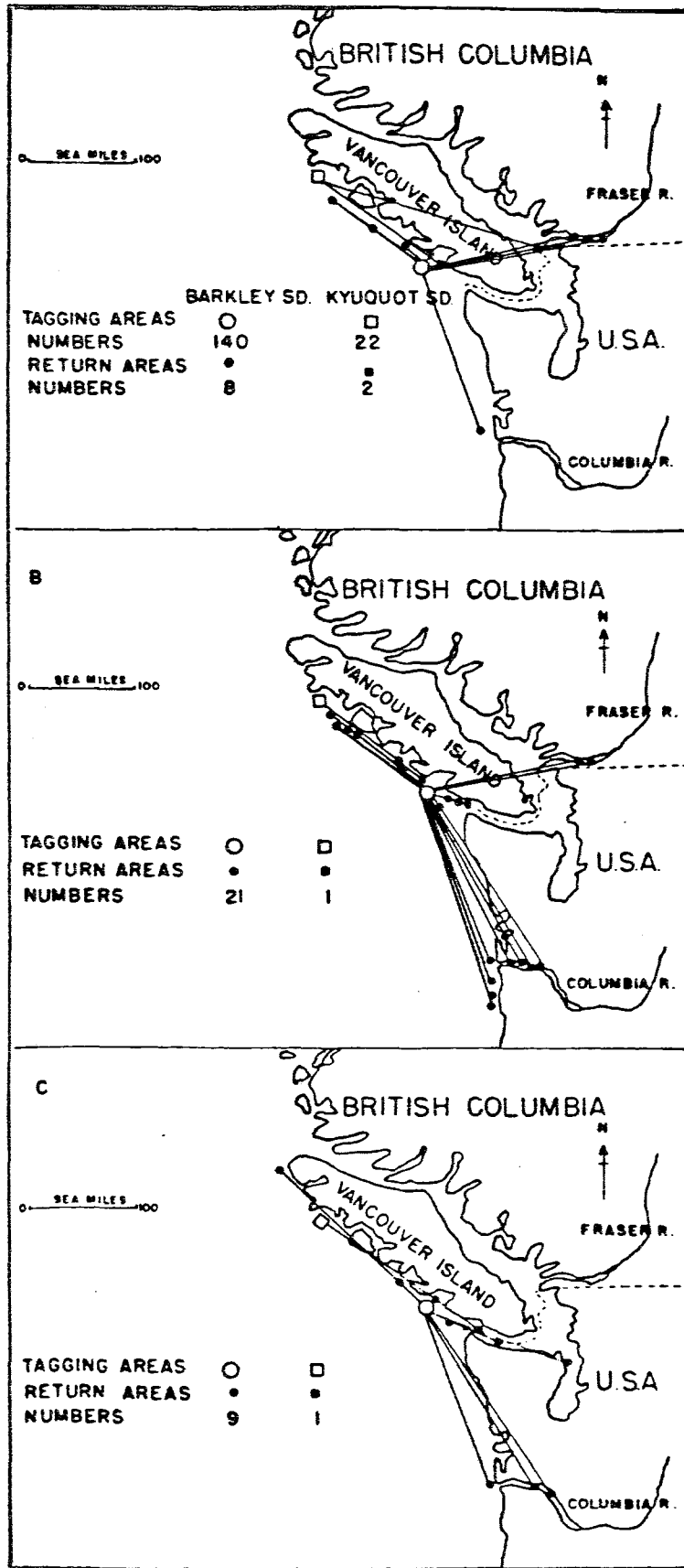


Figure Recoveries of chinook salmon tagged by Canada off Kyuquot and Barkley Sounds in 1950. Reproduced from Milne, 1957. (From Godfrey, 1968, Fig. 13.)

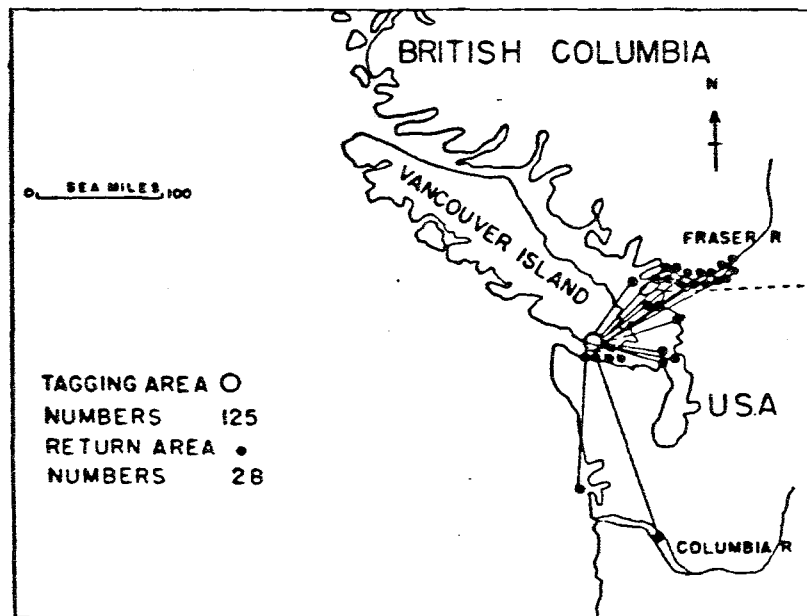


Figure Recoveries of chinook salmon tagged by Canada from the traps at Sooke in 1952. Reproduced from Milne, 1957. (From Godfrey, 1968, Fig. 14.)

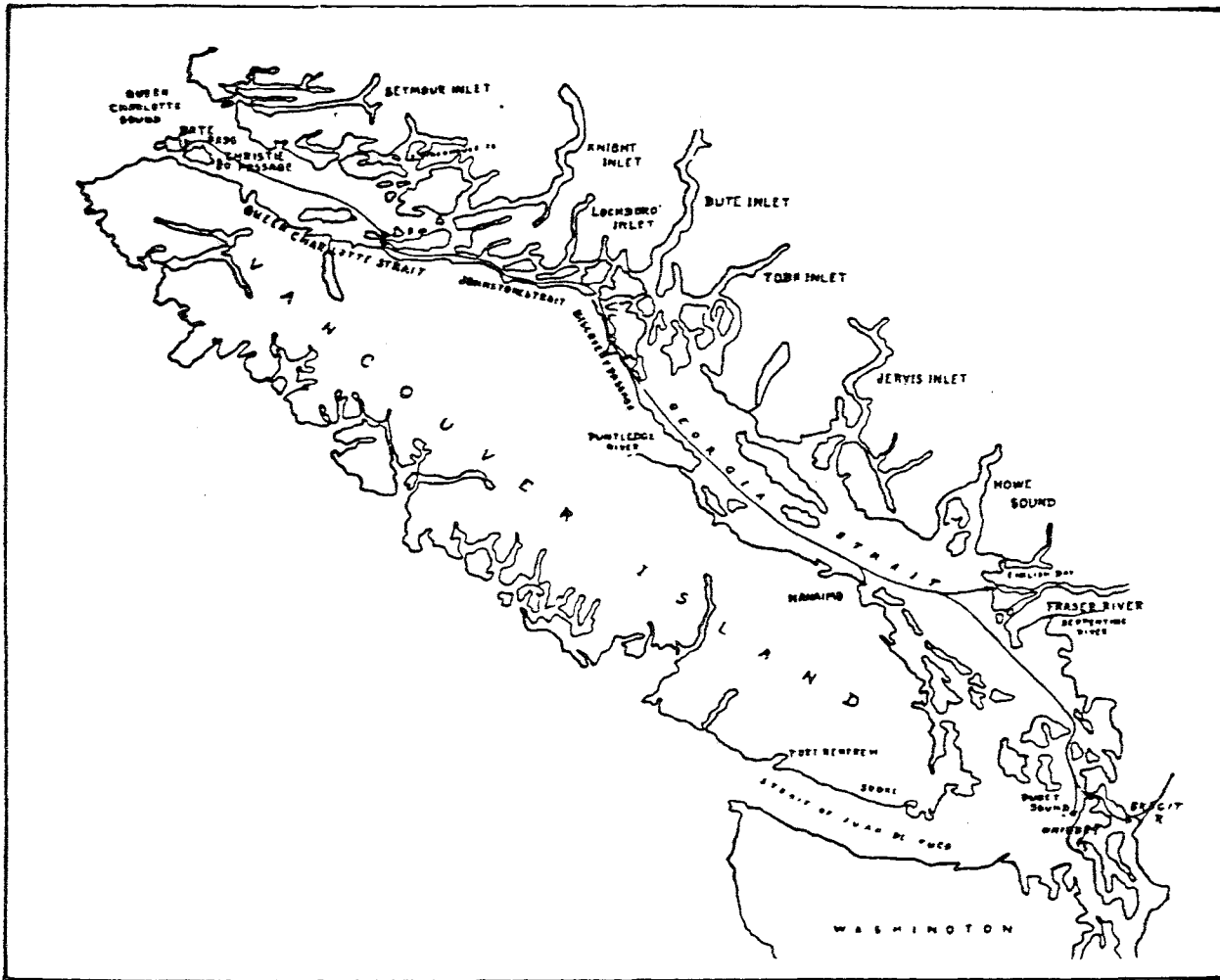


Figure Recoveries of chinook salmon tagged by Canada in Queen Charlotte Strait in 1928. Reproduced from Clemens, 1932. (From Godfrey, 1968, Fig. 15.)

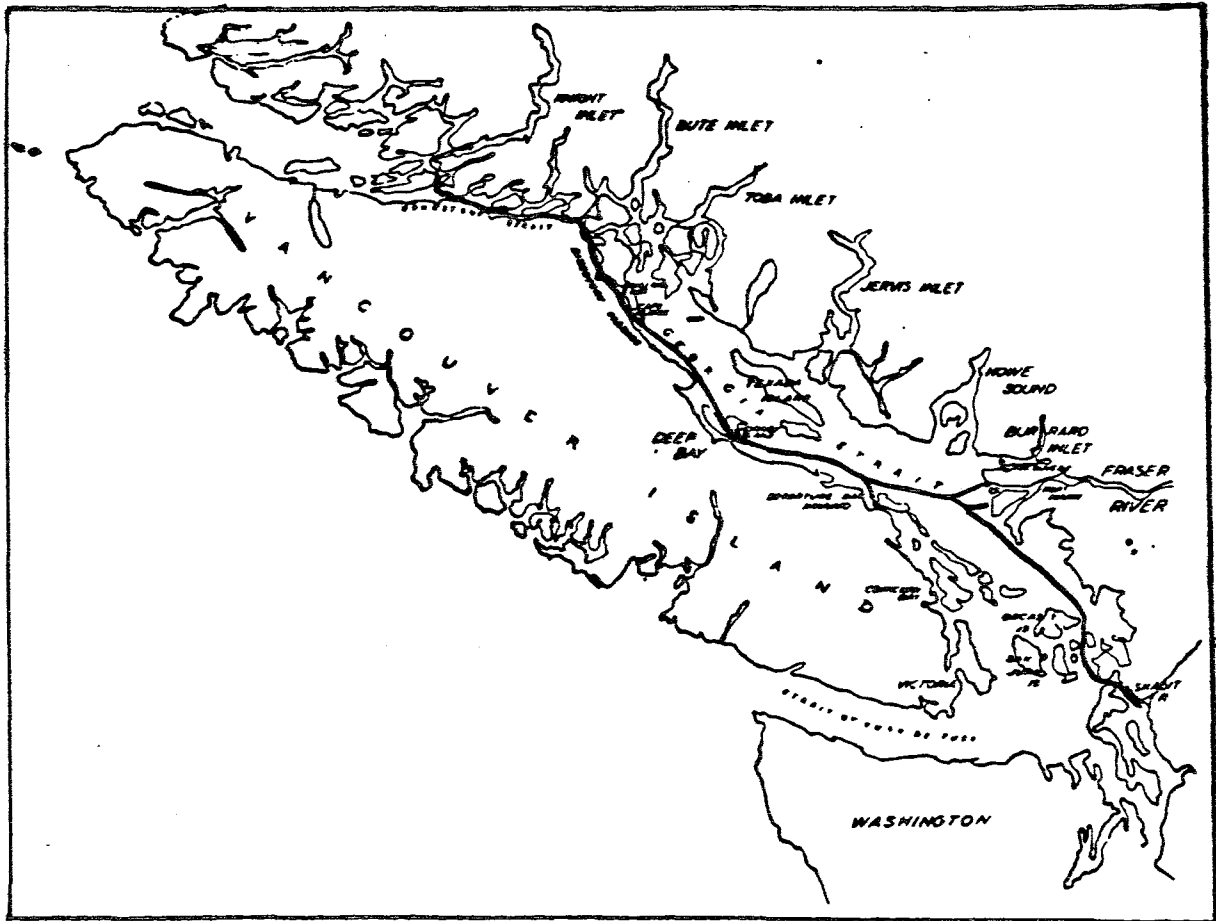
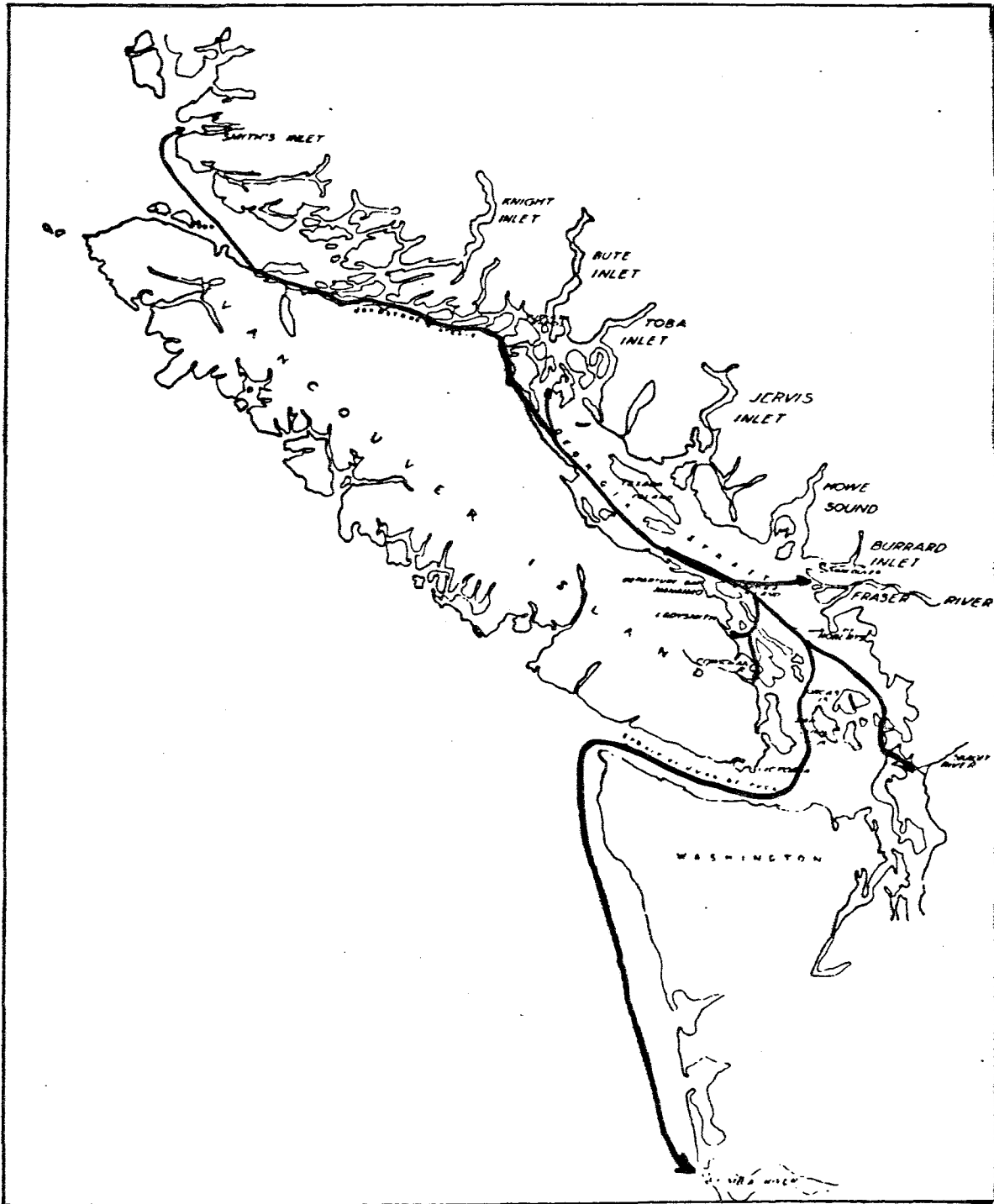
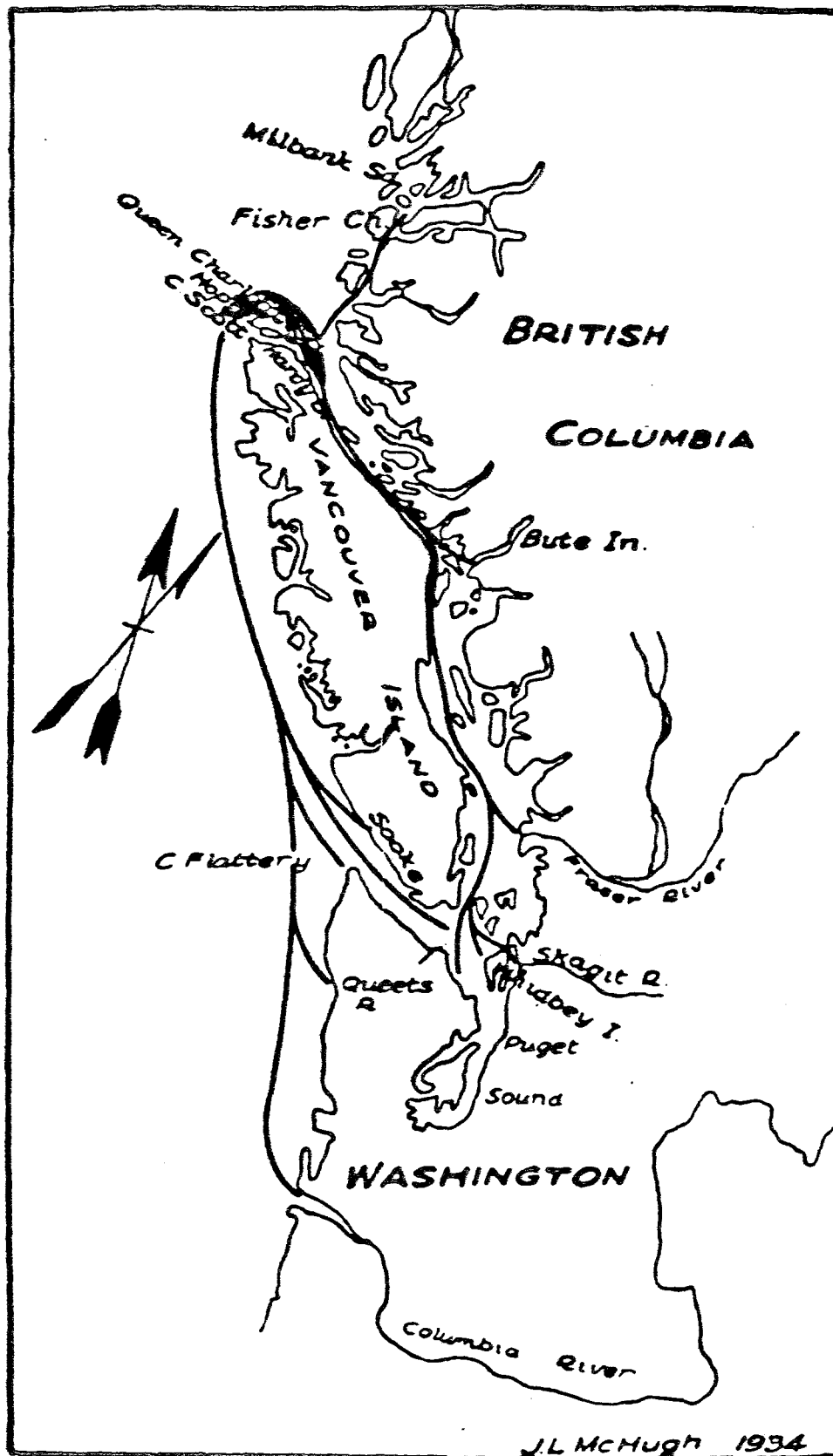


Figure Recoveries of chinook salmon tagged by Canada at Deep Bay in 1927. Reproduced from Clemens, 1932. (From Godfrey, 1968, Fig. 16.)



Figure

Recoveries of chinook salmon tagged by Canada in the Nanaimo area in 1928. Reproduced from Clemens, 1932. (From Godfrey, 1968, Fig. 17.)



Figure

Recoveries of chinook salmon tagged by Canada off the north and north-east coasts of Vancouver Island in 1930. Reproduced from Pritchard, 1934a. (From Godfrey, 1968, Fig. 18.)

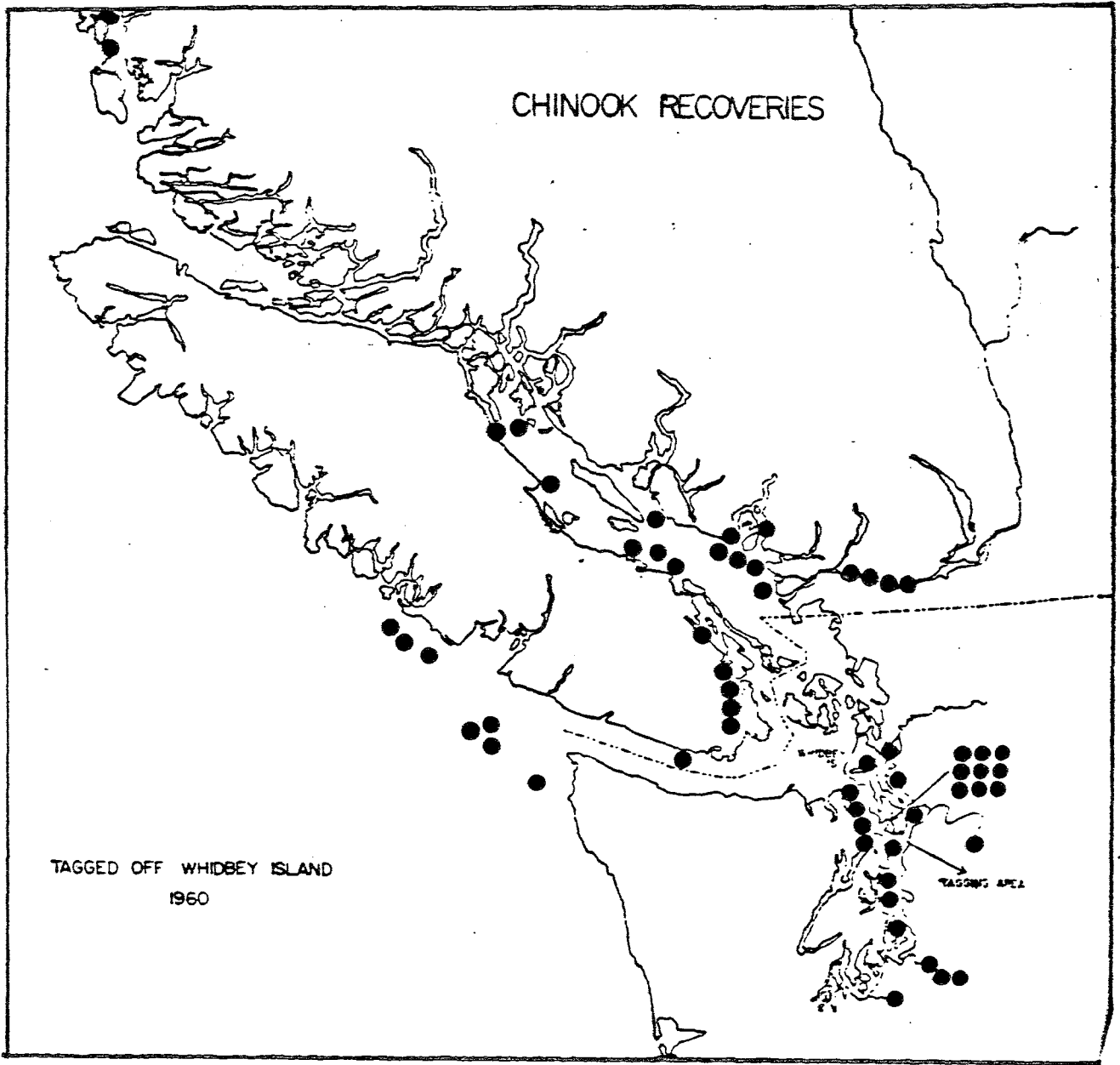


Figure Recoveries of chinook salmon tagged by the United States off the southwest coast of Whidbey Island in 1960. Redrawn from Fig. 8 of Haw, 1963. (From Godfrey, 1968, Fig. 19.)

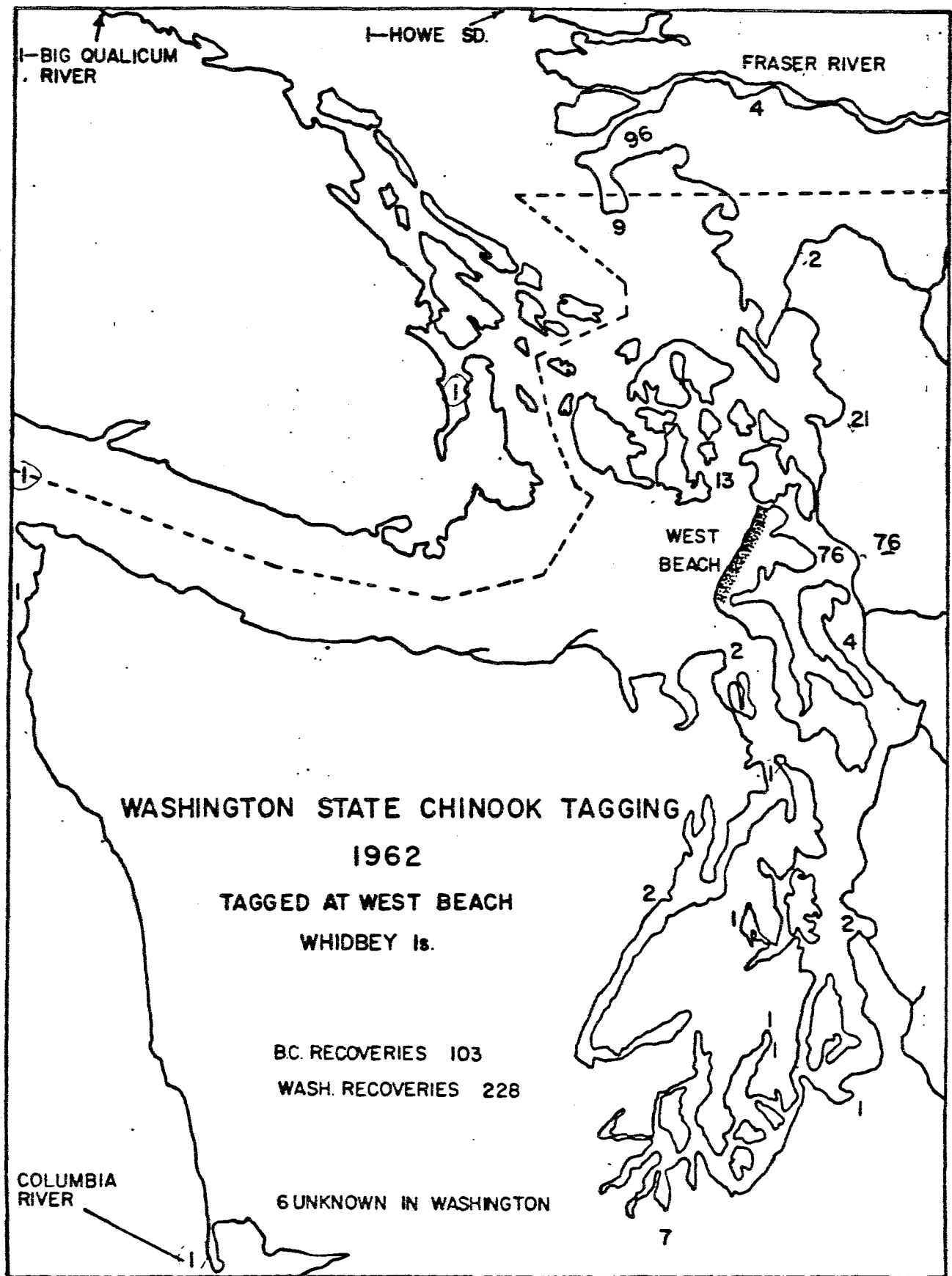


Figure Recoveries of chinook salmon tagged by the United States off West Beach, Whidbey Island, in 1962. Drawn from data provided by Washington State Department of Fisheries. (From Godfrey, 1968, Fig. 20.)

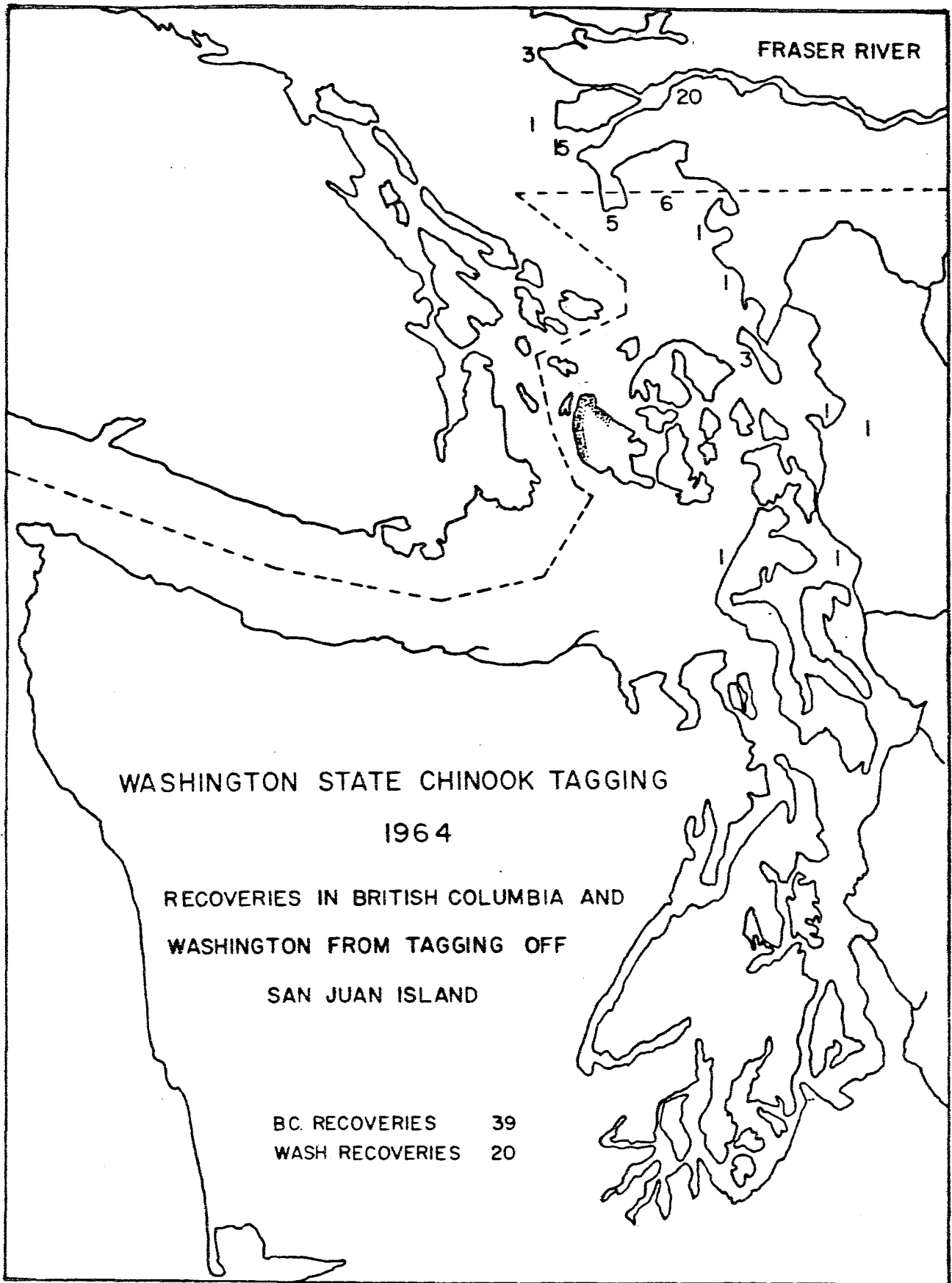


Figure Recoveries of chinook salmon tagged by the United States off San Juan Island in 1964. Drawn from data provided by Washington State Department of Fisheries. (From Godfrey, 1968, Fig. 22.)

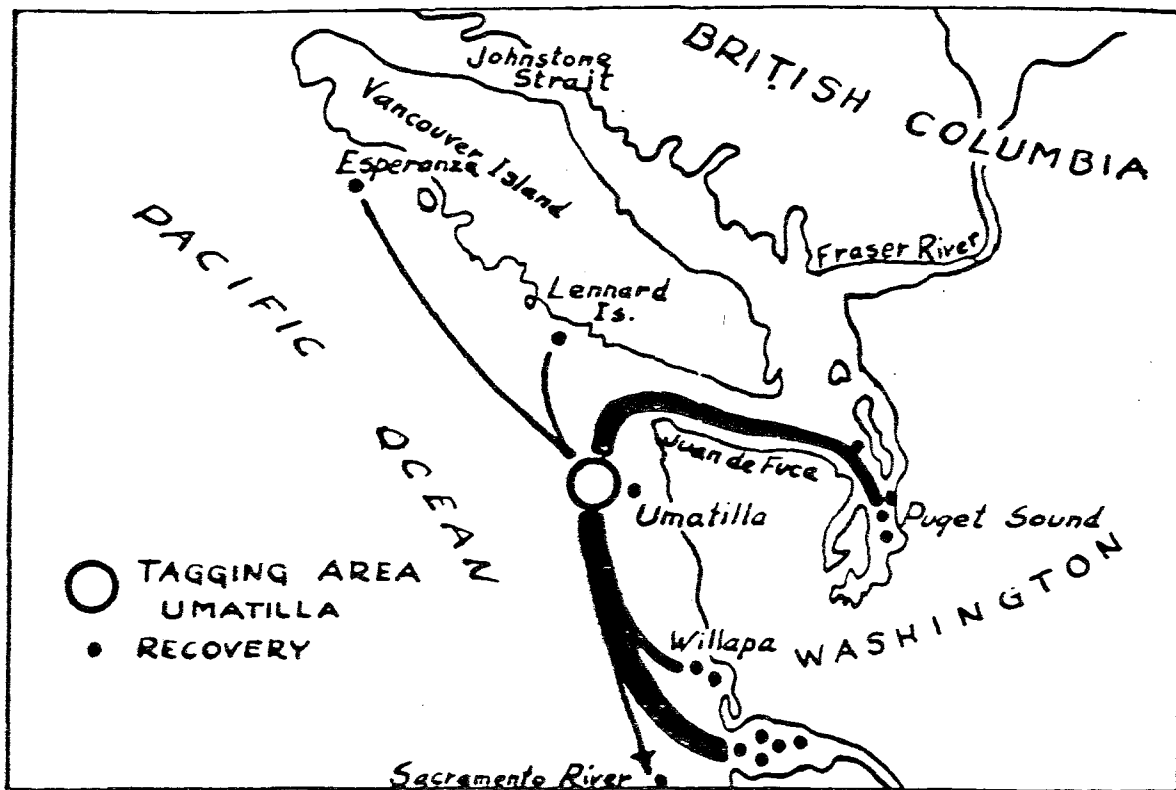


Figure Recoveries of chinook salmon tagged by the United States in the Umatilla Reef area in 1949. Reproduced from Kauffman, 1951. (From Godfrey, 1968, Fig. 23.)

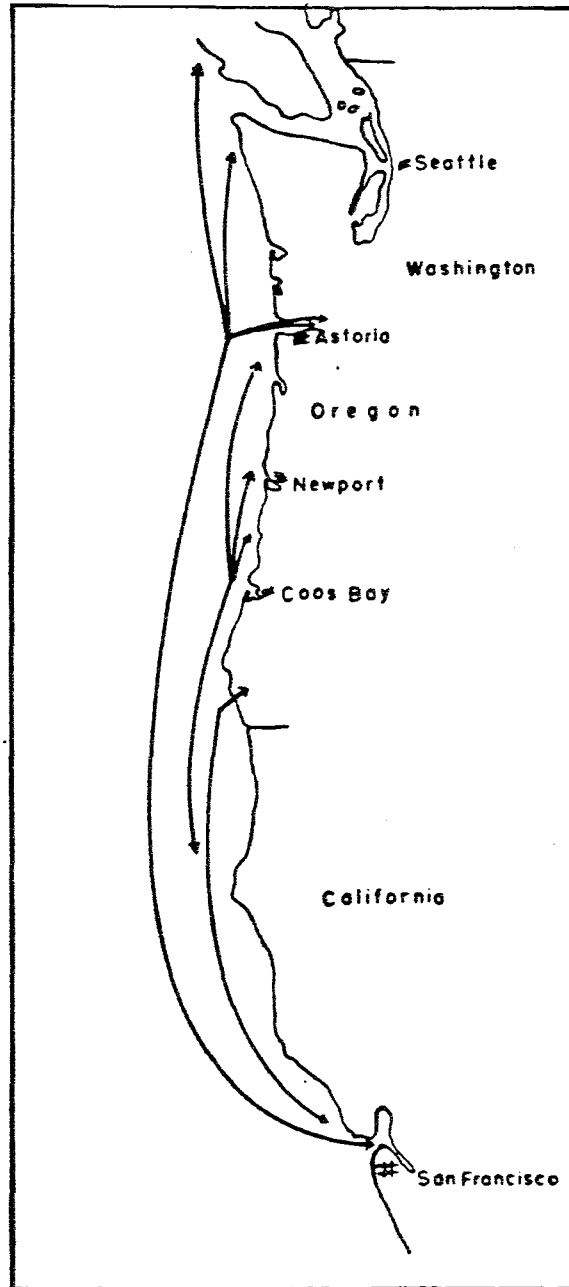
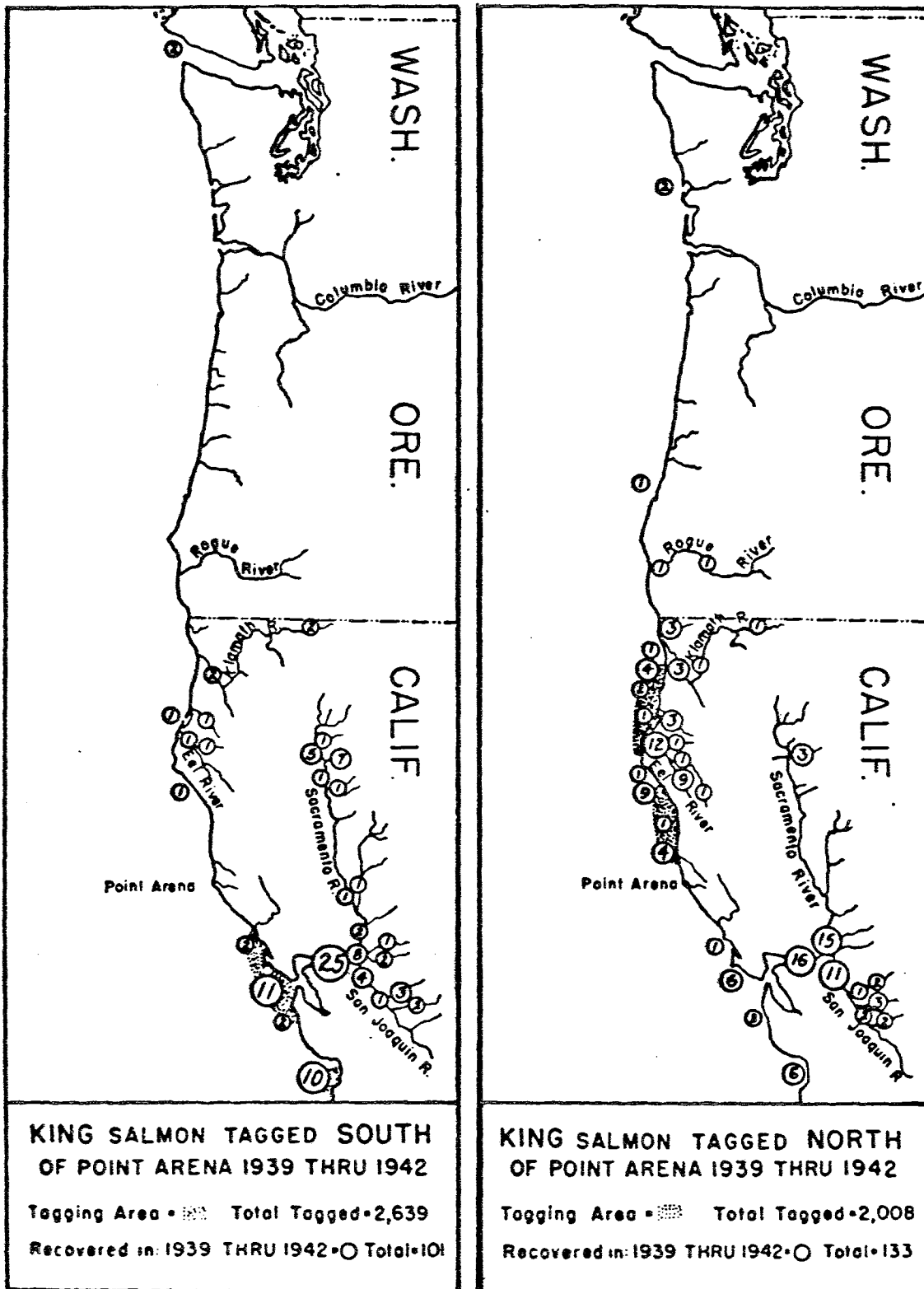
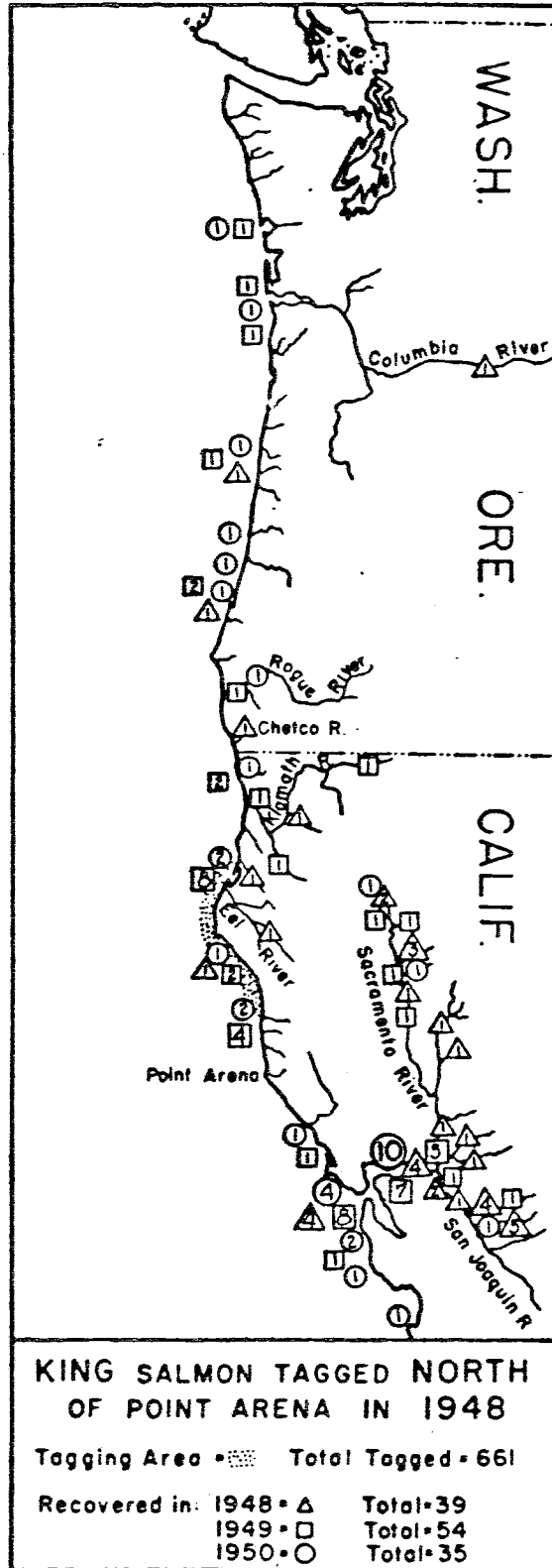


Figure Recoveries of chinook salmon tagged by the United States off the Columbia River and the coast of Oregon in 1948-1949. Reproduced from Van Hying, 1951. (From Godfrey, 1968, Fig. 24.)



Figure

Recoveries of chinook salmon tagged by the United States off the coast of California north and south of Point Arena in 1939-1942. Reproduced from Fry and Hughes, 1951. (From Godfrey, 1968, Fig. 25.)



Figure

Recoveries of chinook salmon tagged by the United States off the coast of California north of Point Arena in 1948. Reproduced from Fry and Hughes, 1951. (From Godfrey, 1968, Fig. 26.)

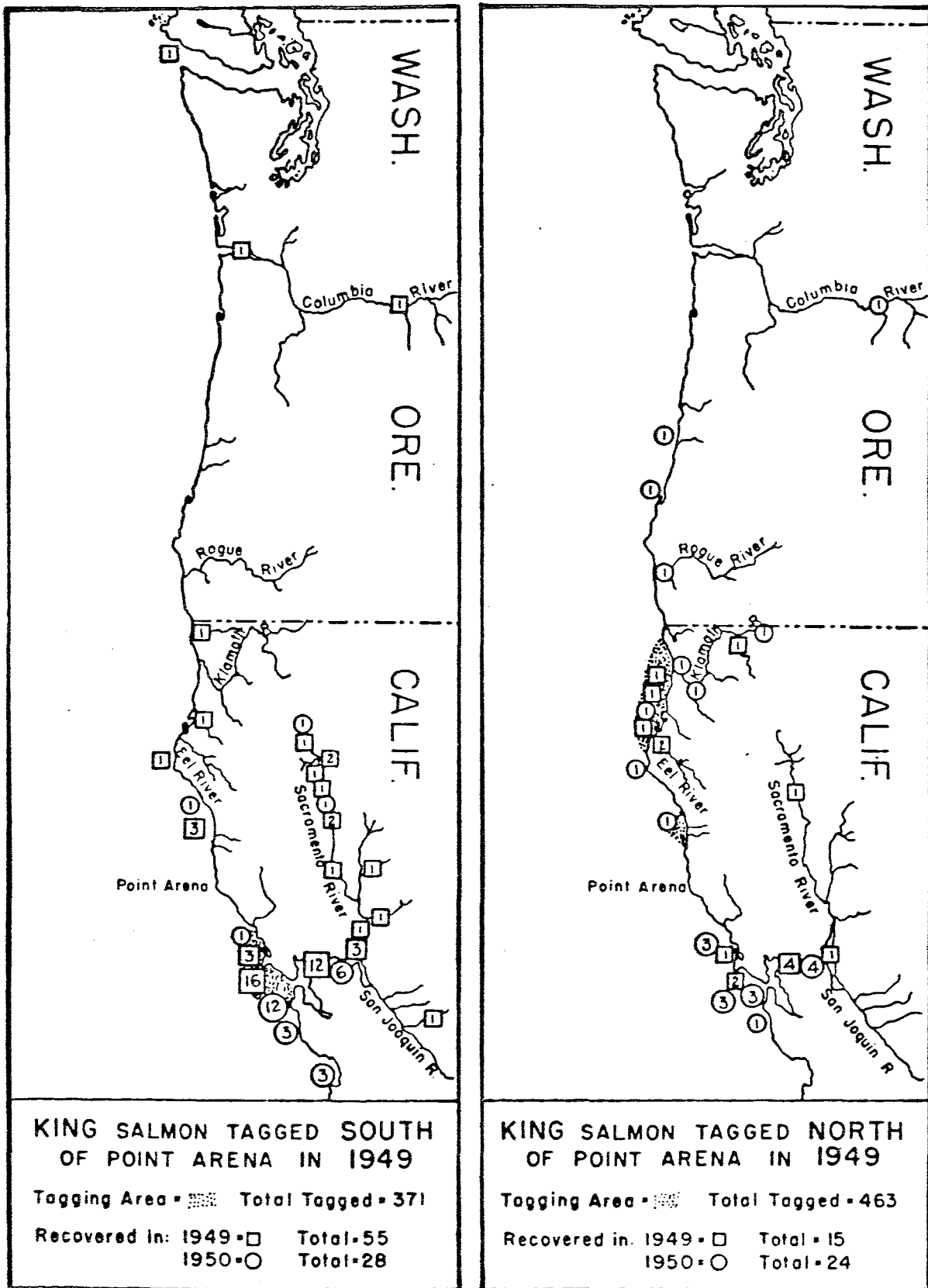
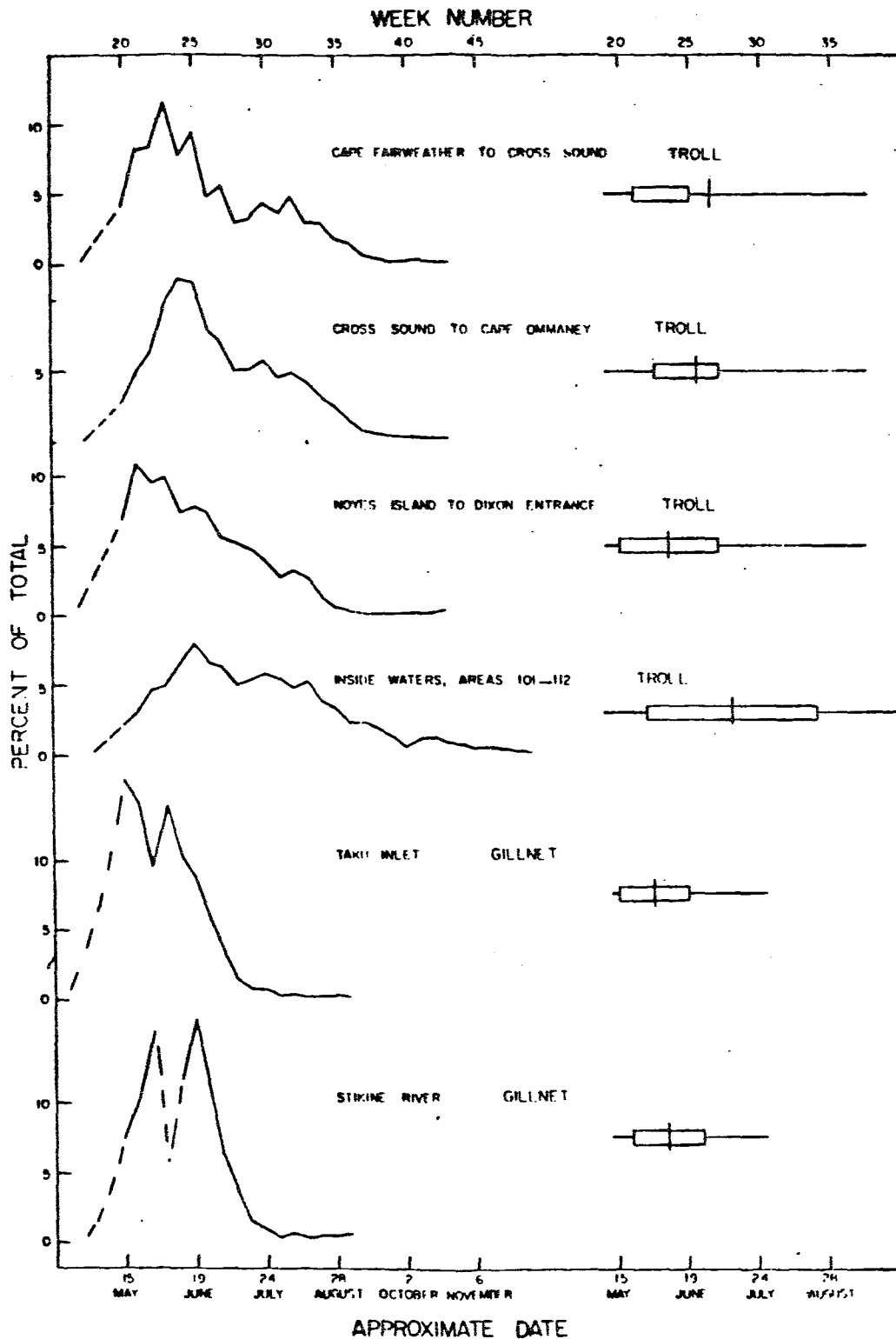


Figure Recoveries of chinook salmon tagged by the United States off the coast of California north and south of Point Arena in 1949. Reproduced from Fry and Hughes, 1951. (From Godfrey, 1968, Fig. 27.)



Figure

Average weekly catches of chinook salmon in areas in Southeast Alaska, 1960-1964; in pieces. The illustrations on the right show the full period (approximately) over which some catches of chinook salmon were made (the horizontal line), the period over which relatively large catches were made (the bar), and the date when 50% of the final total (average) catch had been attained (the vertical line). (Catches for areas 101-112 combined have been averaged for the years 1963-1965.) (From Godfrey, 1968, Fig. 55.)

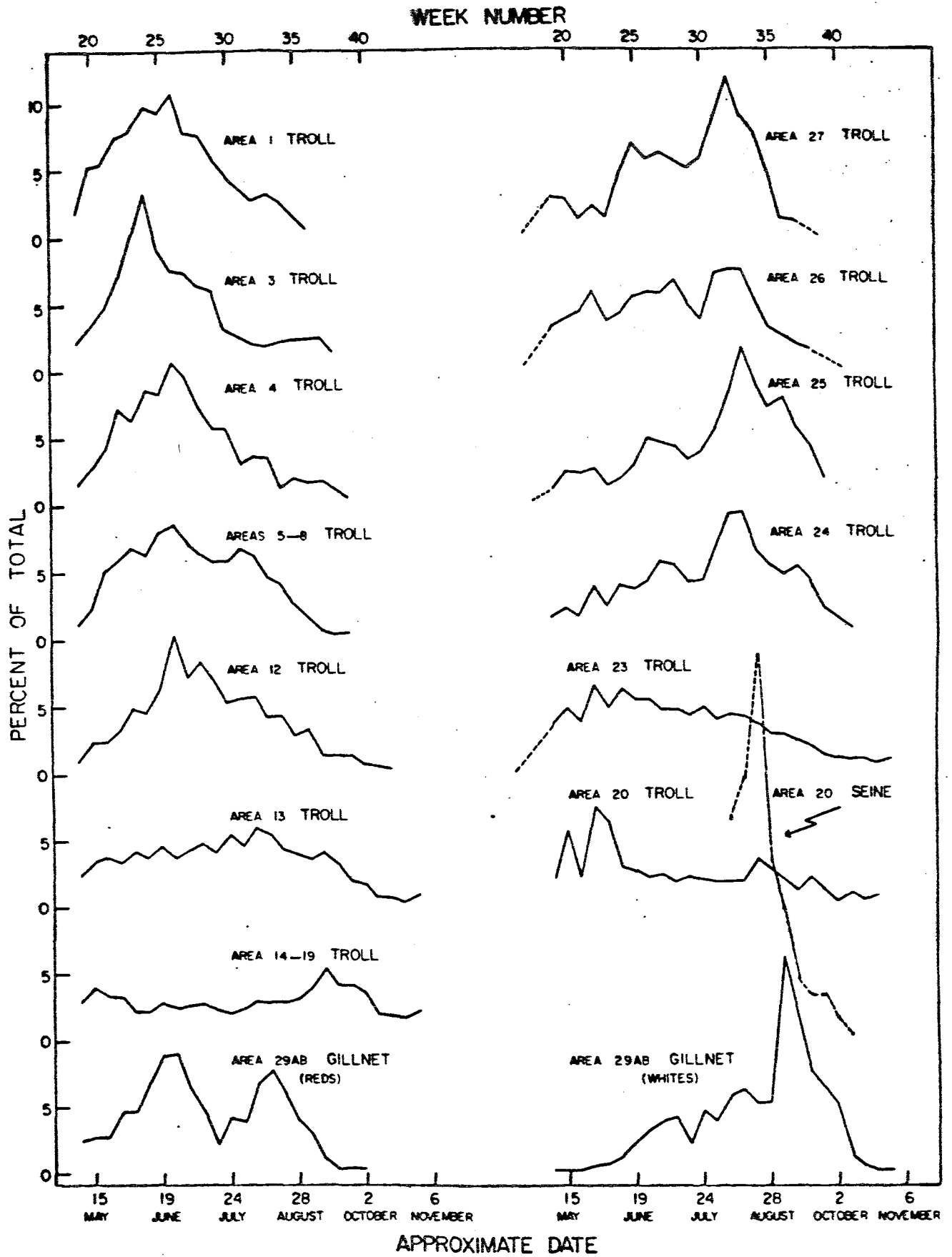
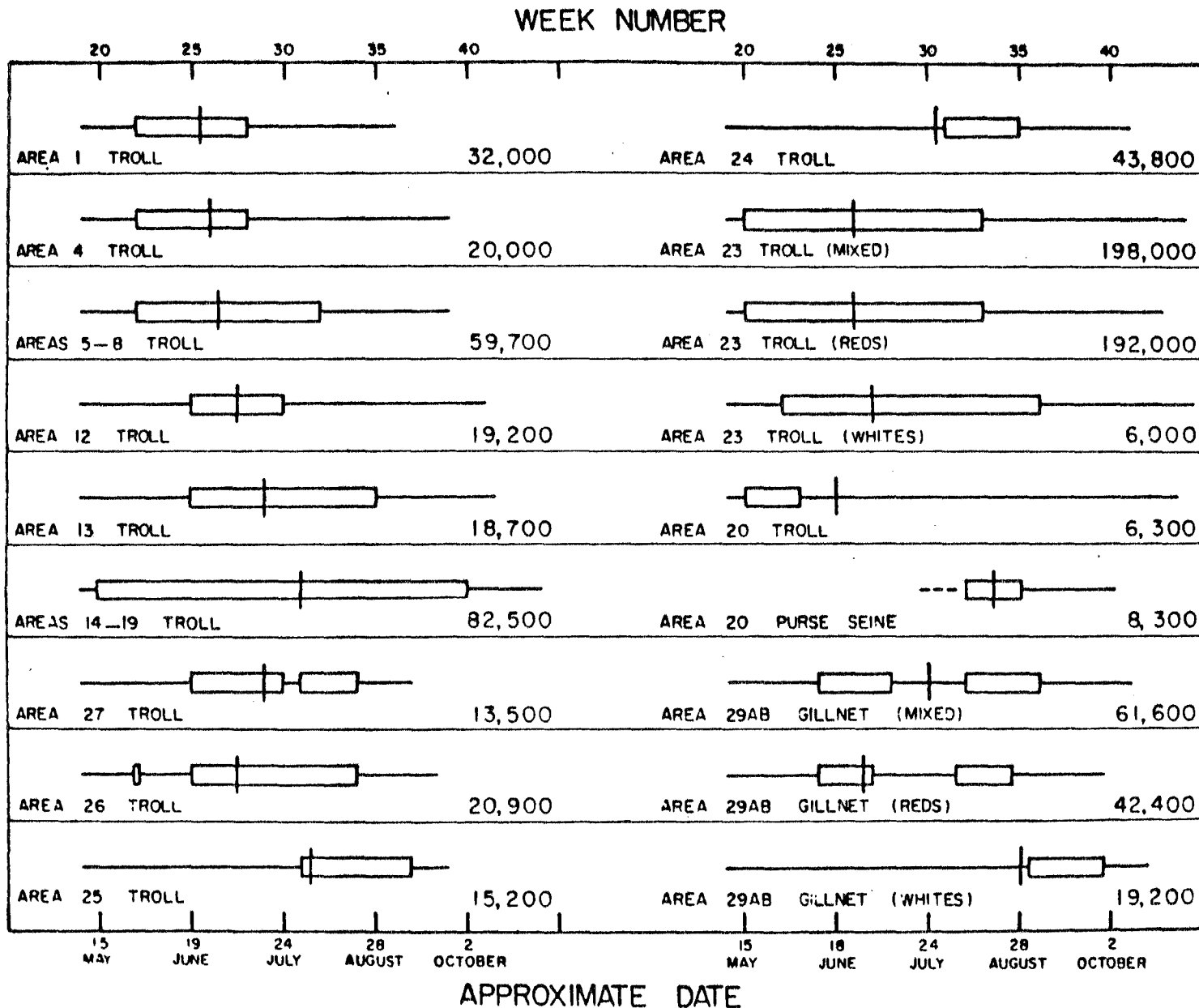


Figure Average weekly catches of chinook salmon in areas in British Columbia, 1961-1965; in pieces. (From Godfrey, 1968, Fig. 56.)



Figure

Based on 1961-1965 average catches of chinook salmon in British Columbia (in pieces): (a) the full period (approximately) over which some catches of chinook salmon were made (the horizontal line); (b) the period over which relatively large catches were made (the bar); (c) the date when 50% of the final total (average) catch had been attained (the vertical line); (d) the actual average total catch for the indicated area and gear. (From Godfrey, 1968, Fig. 57.)

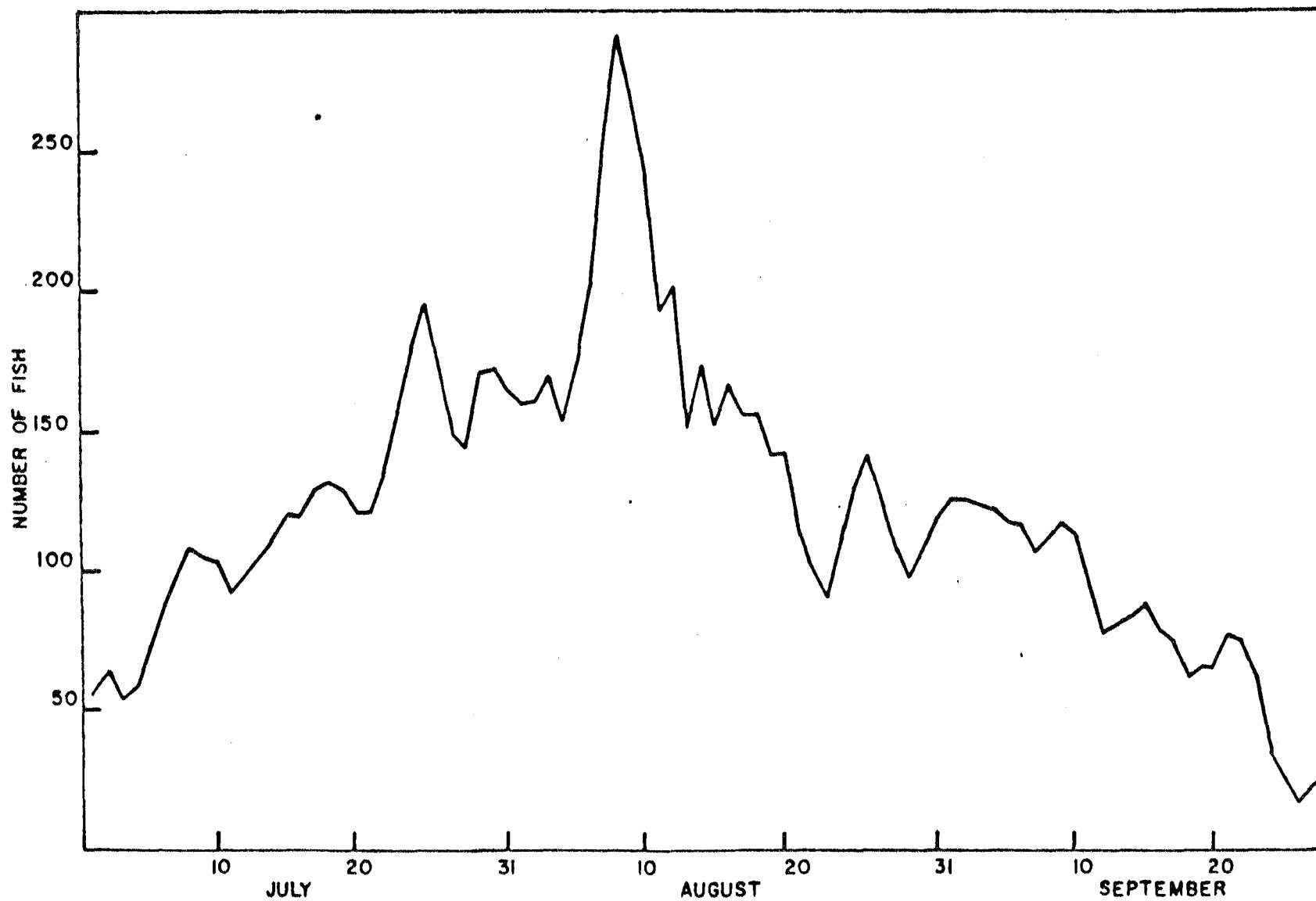


Figure Average 1950-1960 daily catches (all gear) of chinook salmon in the San Juan Islands area (U. S. waters); in pieces. (Smoothed by threes.) Redrawn from Fig. 14 of Jewell and Fiscus, 1962/63. (From Godfrey, 1968, Fig. 58.)

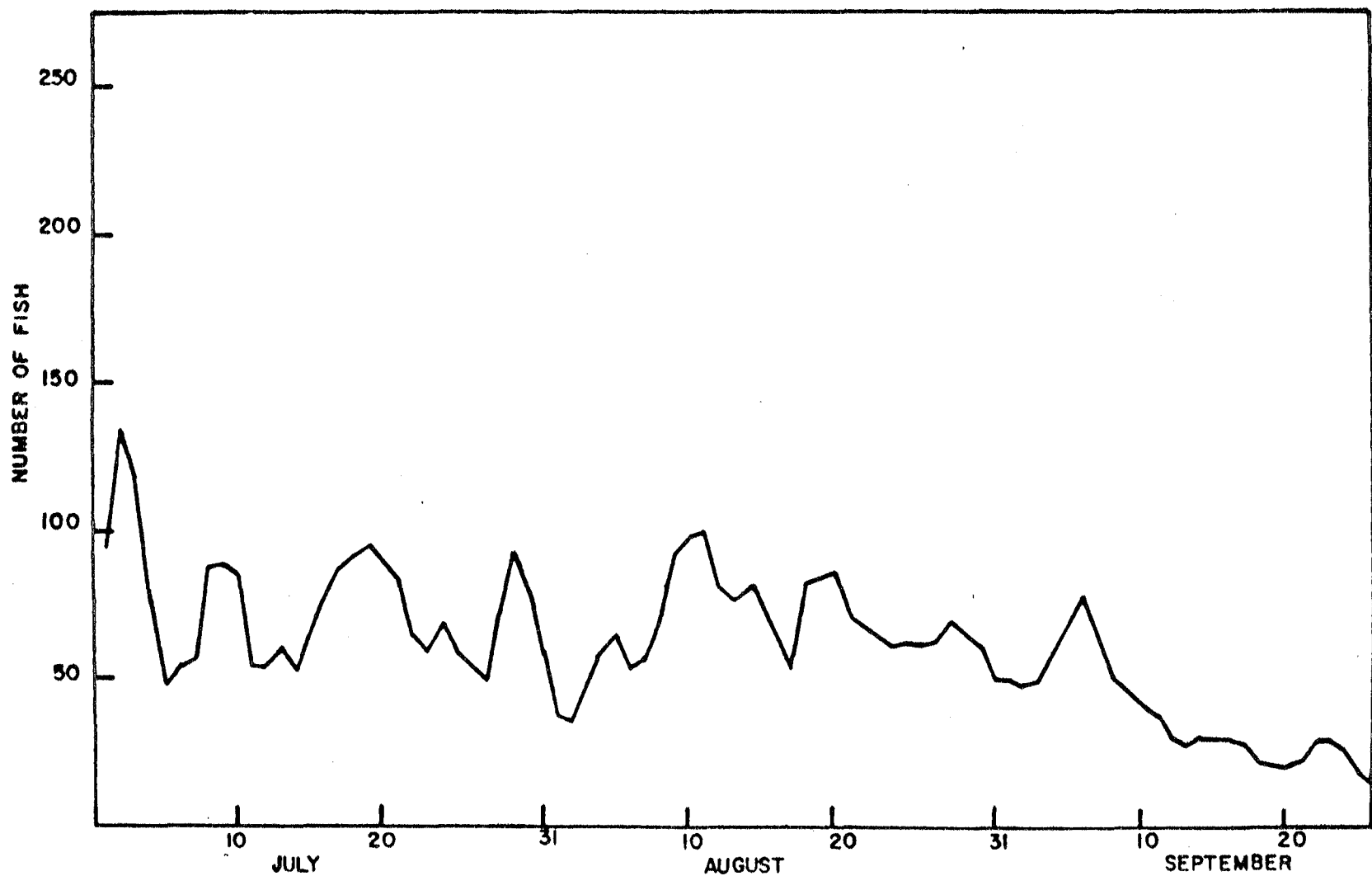


Figure Average 1950-1960 daily catches (all gear) of chinook salmon in the West Beach, Whidbey Island area (U. S. waters); in pieces. (Smoothed by threes.) Redrawn from Fig. 16 of Jewell and Fiscus, 1962/63. (From Godfrey, 1968, Fig. 59.)

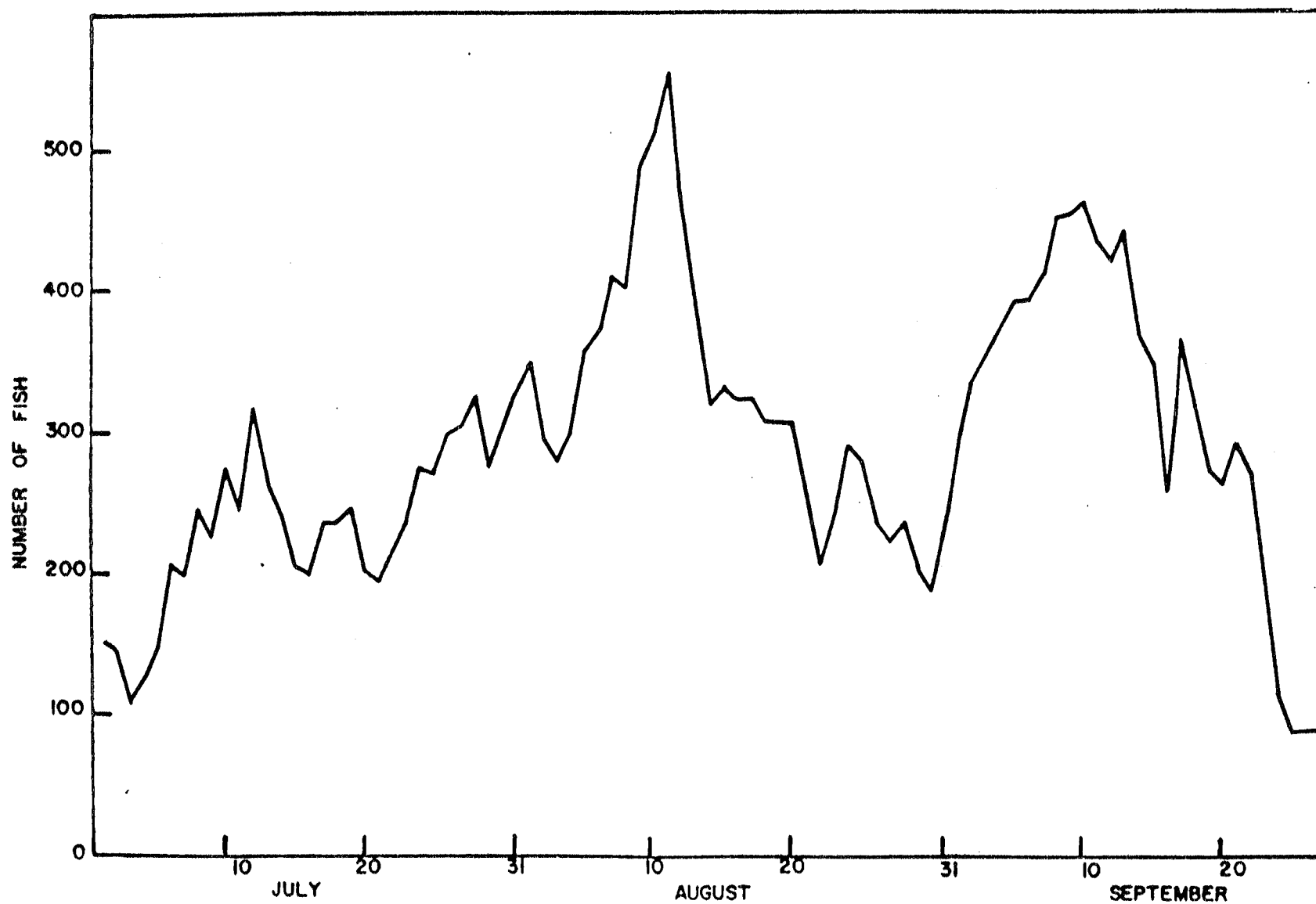
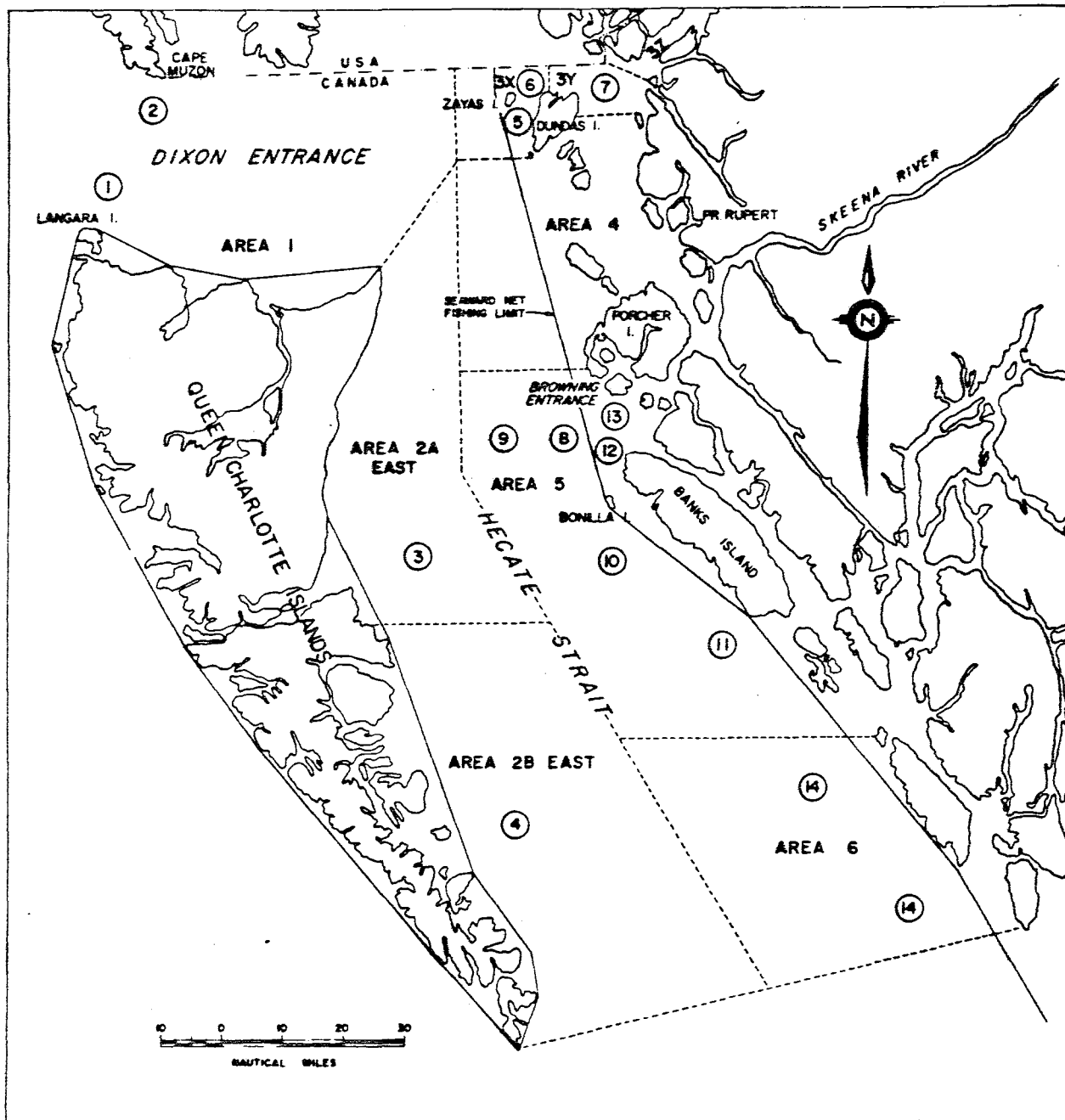


Figure Average 1950-1960 daily catches (all gear) of chinook salmon in the Point Roberts area (U. S. waters); in pieces. (Smoothed by threes.) Redrawn from Jewell and Fiscus, 1962/63. (From Godfrey, 1968, Fig. 60.)

TABLE X Chinook salmon tag recoveries by recovery location and year.

Tagging location	Dixon Entrance (locations 1 & 2)	Dundas Island (locations 5, 6 & 7)	Browning Entrance (locations 8, 9, 10, 12 & 13)	Hecate Strait (locations 3, 4, 11 & 14)
Number tagged	11	23	247	23
Number recovered	3	3	26	4
Recovery location number and year of recoveries				
Southeast Alaska Area 113 unknown			1(68)	1(68)
British Columbia Area 4 5 6 7 9 12 25 26 27 29 unknown	1(68)	1(68) 1(69) 1(69)	2(68) 2(68) 2(69) 2(68) 1(68) 1(68) 2(68) 1(68) 1(68) 1(68)	1(68) 2(68)
Washington Ocean Columbia R.			2(68) 6(68) 1(70)	

The following information was extracted from reference no. 49 (Hollitt, 1970). Refer to pink salmon section for introduction of report.



TAGGING LOCATIONS					
NO.	STAT AREA	GEOGRAPHICAL LOCATION	NO.	STAT AREA	GEOGRAPHICAL LOCATION
①	1	DIXON ENTRANCE - LANGARA	⑧	5	HECATE STRAIT
②	1	DIXON ENTRANCE - MUZON	⑨	5	HECATE STRAIT
③	2A EAST	HECATE STRAIT	⑩	5	HECATE STRAIT
④	2B EAST	HECATE STRAIT	⑪	5	HECATE STRAIT
⑤	3X	ZAYAS ISLAND	⑫	5	BROWNING ENTRANCE - WEST
⑥	3X	DUNDAS ISLAND	⑬	5	BROWNING ENTRANCE - EAST
⑦	3Y	DUNDAS ISLAND - MAINLAND	⑭	6	HECATE STRAIT

Figure 1. Tagging locations

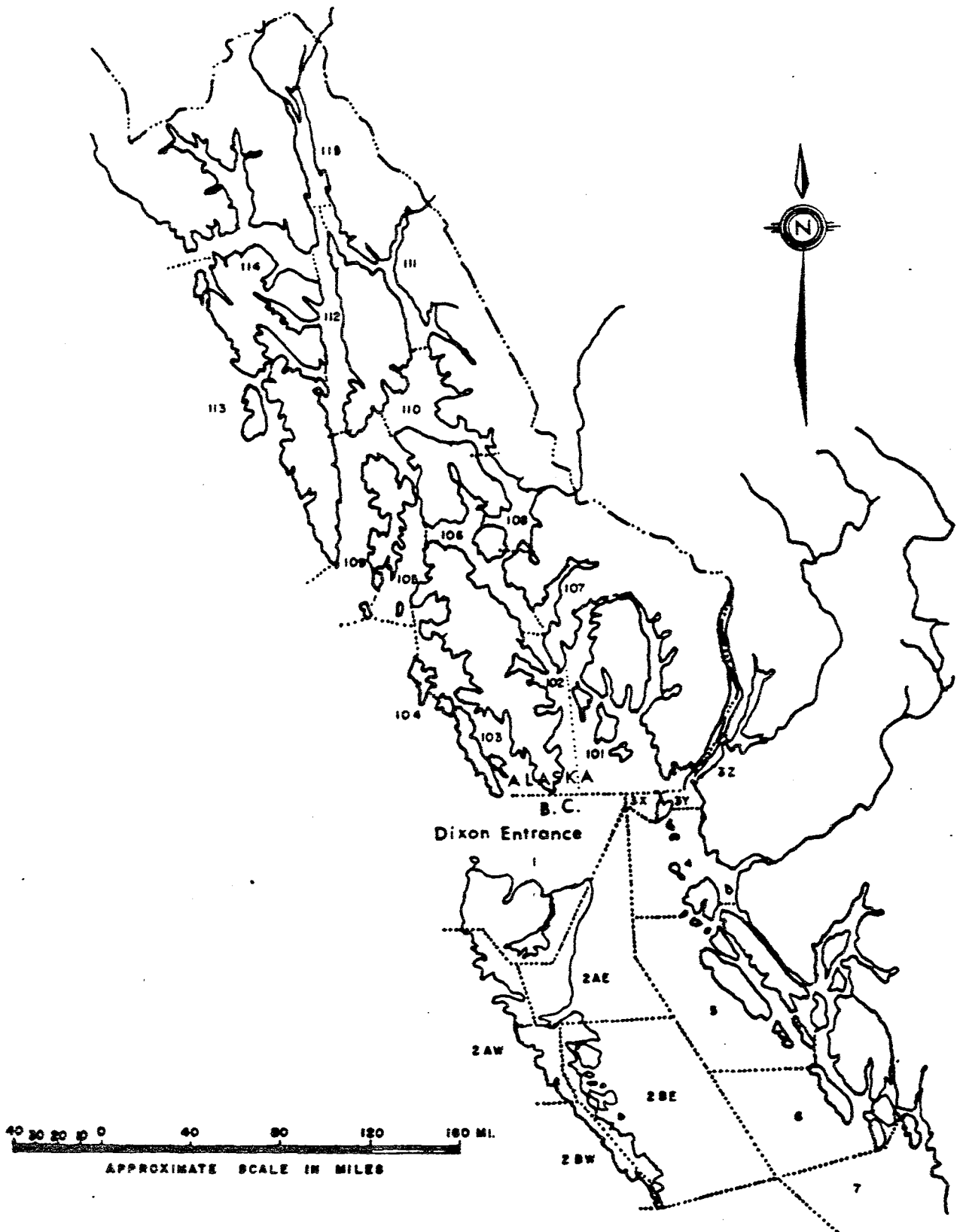


Figure 2. Statistical areas in northern British Columbia and southeast Alaska

The following information was extracted from reference no. 22 (Argue, 1970). Refer to sockeye section for a general description of factors affecting exploitation.

b) Chinook salmon

Timing of exploitable chinook salmon is without doubt the most complex of all five species. In addition to out-migration and in-migration phases, some chinook remain in the Strait for extended time periods, perhaps as semi-permanent "resident" populations.

Timing of out-migrations (phase one) of first ocean year sexually immature chinook is virtually undocumented. Test trolling in 1967 began capturing 1_1 and 2_2 chinook during Cp3 (July 26 to August 8, Appendix Table 3A). Catches (BaIII) showed the largest increase during Cp6 (September 26 to October 11) when 44 were landed. Ageing of readable scales (Appendix Table 5A) indicated over 50 per cent sub-twos (stream types, aged 2_2 , more than one year in fresh water). Based on test troll catches, first ocean year chinooks were not nearly as abundant as 2_2 coho, during comparable charter periods. Chinooks averaged about 26cm. (10.2 in.) fork length which, in combination with apparent low abundance, suggests this age class is of little importance to sport gear. Sport catch statistics provide no indication of first ocean year chinook timing as the three pound or less category includes second ocean year as well as small third ocean year chinook.

In-migrations of sexually maturing chinook (phase two) probably

To confuse matters regarding out-migrations, certain CDFD chinook taggings (1963 to 1967, unpublished) at various Georgia Strait locations produced west coast summer troll recoveries of chinook which at time of tagging were obviously in their second or third ocean year. This implies either that outside stocks contribute to Georgia Strait rearing populations, or that immature chinook from inside stocks split marine "residency" between inside and outside waters.

The chief indication that some chinook rear in the Strait came from 1967 test troll data. Throughout the study period (June 19 to October 11) catches of 2_1 and 3_1 aged chinook were highest in mid-Strait (BaII) between Port San Juan and Sheringham Point and near Swiftsure Bank (Figure 15). Except during Cpl and 2 (June 19 to July 19), over 90 per cent were immature and were more abundant near shore in almost all daily areas. The 2_1 age class consistently formed the highest percentage of the BaII test troll catch (Appendix Table 5A). Consistent catches between charter periods, a mid-Strait catch peak and the high proportion of immatures and age class 2_1 (notwithstanding gear selectivity, Section E) suggest that moderate numbers of 2_1 and 3_1 chinooks (relative to high abundance on west coast continental shelf areas) form a semi-permanent rearing population in the Strait, primarily along the narrow shelf which extends the length of the Strait. Most 2_1 chinook were below the commercial size limit (Figure 7), but they exceeded the sport size limit and their consistent presence would therefore be of considerable value to the more regular sports fishermen.

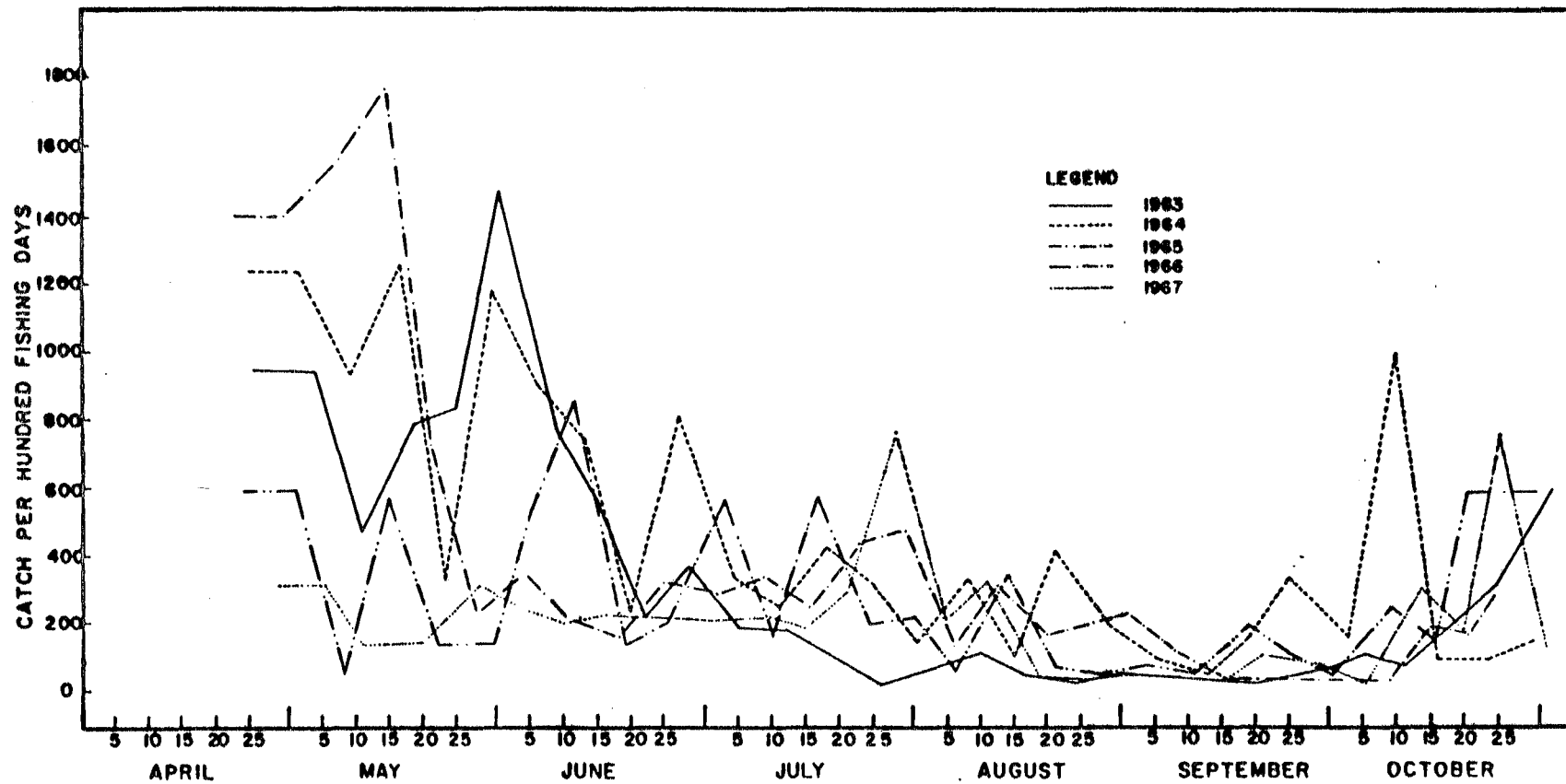


Figure 8. Weekly troll CPUE on chinook salmon in Area 20, 1963 to 1967.

Relating the above timings to Juan de Fuca Strait is difficult considering the restricted net fishing period and fluctuating troll effort. On this basis, troll CPUE (Figure 8) appears the best timing index. The pattern between years is anything but consistent. In general, many sharp peaks occur during April, May and June. After mid-August there is an apparent lull until late October when CPUE increases to June-July levels. It is possible that the latter peak represents a significant in-migration although it does occur later than reported catch peaks for inside fisheries. Area 20 net catches (Figure 9) are consistently highest in mid-August dropping rapidly thereafter. This peak appears on the troll CPUE graph, but it is low compared to earlier troll CPUE. The net-troll discrepancy may result from a change in species orientation by troll gear or perhaps reflects a change in chinook catchability (susceptibility). Mathews and Wendler (1968) noted that spring run Columbia River chinook were approximately five times as catchable by hook and line gear as fall run chinook and postulated that this reflected a behavioural difference between the two runs.

Tag recoveries (Table V) from 1969 CDFW west coast tagging imply that inside chinook stocks on the west coast from March 15 to the fall, pass through the Strait during August and September. Five inside recoveries prior to August confirm earlier in-migrations which are likely larger than recoveries indicate, due to low recovery effort early in the season.

The extended chinook run is advantageous to sport and troll fisheries as it provides exploitable salmon during most of the year, and particularly when other species are absent or in low abundance. Hook and line effort from late fall to early summer might be higher (see Figure 2)

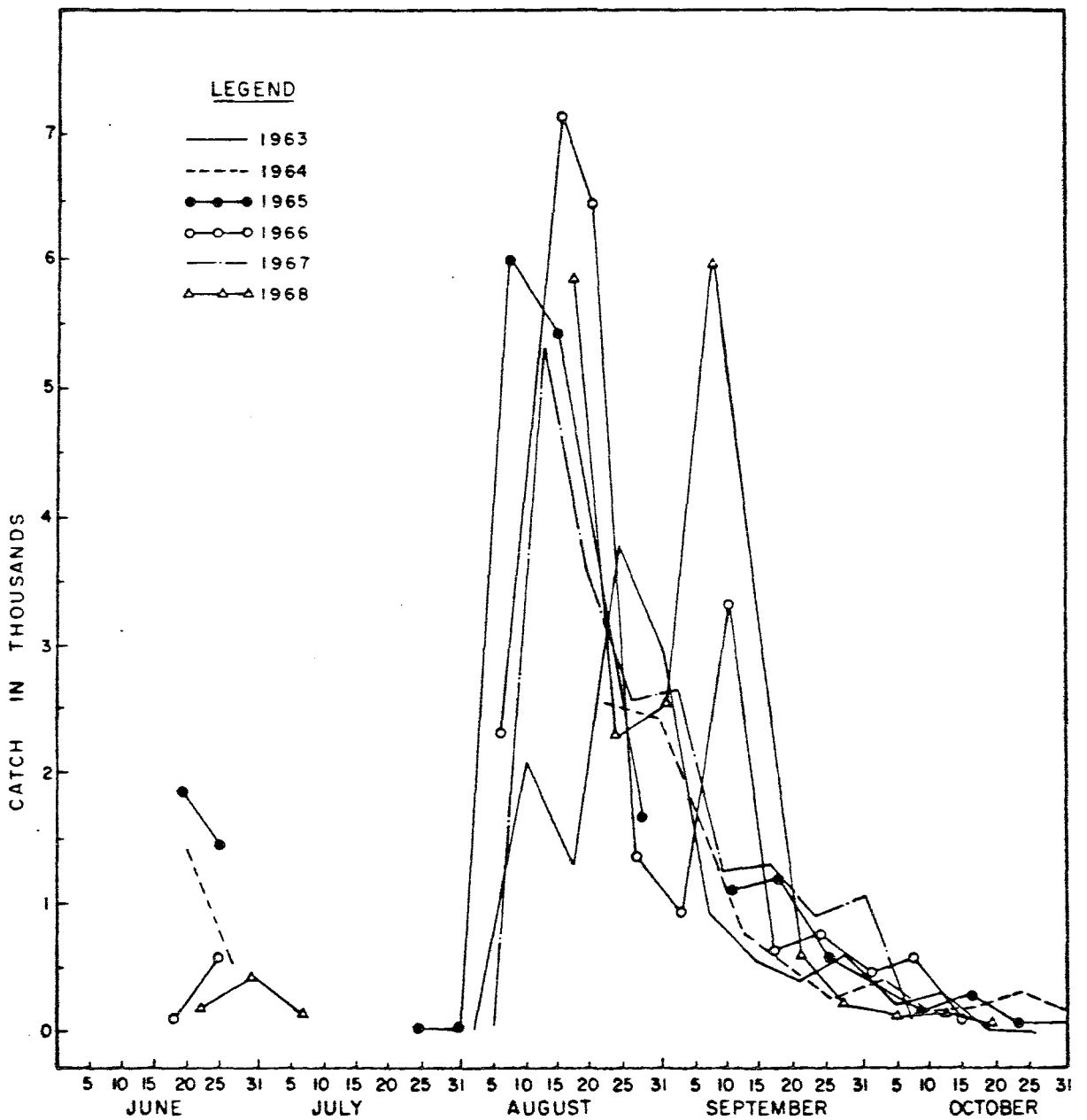


Figure 9. Weekly net catch (gillnet plus seine) of chinook salmon in Area 20, 1963 to 1968.

were it not for generally poor weather. Wind speeds at Victoria (1922-1945) averaged over eleven miles per hour between December and July with periods of relatively strong west and southwest winds (13.7 to 17.8mph between March and June (Boughner and Thomas, 1948, from Herlinveaux, 1954).

The prolonged chinook in-migration probably reflects diversity of spawning area and timing, as well as numbers of contributory stocks (artificial and natural). Mason (1965), in a review of chinook life history, points out that many coastal rivers (generally south of Vancouver Island) have up to three distinct fresh water spawning runs extending from April to October. In the Fraser system, chinook are found in 29 tributaries covering almost all waters accessible to salmon. Spawning times show a wide range. In some tributaries spawning initiates in June, peaking in July, whereas at the other extreme (generally the more coastal tributaries) spawning may not begin until October, peaking in November (Aro and Shepard, 1967).

Age composition of in-migrants is only partially known. Between 1957 and 1959 Fraser gillnet samples (Milne, 1964 MS) were dominated by ocean age four, followed by three, two and five. It is reasonable to suppose that Fraser River age classes are also present in Juan de Fuca in-migrations in roughly the same order of importance.

TABLE V. Chinook tag recoveries (1969) inside the entrance of Juan de Fuca Strait from chinook tagged off the southwest coast of Vancouver Island in 1969.*

Recovery Period	Tagging Period		
	March 15 - April 15	April 30 - June 29	July 3 - October 7
April	1		
June		2	
July		2(2)	
August 1-15	(2)**	(4)	(1)
August 16-31	1(1)	7(4)	(2)
September 1-15	2	5(2)	(1)
September 16-30 ⁺		5(1)	(1)
≥October ⁺	5	18	5

* Numbers tagged: period one 257; period two, 2208; period three, 938. (K. Pitre, pers. comm.).

** Bracketed recoveries by Canadian and American Juan de Fuca Strait sport and commercial fisheries; unbracketed recoveries by all gears east of Victoria.

⁺ About 70% recoveries from Puget Sound hatcheries.

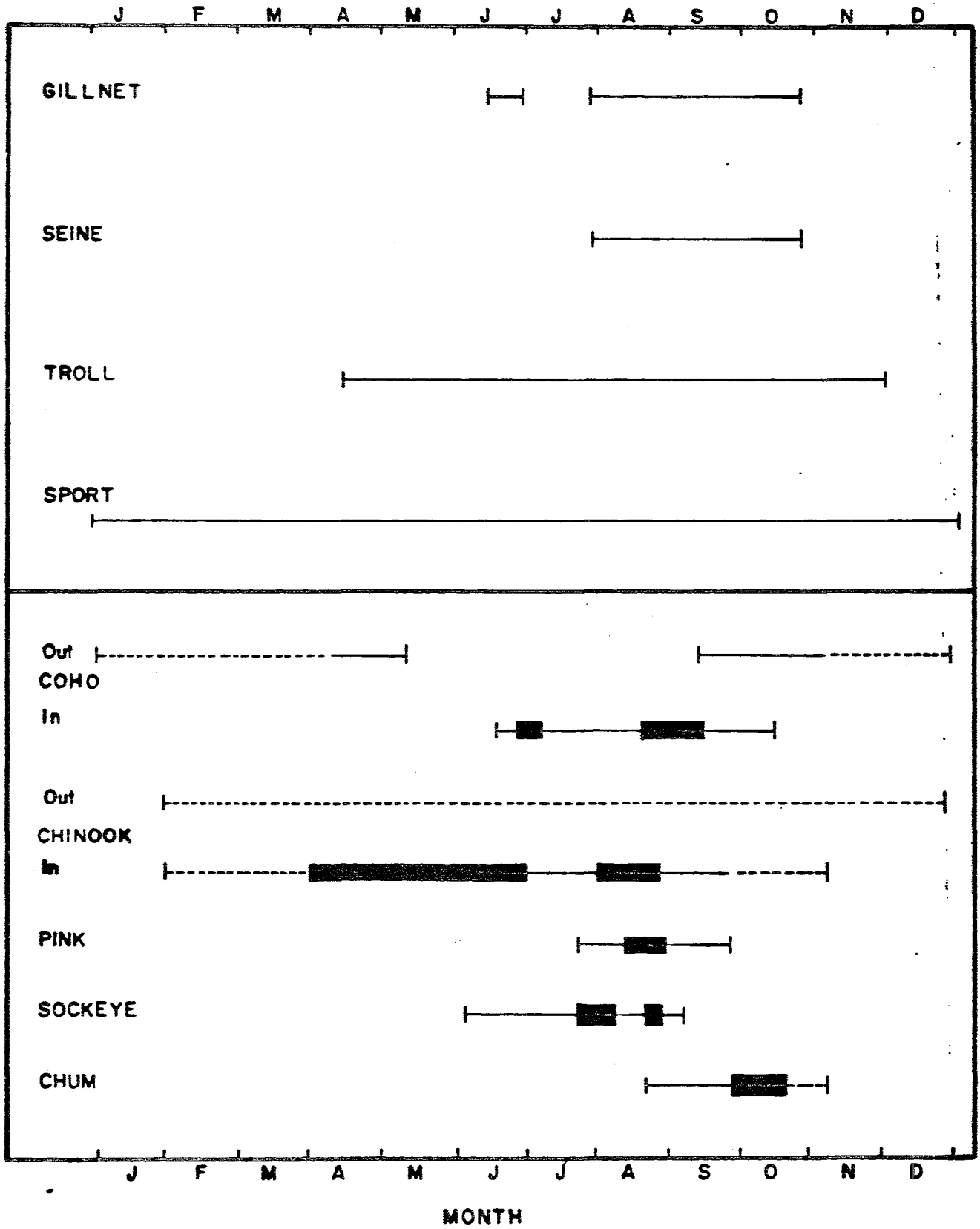


Figure 13. Seasonal timing of Juan de Fuca gear types and exploitable salmon species. For salmon dotted line refers to possible timing, solid line known timing, and bar, timing of abundance peaks.

The following information was extracted from reference no. 24 (Argue and Heizer, 1971). The report is a computer printout of tag recovery information on chinook and coho salmon tagged off the coast of British Columbia between 1963 and 1969. Pictorial representation of the data is given in reference no. 25 (Argue and Heizer, 1974). The data previous to 1963 has been summarized by Godfrey (MS 1968) (reference no. 45 and 55). Additional data for 1970 to 1971 for the west and east coasts of Vancouver Island have been summarized by Bourque and Pitre (1972) (reference no. 30) and Heizer and Argue (1972) (reference no. 47). All of these reports contain tables or figures from which migration routes can be inferred. Refer to report and tables (reference no. 25) for further details.

INTRODUCTION

Over 28,000 coho (Oncorhynchus kisutch) and 7,900 chinook (O. tshawytscha) salmon of various ages and maturities were tagged in marine waters of British Columbia, from Dixon Entrance to Juan de Fuca Strait, by the Canada Department of Fisheries and Forestry between 1963 and 1969. In comparison, other reported Canadian marine taggings of these species from 1925 to 1967 totalled approximately 14,800 coho and 8,150 chinook (Sparrow, 1967 MS; 1968 MS; Godfrey, 1968 MS; Giovando, 1969 MS).

The purpose of the 1963 to 1969 Department of Fisheries and Forestry chinook and coho taggings was to increase understanding of marine distribution and movement patterns, particularly in inside waters. Taggings took place in six general areas: Dixon Entrance, Hecate Strait, Johnstone Strait, Georgia Strait, Juan de Fuca Strait and off the west coast of Vancouver Island.

In Dixon Entrance and Hecate Strait coho and chinook were tagged incidental to a pink salmon tagging program.

Consequently, no specific objectives were formulated or methods followed viz a viz coho and chinook.

Coho tagging in Johnstone Strait and the Strait of Georgia areas were aimed at clarifying summer dispersal patterns from winter rearing areas and observing summer movement patterns of resident coho which spend their marine life east of Vancouver Island. For chinook taggings in these waters, objectives were simply to assess marine distribution and movement patterns.

The Juan de Fuca Strait taggings were directed towards immature coho migrating west to determine their eventual west coast rearing area and return timing to the Strait, and to assess the effect of out-migration timing on the above activities. Chinook were tagged incidental to coho.

Taggings off the west coast of Vancouver Island (1969 only) totalling 2,077 coho and 3,565 chinook assessed marine dispersal patterns. West coast data will be presented in a separate report.

This report presents tag and recapture data in discrete time and area groups called 'taggings' for Dixon Entrance, Hecate Strait, Johnstone Strait, Georgia Strait, and Juan de Fuca Strait areas. Tables for each tagging show number of fish tagged, number recaptured, percent recaptured, tagging dates, tagging gear, tag type and detailed tag and recovery information for every tag recovery. The general format of presentation is similar to that followed by Giovando (1969 MS).

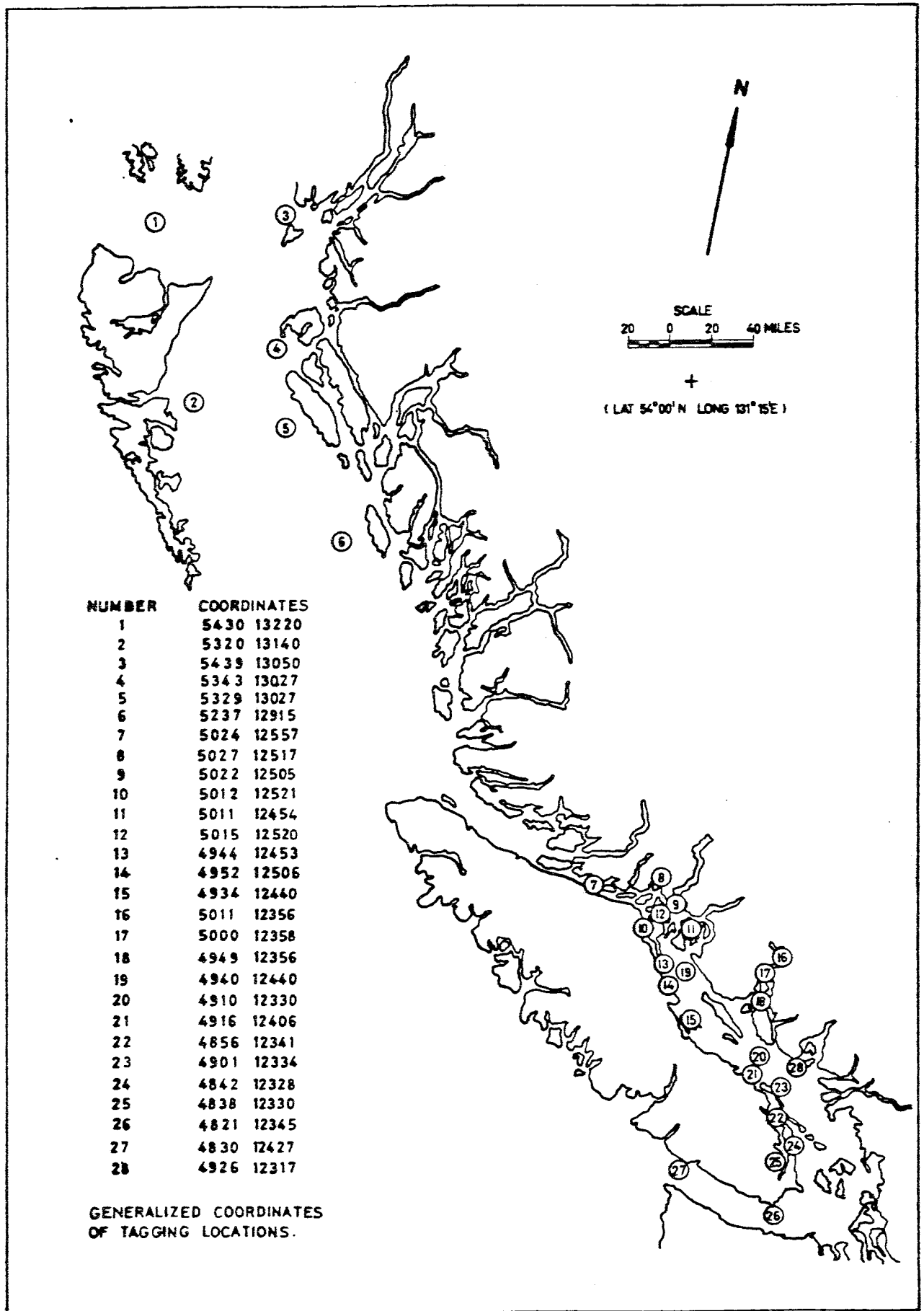


Fig. 2. Location of taggings.

Table 3. Tagging locality numbers, descriptions and codes for coho and chinook taggings, 1963 to 1969

Locality Number	Locality Description	Tagging Codes
1	Dixon Entrance (includes Cape Chacon, Cape Muzon, Northern Queen Charlotte Islands and Langara Island) ¹	D 01-02 101
2	West Hecate Strait	H 01 102
3	Dundas Island (includes Zayas Island and Dundas Island) ¹	D 01-02 103
4	Browning Entrance	H 01-02 105
5	Northeast Hecate Strait	H 01-02 205
6	Southeast Hecate Strait	H 01-02 106
7	Kelsey Bay	J 01 113
8	Frederick Arm	J 01-02 213
9	Bute Inlet	J 01 313
10	Deepwater Bay	J 01-03 413
11	Teakerne Arm	J 01 513
12	Kanish Bay	J 01 613
13	Little River	G 01 314
14	Kuhushan Point	G 01 414
15	Hornby - Denman	G 01-02 114
16	Head Jervis Inlet	G 01-02 116
17	Mid-Jervis Inlet	G 01-02 216
18	Entrance Jervis Inlet	G 01-02 316
19	Mid-Strait North ²	G 01 214
20	Mid-Strait South	G 01 117
21	Nanoose - Nanaimo	G 01-02 217
22	Stuart - Trincomali	G 01-02 317
23	Porlier Pass	G 01 417
24	Satellite Channel	G 01-02 118
25	Saanich Inlet ³	G 01-03 218
26	Sooke - Victoria	F 01-03 119
27	Port San Juan	F 01 120
28	Entrance Howe Sound	G 01 128

¹Dixon Entrance and Dundas Island tagging locations consist of four and two sub-areas respectively. Tables 20 to 22 summarize numbers tagged and recovered for each sub-area, 1966 to 1968. Sub-area codes were included on recovery computer cards (field 29) but were not part of the tagging sort routine and therefore do not appear on the recoveries listed in Table 24.

²In 1966, during a seismic survey, salmon were tagged by a troller running a grid pattern in Georgia Strait. Tagging took place in areas 13 to 17 and 28. For convenience, areas 13 to 16 were called Mid-Strait North and assigned to area 14; areas 17 and 28 were called Mid-Strait South and assigned to area 17.

³Saanich Inlet is now designated as statistical area 19A.

TABLE 5. SUMMARY OF NUMBERS OF COHO AND CHINOOK TAGGED BY CANADA DEPARTMENT OF FISHERIES AND FORESTRY, 1963 - 1969.^A

LOCATION NUMBER	TAGGING LOCATION	STATISTICAL AREA	1963		1964		1965		1966		1967		1968		1969		SUB-TOTALS		TOTAL
			COHO	CHIN.	COHO	CHIN.	COHO	CHIN.	COHO	CHIN.	COHO	CHIN.	COHO	CHIN.	COHO	CHIN.	COHO	CHINOOK	
1	DIXON ENTRANCE	1							599	7	1180	116	600	11			2439	134	2573
2	WEST HECAETE STRAIT	2											222	9			222	9	231
3	DUNDAS ISLAND	3							301	17	104	97	783	22			1166	136	1304
4	BROWNING ENTRANCE	5							47	12	168	98	521	148			736	258	994
5	NORTHEAST HECAETE STRAIT	5											434	104			434	104	538
6	SOUTHEAST HECAETE STRAIT	6											66	5			66	5	71
7	KELSEY BAY	13					189										189	0	189
8	FREDERICK ARM	13	353	27			425	102									778	129	907
9	BUTE INLET	13					1092										1092	0	1092
10	DEEPWATER BAY	13					2700	43									2700	43	2743
11	TEAKERNE ARM	13	293				430										723	0	723
12	KANISH BAY	13	10														10	0	10
13	LITTLE RIVER	14					27	13									27	13	40
14	KUNUSHAN POINT	14					370	4									370	4	374
15	HORNBY-DENMAN	14	48	197	80	148			946	118							1074	463	1537
16	HEAD JERVIS INLET	16	38		38	93											76	93	169
17	MID JERVIS INLET	16	201	25	5	11	91										297	36	333
18	ENTRANCE JERVIS INLET	16	75														75	0	75
19	MID-STRAIT NORTH	14							22	28							22	28	50
20	MID-STRAIT SOUTH	17							186	64							186	64	250
21	NANOOSE-NANAIMO	17	186	88	124	287			108	616	18	532					436	1523	1959
22	STUART-TRINCOMALI	17			1003		1232		66	629					678	20	2979	657	3636
23	FORLIER PASS	17	4														4	0	4
24	SATELLITE CHANNEL	18	16	24									145	344	7	6	168	374	542
25	SAANICH INLET	18	1350				5605						1158	4	96	8	6209	12	8221
26	SOOKE-VICTORIA	19											1428	111	8	26	1436	137	1573
27	PORT SAN JUAN	20											213	197			213	197	410
28	ENTRANCE HOVE SOUND	28					10										0	10	10
TOTALS			2574	361	1250	549	12161	162	2275	1491	1470	843	5630	955	789	68	26149	4429	30578

^A TAGGINGS OF 2077 COHO AND 3565 CHINOOK OFF THE WEST COAST OF VANCOUVER ISLAND WILL BE REPORTED SEPARATELY.

NB: There are some errors in the tabled data. Refer to Argue and Heizer (1974) for details (ref. no. 25).

The following information was extracted from reference no. 30 (Bourque and Pitre, 1972).

Tables 2 and 3 summarize the tagging data for chinook and coho salmon for 1969 and 1971. Included in the original report (reference no. 30) are figures for tag recovery statistics for 12 sampling periods for each of three years. For the purposes of this report new figures were redrawn to pool the recovery data for the 12 tagging periods by year (see Table and Figures). The redrawn figures allow the reader to visualize the maximum distribution of the recaptured fish species. The complexity of the recovery data by tagging period and recovery period can only be appreciated by referring to the original document. (Note: In some instances it appears that the number of points plotted do not agree with tabled information in the original report.)

"Introduction

"In 1969 and 1971 tagging programs were conducted off the lower west coast of Vancouver Island to determine marine distribution and dispersal patterns of chinook (Oncorhynchus tshawytscha), and coho (O. kisutch) salmon available to the troll fishery. A total of 3,491 chinook and 1,804 coho were tagged in 1969; 1,226 chinook and 259 coho were tagged in 1971.

"This report presents basic tag and recovery information in discrete groupings of time and area called 'taggings'. Detailed tag and recovery information for each tag recovery, and data showing the number of fish tagged, number recovered, percent recovery, and tagging dates are included. Frequency distributions of fork length at the time of tagging for tagged, aged, and recaptured fish, and maps of recovery locations are included in separate appendices. The format of this report is essentially that of Argue and Heizer (1971).

"Field Methods

"All fish tagged were captured by chartered trollers working on a schedule of ten days tagging followed by a five day break, weather conditions permitting. In 1969 the boats and periods of employment were as follows: Phaedra, March 19-June 10; Silver Mist, March 26-April 17, June 8-October 5; two boats, the Meridian and Merilda, tagged a few fish during a lure selectivity study April 15 to June 10. In 1971 two boats, Miss Joni and Viking Princess tagged fish from February 11 to March 26. Areas and sub-areas fished are shown in Figure 1.

"Fish were landed into canvas tanks, tagged, scale samples taken, measured for fork length, then released. This was usually done without anaesthetics for chinook which were relatively docile when landed. However coho had to be anaesthetized before tagging, then placed in revival tanks before being released. Salmon suffering from gill, head, or jaw damage were not tagged; fish showing aberrant behaviour after sufficient time in revival tanks or bleeding around the tag area were released without tags.

"Floy spaghetti-anchor tags were used for tagging except in August 1969 when Carlin and Petersen tags were also tried."

Table: Summary of the number of chinook salmon recaptures from tag recovery programs conducted in 1969, 1970 and 1971 (compiled from Bourque and Pitre, 1972). The number of salmon recaptured for the 12 time periods was pooled to develop the figures.

Tag* Period	1969		1970		1971	
	Number Recapt'd	Number Plotted	Number Recapt'd	Number Plotted	Number Recapt'd	Number Plotted
01	35	32	3	-	-	-
02	57	49	8	8	1	-
03	84	76	31	23	8	6
04	121	94	62	53	8	7
05	85	72	37	33	5	-
06	46	42	21	18	8	6
07	24	20	25	19	3	-
08	21	19	15	11	8	6
09	18	15	23	22	8	5
10	4	-	12	12	1	-
11	4	-	4	-	1	-
12	0	-	4	-	3	-
Total	499	419	245	199	54	30
	(Fig: tagged 1969, recaptured 1970)		(Fig: tagged 1969, recaptured 1970)		(Fig: tagged 1969, recaptured 1971)	

Part B: Chinook salmon tagged in 1971 and recaptured in:

Tag* Period	Number Recapt'd	1971 Number Plotted
01	69	58
02	130	113
Total	199	171

*Refer to original document for dates of tagging.

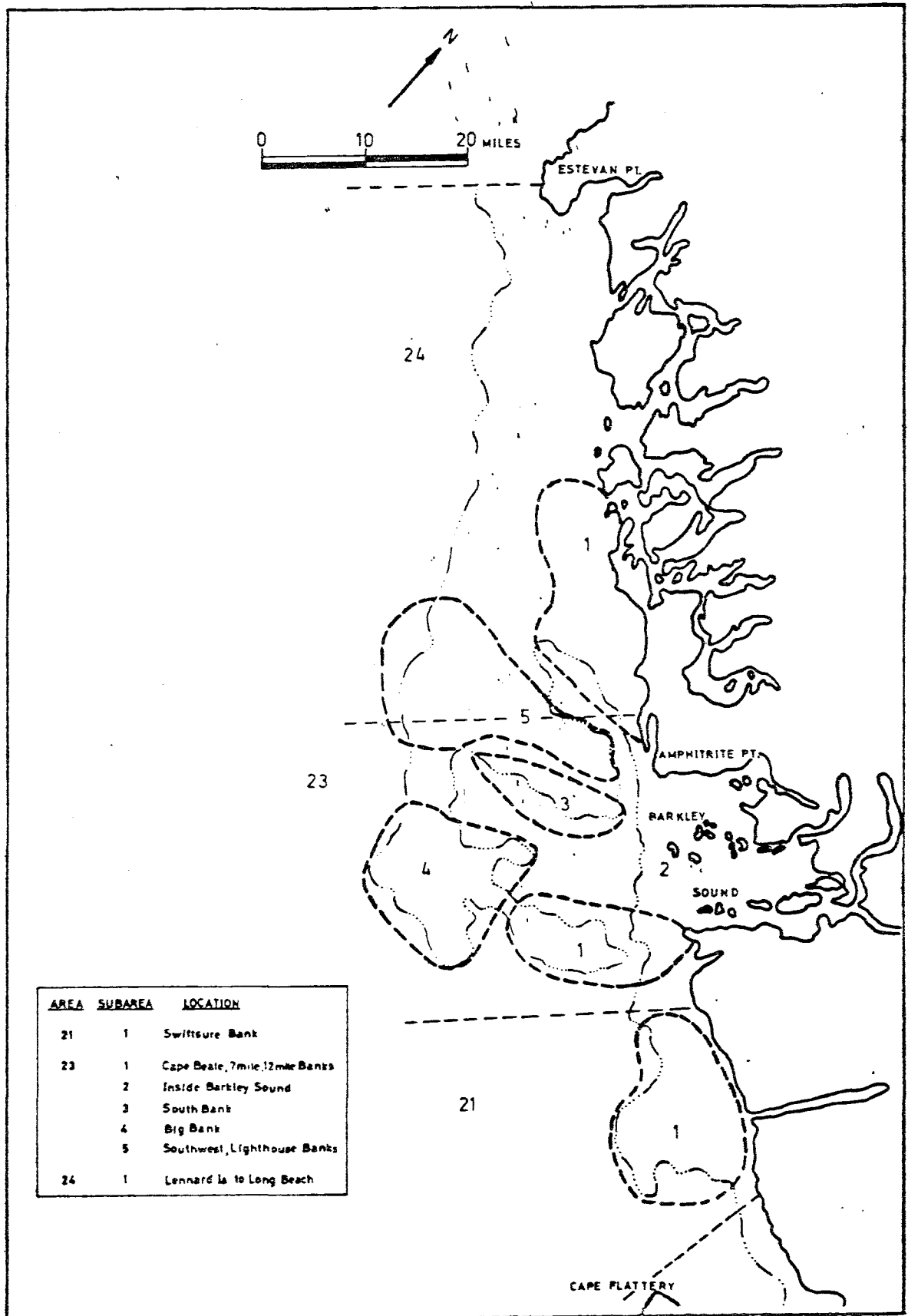


Figure 1. Location of tagging areas off the west coast of Vancouver Island.

Table 2. Taggings of chinook and coho salmon in 1969^a

Tagging Code	Tagging Dates	CHINOOK					COHO				
		Tag Series	Number Tagged	Number Recovered	%	Tag Series	Number Tagged	Number Recovered	%		
Area 21											
W 21 1 03	Apr 30-May 9	14131 - 14142	12	2	17	04111 - 04118	8	1	12		
W 21 1 04	May 15-May 23	14884 - 14886	138	29	21	04278 - 04284	7	0	0		
W 21 1 05	May 30-June 10	15044 - 15088 R04821 - R04960	72	10	14	04478 - 04499 05000 - 05077 R04820 - R04962	208	53	25		
W 21 1 08	July 16-July 28	15479 - 15509	22	3	14	05196 - 05201	3	2	66		
Total			244	46	19	Total	228	57	25		
Area 22											
W 22 1 (3,4) ^b 01	Mar 15-Mar 31	13000 - 13128	107	38	36	07007 - 07025	19	1	5		
W 22 3 02	Apr 1-Apr 17	13129 - 13267 13500 - 13504	138	52	41	04500 - 04614	62	9	14		
W 22 3(1,5) 03	Apr 30-May 9	R04553 - R04584 07037 - 07124 13268 - 13355 14118 - 14129 14143 - 14211	337	99	29	R04566 - R04583 04616 - 04663 04021 - 04118 04119 - 04194 07035 - 07116	233	43	17		
W 22 1(5) 04	May 15-May 23	R04588 - R04665 04721 - 04734 07163 - 07282 13356 - 13499 13505 - 13560 14313 - 14483	733	162	22	R04591 - R04664 04196 - 04277 04685 - 04720 04735 - 04773 07126 - 07283	246	47	19		
W 22 1(5) 05	May 30-June 10	R04667 - R04816 07285 - 07493 13561 - 13682 13714 - 13759 15020 - 15043 15089 - 15101	343	71	21	R04666 - R04817 04774 - 04940 05078 - 05180 07284 - 07491 07505 - 07515 04470 - 04477 04944 - 04958	532	111	21		
W 22 3 07	July 3-July 12	15152 - 15209	55	20	36	04967 - 04973	7	3	43		
W 22 5 08	July 18-July 28	15343 - 15368 15397 - 15478 15501 - 15549	153	34	22	05186 - 05195 05202 - 05209	15	4	27		
W 22 1(5) 09	Aug 3-Aug 11	15614 - 15673 15763 - 15869	189	21	11	05213 - 05247 05270 - 05323	87	16	18		
W 22 4(5) 10	Aug 17-Aug 23	15923 - 15982 R01300 - R01333	89	18	20	R3600 - R3633 05360 - 05368	41	9	22		
W 22 5 11	Sept 6-Sept 11	15983 - 16065	81	10	12	06000 - 06033	33	6	18		
W 22 3(5) 12	Sept 27-Oct 4	16069 - 16117	48	7	15	06034 - 06044	7	0	0		
Total			2261	532	24	Total	1304	249	19		
Area 24											
W 24 1 01	Mar 15-Mar 31	14000 - 14005	6	0	0						
W 24 1 02	Apr 1-Apr 17	14006 - 14070	60	14	23	04000 - 04019	17	2	12		
W 24 1 03	Apr 30-May 9	14071 - 14109 14775 - 14799 14312	64	22	34	04195	1	0	0		
W 24 1 05	May 30-June 10	13883 - 13710 14847 - 15019 15102 - 15117 07494 - 07523	348	47	19	04285 - 04469 04942 - 04943 05181 - 05183 07524	189	40	21		
W 24 1 06	June 18-June 28	13740 - 13999 15118 - 15151	272	74	27	04962	1	1	100		
W 24 1 07	July 3-July 12	15210 - 15341	138	31	23						
W 24 1 08	July 18-July 28	15349 - 15394	28	3	18						
W 24 1 09	Aug 3-Aug 11	15550 - 15589 15674 - 15762 15870 - 15920	180	28	16	05210 - 05212 05248 - 05249 05324 - 05359	63	13	21		
W 24 1 10	Aug 17-Aug 23					05369 - 05370	1	1	20		
Total			986	222	22	Total	273	37	21		

^a Recoveries virtually complete, table covers recoveries to December 31, 1971.

^b Minor subareas sampled; major subareas sampled precedes brackets.

NO. 1 - 1000-10000

Table 3. Taggings of chinook and coho salmon in 1971^a

Tagging Code	Tagging Dates	CHINOOK			COHO				
		Tag Series	Number Tagged	Number Recovered	\$	Tag Series	Number Tagged	Number Recovered	\$
<u>Area 21</u>									
W 21 1 02	Mar 1-Mar 31	B19043 - B19056 B20031 - B20048 B20325 - B20374	72	9	12				
<u>Area 23</u>									
W 23 1-5 01	Feb 1-Feb 26	B04211 - B04496	506	69	14	11200 - 11294 11900 - 12043	238	18	8
W 23 1-5 02	Mar 1-Mar 31	B19000 - B19042 B19058 - B19425 B20000 - B20030 B20049 - B20324 B20375 - B20426	648	121	19	11295 - 11310 12044 - 12048	21	1	5
Total			1154	190	16	Total	259	19	7

^a Recoveries incomplete, table covers recoveries to December 31, 1971.



Figure: Distribution of chinook salmon tagged in 1969 and recaptured in 1971 (pooled time periods) (developed from Bourque and Pitre, 1972).

The following information was extracted from reference no. 47 (Heizer and Aruge, 1972). The report summarizes tagging programs on the east coast of Vancouver Island during 1970 and 1971. The following table lists the recovery of species for each year of years of study.

Year of Study	Sockeye	Pink	Chum	Coho	Chinook
1970		X*	X	X*	X
1971	X	X	X	X	X

*Figure included in this report (see species section).

Note: Tabular information listing the areas of individual recapture and figures of tagging locations of recovery sites are available in the publication. Included are some representative figures from which migration routes can be inferred. The validity of the interpretation in this format is questionable. Refer to paper for the remaining figures.

Included, figures from:

<u>Page:</u>	<u>Species:</u>	<u>Reference No.:</u>
121	Coho	47 (Table 1, p. 38)
147	Pink	47 (Table 3, p. 39)
173	Chinook	47 (Table 5, p. 39)

- Note: 1. The recoveries of chum salmon are incomplete because the chum salmon have not entered the fishery (546 chum tagged in 1971 - no recoveries).
2. The recoveries of sockeye salmon are incomplete because the sockeye salmon have not entered the fishery (70 sockeye tagged in 1971 - 2 recaptures).

INTRODUCTION

In 1970 and 1971 the Fisheries Service tagged approximately 10,000 coho and 3,000 chinook salmon in southern Georgia Strait and northern Johnstone Strait as part of expanding studies on marine biology of these species. This report presents basic tag and recovery data for coho and chinook taggings as well as for incidental taggings of pink, chum and sockeye salmon. Recoveries to December 31, 1971 are included. In addition, we include length frequency distributions and age compositions for 1963 to 1969 and 1970 and 1971 coho and chinook taggings plus fishing effort data, as an aid to interpretation of recovery data. Argue and Heizer (1971 MS) present basic data for 1963 to 1969 taggings. Bourque and Pitre (1972 MS) complete coverage of Fisheries Service coho and chinook taggings since 1963.

There were four major groups of taggings during 1970 and 1971: those in English Bay, those at the mouth of Fraser River, those in Johnstone Strait, and those we call the transplant series which took place in Saanich Inlet and Stuart Channel.

The tagging in English Bay was instituted because of the unusually large numbers of chinooks which appeared in this area in the winter 1970 sport fishery. Tags were applied to determine whether the fish were residents of the Strait of Georgia or were bound for the west coast of Vancouver Island and to determine their freshwater origin.

Fraser River taggings were carried out to determine if coho and chinook in the Fraser River estuary, at different periods of the year, have distinct marine migration patterns, and how these patterns might relate to chinook residency in Georgia Strait.

Johnstone Strait taggings were carried out in a search for an over-wintering population of coho, and were designed to determine the timing of the northern outmigration and the marine distribution and freshwater origin of these fish. Chum and pink salmon were surprisingly abundant; tags were applied to these species to assess the same parameters as were assessed for coho. Chinook and sockeye salmon were tagged incidentally to the coho, pink and chums.

Previous winter taggings in Saanich Inlet and Stuart Channel indicated that over-wintering coho in Saanich Inlet favored the west coast of Vancouver Island for summer residency whereas Stuart Channel coho favored Georgia Strait in the summer (Anon., 1965). In the transplant series we made a reciprocal transplant, with appropriate controls, between these two areas to determine whether switching winter rearing areas would alter summer migration patterns and freshwater homing behaviour.

The primary objective of this report is publication of basic tag and recovery data so that others may make independent interpretations of our data. A second feature, which we feel will be most useful to those wanting a capsule review of results from any particular tagging, are the maps and tables in Appendix I showing actual marine distributions of tag recoveries for the 1970 and 1971 taggings. A similar treatment of the 1963 to 1969 data will be finished in late 1972.

TABLE 9. Summary of salmon tagged in 1970 and 1971 which are dealt with in this report.

Location Number	Tagging Location	Statistical Area	1970				1971					Sub-Totals					Totals				
			Coho	Chinook	Chum	Pink	Coho	Chinook	Chum	Pink	Sockeye	Coho	Chinook	Chum	Pink	Sockeye					
22	Stuart-Trincomali	17	1,842	88			2,105	52								3,947	140				4,087
25	Saanich Inlet	18	2,426	19			2,048	7								4,474	26				4,500
29	Bauza Cove	12	4	28	214	3	11	73	14	1,103					15	101	228	1,106			1,450
30	Robson Bight	12	4						494	22					4		494	22			520
31	Hanson Island	12	7	6		544	84	30	8	831	10				91	36	8	1,375	10		1,520
32	Baker Island	12						15	12	7	9					15	12	7	9		43
33	Knight Inlet	12					19	34	18	14	51				19	34	18	14	51		136
34	English Bay	28					40	402							40	402					442
35	Fraser River	29	1,497	2,250											1,497	2,250					3,747
TOTALS			5,780	2,391	214	547	4,307	613	546	1,977	70				10,087	3,004	760	2,524	70		16,445

TABLE 1. Taggings of Coho Salmon in 1970

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
G 01 317C	22	Stuart-Trincomali	Sept 3	Seine	Floy - spaghetti anchor	26	1	4	26	26	16642- 16682 Yellow
G 02 317C	22	Stuart-Trincomali	Nov 4-26	"	"	789	* 158	20	789	427	17818- 18005 Yellow 16683- 17494 Yellow 18616- 18617 Yellow
G 02 317T	22	Stuart-Trincomali	Nov 13-21	"	"	1027	78	8	1027	1010	17818- 18008 Yellow 17495- 17817 Yellow 18009- 18615 Yellow
G 01 218C	25	Saanich Inlet	Aug 31- Sept 2	"	"	502	32	6	325	325	16118- 16641 Yellow
G 02 218C	25	Saanich Inlet	Dec 2-13	"	"	1096	153	14	1096	1061	18825- 18999 Yellow 05375- 06102 Red 10710- 10969 White
G 02 218T	25	Saanich Inlet	Dec 12,13	"	"	828	31	4	828	665	06103- 06999 Red
G 01 229	35	Fraser River	May 4- June 30	"	"	33	0	-	33	26	07562- 07752 White R 1334-R 1390 Red
G 02 229	35	Fraser River	July 1- July 31	"	"	32	1	3	32	13	07753- 08607 White R 1562-R 1563 Red
G 03 229	35	Fraser River	Aug 2- Aug 29	"	"	354	11	3	354	152	08610- 09365 White
G 04 229	35	Fraser River	Sept 13- Sept 30	"	"	227	18	8	226	138	09380- 10567 White
G 05 229	35	Fraser River	Oct 1- Oct 28	"	"	51	4	8	51	30	10568- 10709 White
J 01 112	29	Bauza Cove	Dec 18	"	"	4	0	-	4	4	B00001-B00252 Red
J 01 212	30	Robson Bight	Dec 19	"	"	4	0	-	4	4	B00253-B00256 Red
J 01 312	31	Hanson Island	Dec 20-21	"	"	7	0	-	7	7	B00257-B00526 Red
TOTALS						4980	487	10	4802	3888	

*Figure extracted (coho section of report).

TABLE 2. Taggings of Chinook Salmon in 1970^a

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
G 01 317C	22	Stuart-Trincomali	Sept 3	Seine	Floy spaghetti anchor	10	0	-	10	10	16642- 16682 Yellow
G 02 317C	22	Stuart-Trincomali	Nov 4-26	"	"	71	0	-	51	51	17818- 18005 Yellow 16683- 17494 Yellow 18616- 18617 Yellow
G 02 317T	22	Stuart-Trincomali	Nov 13-21	"	"	7	0	-	7	7	17818- 18008 Yellow 17495- 17817 Yellow 18009- 18615 Yellow
G 01 218C	25	Saanich Inlet	Aug 31- Sept 2	"	"	5	0	-	6	6	16118- 16641 Yellow
G 02 218C	25	Saanich Inlet	Dec 2-13	"	"	5	1	20	5	5	18825- 18999 Yellow 05375- 06102 Red 10710- 10969 White
G 02 218T	25	Saanich Inlet	Dec 12,13	"	"	9	0	-	7	7	06103- 06999 Red
G 01 229	35	Fraser River	May 4- June 30	"	Floy spaghetti & Carlin	177	4	2	177	106	07562- 07752 White R 1334-R 1390 Red
G 02 229	35	Fraser River	July 1- July 31	"	"	770	9	1	770	360	07753- 08607 White R 1562-R 1563 Red
G 03 229	35	Fraser River	Aug 2- Aug 29	"	Floy spaghetti anchor	270	10	4	270	134	08610- 09365 White
G 04 229	35	Fraser River	Sept 13- Sept 30	"	"	942	20	2	938	412	09380- 10567 White
G 05 229	35	Fraser River	Oct 1-28	"	"	91	2	2	91	28	10568- 10709 White
J 01 112	29	Bauza Cove	Dec 18	"	"	28	0	-	28	28	B00001-B00252 Red
J 01 312	31	Hanson Island	Dec 20,21	"	"	6	0	-	5	5	B00257-B00526 Red
TOTALS						2391	46	2	2365	1159	

^a Recoveries incomplete. This table covers recoveries through December 1971.

TABLE 3. Taggings of Chum^a and Pink Salmon in 1970

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
<u>Chum</u>											
J 01 112	29	Bauza Cove	Dec 18	Seine	Floy spaghetti anchor	214	0	-	214	214	B00001-B00252 Red
TOTALS						214	0	-	214	214	
<u>Pink</u>											
J 01 112	29	Bauza Cove	Dec 18	Seine	Floy spaghetti anchor	3	0	-	3	3	B00001-B00252 Red
J 01 312	31	Hanson Island	Dec 20,21	"	"	544	* 25	5	-	-	B00257-B00526 Red
TOTALS						547	25	5	3	3	

^a Recoveries incomplete. This table covers recoveries through December 1971.

*Figure extracted (pink section of report).

TABLE 4. Taggings of Coho Salmon in 1971

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
G 01 317C	22	Stuart-Trincomali	Jan 27-31	Seine	Floy spaghetti anchor	1030	263	26	1030	1030	B13001-B14085 Yellow
G 01 317T	22	Stuart-Trincomali	Jan 31-Feb 1	"	"	1075	317	29	1075	1075	B14296-B15376 Yellow
G 01 218C	25	Saanich Inlet	Jan 29-Feb 2	"	"	1004	271	27	1004	1004	B15626-B16640 Yellow
G 01 218T	25	Saanich Inlet	Feb 1-2	"	"	1044	186	18	1044	996	B16921-B17968 Yellow
G 01 228	34	English Bay	Jan 26-Feb 26	Troll	"	40	9	23	38	38	B10526-B10970 White
J 02 112	29	Bauza Cove	Feb 24	Seine	"	7	0	-	7	7	B02101-B02184 Red
J 03 112	29	Bauza Cove	Apr 2-6	"	"	4	1	25	4	4	B02285-B02463 Red B06752-B06805 Red
J 01 312	31	Hanson Island	Feb 8	"	"	9	1	11	0	0	B01685-B01694 Red
J 03 312	31	Hanson Island	Apr 5-6	"	"	75	13	17	47	75	B06632-B06751 Red
J 01 512	33	Knight Inlet	Feb 4	"	"	10	0	-	10	10	B00503-B00866 Red
J 02 512	33	Knight Inlet	Feb 24	"	"	2	0	-	2	2	B02206-B02284 Red
J 03 512	33	Knight Inlet	Apr 3	"	"	7	2	29	7	7	B06576-B06588 Red
TOTALS						4307	1063	25	4268	4248	

TABLE 5. Taggings of Chinook Salmon in 1971^a

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
G 01 317C	22	Stuart-Trincomali	Jan 27-31	Seine	Floy spaghetti anchor	52	5	10	52	52	B13001-B14085 Yellow
G 01 218C	25	Saanich Inlet	Jan 29-Feb 2	"	"	6	1	17	6	6	B15676-B16640 Yellow
G 01 218T	25	Saanich Inlet	Feb 1, 2	"	"	1	0	-	1	1	B16921-B17968 Yellow
G 01 228	34	English Bay	Jan 28-Feb 26	Troll	"	396	* 77	19	383	381	B10526-B10970 White
G 02 228	34	English Bay	Mar 1	"	"	6	2	33	6	6	B10971-B10976 White
J 01 112	29	Bauza Cove	Feb 7, 8	Seine	"	11	0	-	11	11	B13001-B14085 Red
J 02 112	29	Bauza Cove	Feb 24	"	"	12	0	-	12	12	B02101-B02184 Red
J 03 112	29	Bauza Cove	Apr 2-6	"	"	50	1	2	50	50	B02285-B02463 Red B06752-B06805 Red
J 03 312	31	Hanson Island	Apr 2-6	"	"	30	2	7	20	29	B02527-B06573 Red B06632-B06751 Red
J 03 412	32	Baker Island	Apr 5	"	"	15	0	-	15	13	B06589-B06631 Red
J 01 512	33	Knight Inlet	Feb 4	"	"	10	1	10	10	10	B00503-B00866 Red
J 02 512	33	Knight Inlet	Feb 24	"	"	18	0	-	18	18	B02206-B02284 Red
J 03 512	33	Knight Inlet	Apr 3	"	"	6	0	-	6	6	B06576-B06588 Red
TOTALS						613	89	15	590	595	

^a Recoveries incomplete; this table covers recoveries through December, 1971.

*Figure extracted (chinook section of report).

TABLE 6. Taggings of Chum Salmon in 1971^a

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
J 02 112	29	Bauza Cove	Feb 24	Seine	Floy spaghetti anchor	5	0	-	5	5	B02101-B02184 Red
J 03 112	29	Bauza Cove	Apr 2	"	"	9	0	-	9	9	B02285-B02463 Red
J 01 212	30	Robson Bight	Feb 7	"	"	434	0	-	82	82	B01248-B01684 Red
J 03 212	30	Robson Bight	Apr 2	"	"	60	0	-	60	31	B02464-B02526 Red B06806-B06824 Red
J 03 312	31	Hanson Island	Apr 2-6	"	"	8	0	-	5	6	B02527-B06573 Red B06632-B06751 Red
J 03 412	32	Baker Island	Apr 5	"	"	12	0	-	12	12	B06589-B06631 Red
J 01 512	33	Knight Inlet	Feb 4	"	"	1	0	-	8	8	B00503-B00866 Red
J 02 512	33	Knight Inlet	Feb 24	"	"	<u>17</u>	<u>0</u>	<u>-</u>	<u>17</u>	<u>16</u>	B02206-B02284 Red
TOTALS						546	0	-	198	169	

^a These fish have not yet entered the fishery; thus the lack of recoveries.

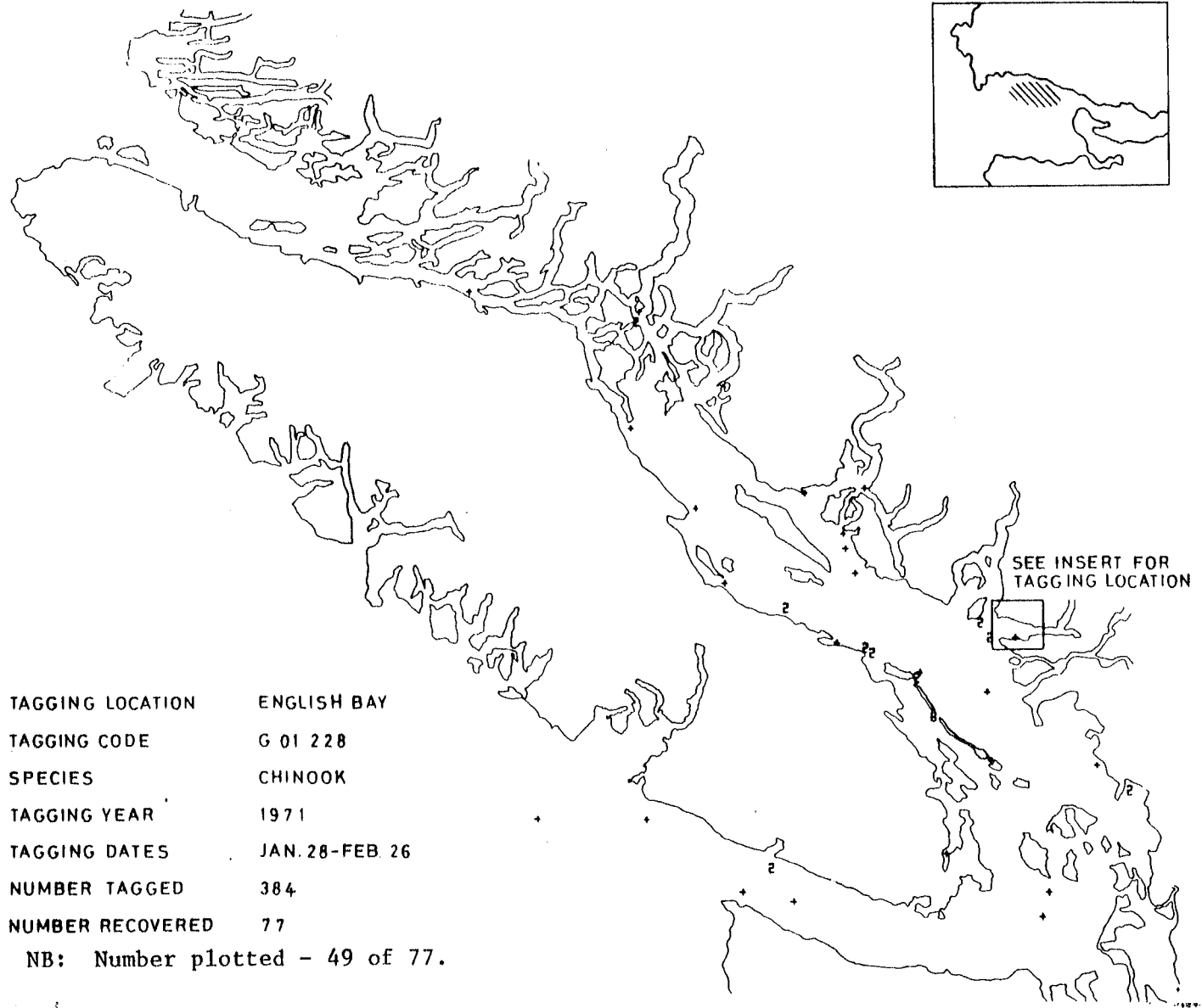
TABLE 7. Tagging of Pink Salmon in 1971

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
J 01 112	29	Bauza Cove	Feb 7, 8	Seine	Floy spaghetti anchor	764	22	3	305	305	B00867-B01244 Red
J 02 112	29	Bauza Cove	Feb 24	"	"	80	3	4	80	78	B02101-B02184 Red
J 03 112	29	Bauza Cove	Apr 2, 6	"	"	259	10	4	256	95	B02285-B02463 Red B06825-B06926 Red
J 03 212	30	Robson Bight	Apr 2, 6	"	"	22	1	5	22	6	B02464-B02526 Red B06806-B06824 Red
J 03 312	31	Hanson Island	Apr 2	"	"	831	20	2	68	48	B02527-B06573 Red
J 03 412	32	Baker Island	Apr 5	"	"	7	0	-	7	7	B06589-B06631 Red
J 01 512	33	Knight Inlet	Feb 4	"	"	10	0	-	10	10	B00503-B00866 Red
J 02 512	33	Knight Inlet	Feb 24	"	"	<u>4</u>	<u>0</u>	<u>-</u>	<u>4</u>	<u>4</u>	B02206-B02284 Red
TOTALS						1977	56	3	752	553	

TABLE 8. Taggings of Sockeye Salmon in 1971^a

Tagging Code	Location Number	Tagging Location	Tagging Dates	Tagging Gear	Tag Type	No. Tagged	No. Recov.	Percent Recov.	No. Lengths	No. Scales	Tag Series & Colour
J 03 312	31	Hanson Island	Apr 5, 6	Seine	Floy spaghetti anchor	10	1	10	2	10	B06632-B06751 Red
J 03 412	32	Baker Island	Apr 5	"	"	9	0	-	9	8	B06589-B06631 Red
J 01 512	33	Knight Inlet	Feb 4	"	"	15	0	-	15	15	B00503-B00866 Red
J 02 512	33	Knight Inlet	Feb 24	"	"	<u>36</u>	<u>1</u>	<u>3</u>	<u>36</u>	<u>35</u>	B02206-B02284 Red
TOTALS						70	2	3	62	68	

^a Recoveries incomplete; this table covers recoveries through December, 1971.



TAGGING LOCATION	ENGLISH BAY
TAGGING CODE	G 01 228
SPECIES	CHINOOK
TAGGING YEAR	1971
TAGGING DATES	JAN. 28-FEB. 26
NUMBER TAGGED	384
NUMBER RECOVERED	77

NB: Number plotted - 49 of 77.

The following information was extracted from reference no. 25 (Argue and Heizer, 1974). See chinook section of reference 24 for further information.

Table 2 is a tag and recovery index for chinook salmon tagged along the coast of British Columbia between 1963 and 1969. Often the number of fish tagged and recovered is not large. Included are some representation figures showing tagging locations and recaptures. Straight line migration routes can be inferred but the validity of the results is questionable.

Included, figures from: Page 254* (reference no. 25)

Page 266* (reference no. 25)

*See footnotes on figures with reference to distributions of other fish.

INTRODUCTION

The first and often most informative step in the process of tag return analysis is a visual presentation of tag returns. Heizer and Argue (MS 1972) and Bourque and Pitre (MS 1972) presented returns from 1969 to 1971 and chinook tagging programs in this manner.

This report maps and tables tag return distributions for 119 of the 1963 to 1969 coho and chinook taggings from Dixon Entrance to Juan de Fuca Strait reported in Argue and Heizer (MS 1971). Basic tag and recovery information, general tagging program objectives for returns mapped and tabulated herein, are described in the previous reports by Argue and Heizer. The final section of this report presents listings of coho and chinook tag returns from 1963 to 1971 tagging programs that were received after publication of the previous reports. Updated recoveries to November 30, 1973 are included.

Future reports in this series will cover detailed analysis of the more informative tagging programs from the 1963 to 1971 returns.

EXPLANATION OF TEXT AND APPENDICES

Figures 1 to 7 are maps of statistical areas for British Columbia, Alaska, Washington, Oregon and California in which fish reported on in this paper were captured. Figure 1 also shows the general location of the taggings dealt with in this report.

Figures 8 to 11 show most of the freshwater locations which are likely to be encountered in this report.

Figure 12 explains the format for data on individual tag recoveries tabled in Appendices I and II.

Tables 1 and 2 show, for coho and chinook taggings respectively, tagging codes, tagging location names, tagging dates, numbers tagged and recovered and page numbers on which distribution map and tables may be found.

The tagging codes, which appear in the first columns of Tables 1 and 2, identify these taggings in the Appendices and may be used for cross reference to the previous reports in this series.

(See report for further details.)

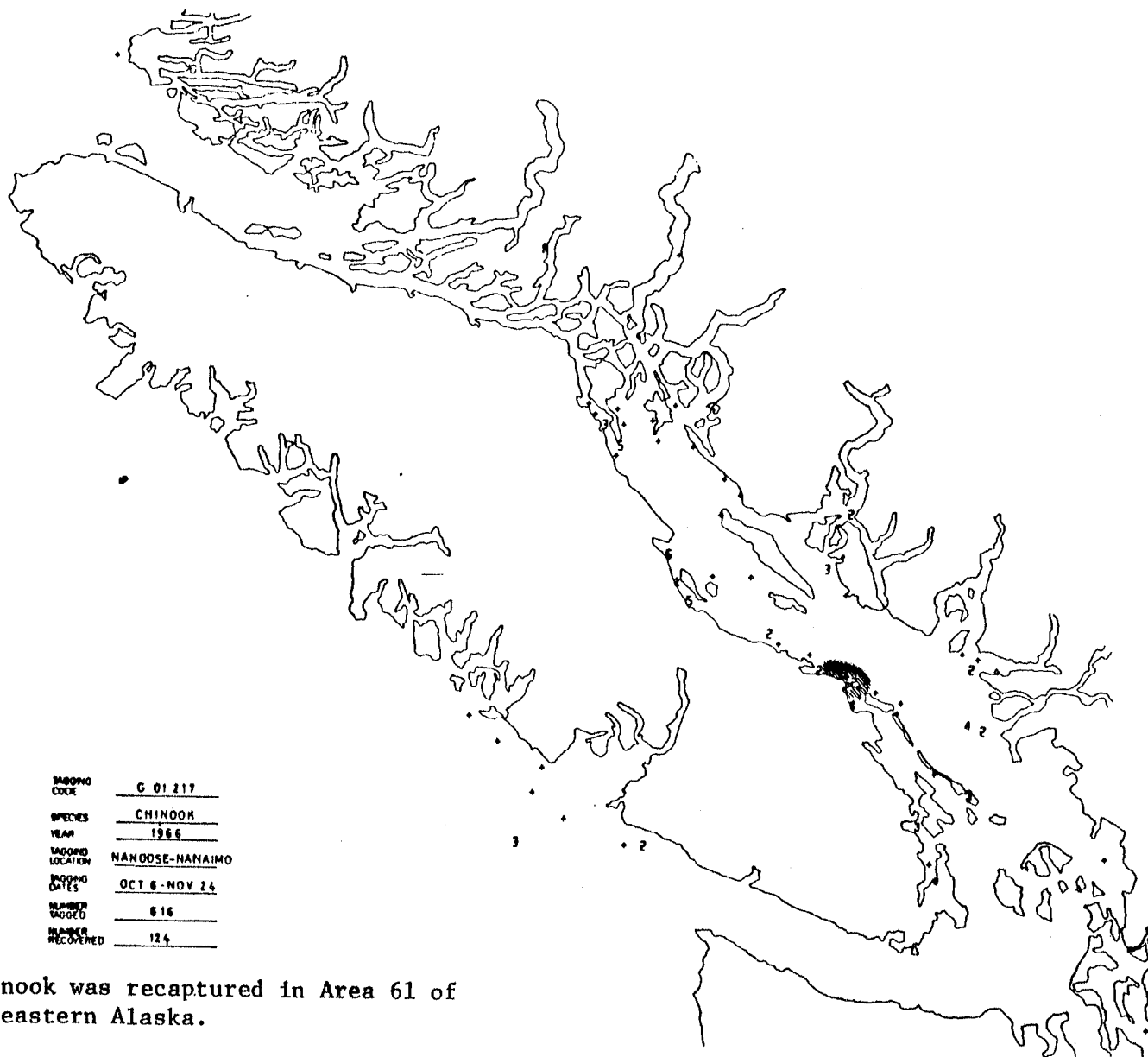
TABLE 2. Tag and recapture index for chinook salmon taggings in Appendix II.

YEAR	TAGGING CODE	TAGGING LOCATION	TAGGING DATES	NO. TAGGED	NO. RECOVERED	PAGE
1966	D 01 101	DIXON ENTRANCE	06/29 to 07/28	6	2	202
67	D 01 101	DIXON ENTRANCE	06/29 to 07/31	98	20	203
68	D 01 101	DIXON ENTRANCE	07/06 to 07/31	5	2	205
67	D 02 101	DIXON ENTRANCE	08/01 to 08/25	18	4	206
66	D 01 103	DUNDAS ISLAND	06/30 to 07/31	17	3	208
67	D 01 103	DUNDAS ISLAND	06/22 to 07/29	70	18	209
68	D 01 103	DUNDAS ISLAND	06/30 to 07/31	20	3	211
68	H 01 102	WEST HECATE STRAIT	06/16 to 07/31	9	2	213
66	H 01 105	BROWNING ENTRANCE	07/01 to 07/29	10	1	215
67	H 01 105	BROWNING ENTRANCE	06/29 to 07/31	73	6	216
68	H 01 105	BROWNING ENTRANCE	06/15 to 07/31	111	10	217
67	H 02 105	BROWNING ENTRANCE	08/02 to 08/18	25	2	218
68	H 02 105	BROWNING ENTRANCE	08/01 to 08/16	37	6	219
68	H 01 205	NORTHEAST HECATE STR.	06/16 to 07/31	100	13	221
68	H 01 106	SOUTHEAST HECATE STR.	06/16 to 07/31	4	1	222
65	J 01 413	DEEPWATER BAY	09/10 to 09/30	24*	3	224
65	J 03 413	DEEPWATER BAY	10/01 to 10/31	29	1	225
63	G 01 114	HORNBY - DENMAN	06/13 to 06/17	197	35	227
64	G 01 114	HORNBY - DENMAN	06/09 to 06/17	148	32	229
66	G 01 114	HORNBY - DENMAN	05/28 to 06/19	32	9	231
66	G 02 114	HORNBY - DENMAN	11/10 to 11/12	86	20	233
66	G 01 214	MID-STRAIT NORTH	02/01 to 02/05	28	6	236
64	G 01 116	HEAD JERVIS INLET	06/24 to 06/25	93	22*	239

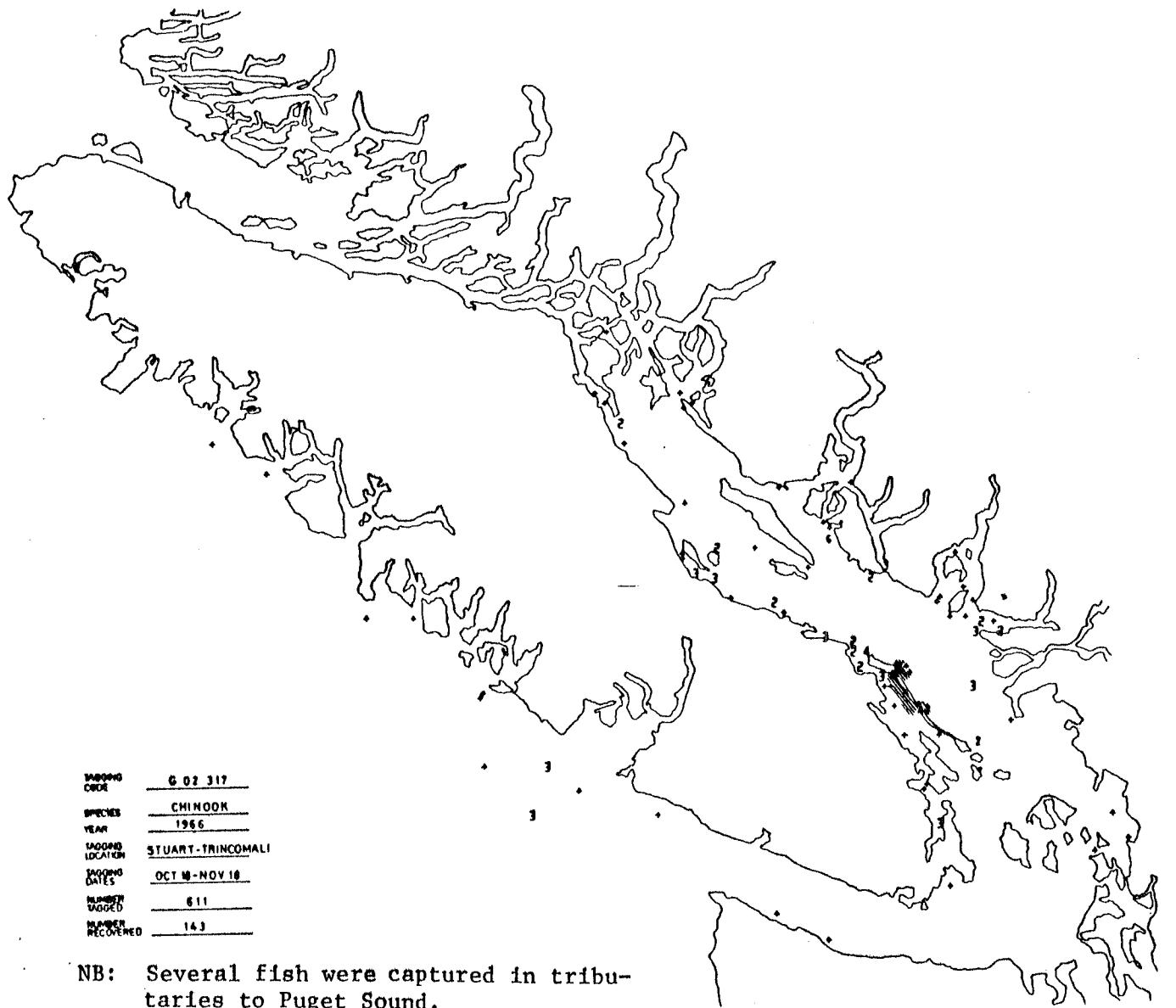
TABLE 2. Continued.

YEAR	TAGGING CODE	TAGGING LOCATION	TAGGING DATES	NO. TAGGED	NO. RECOVERED	PAGE
1963	G 01 216	MID-JERVIS INLET	05/30	7	2	242
64	G 01 216	MID-JERVIS INLET	06/23	11	2	243
63	G 02 216	MID-JERVIS INLET	07/02 to 07/04	18	9	244
66	G 01 117	MID-STRAIT SOUTH	02/06 to 06/25	64	13	248
63	G 01 217	NANOOSE-NANAIMO	05/16 to 05/29	43*	6	250
64	G 01 217	NANOOSE-NANAIMO	05/25 to 06/08	287	68	252
66	G 01 217	NANOOSE-NANAIMO	10/06 to 11/24	616	124	254
67	G 01 217	NANOOSE-NANAIMO	04/03 to 04/28	532	158	257
63	G 02 217	NANOOSE-NANAIMO	06/07 to 06/27	48	14	260
66	G 01 317	STUART-TRINCOMALI	02/22 to 03/07	18	4	263
69	G 01 317	STUART-TRINCOMALI	03/11 to 03/12	28	7	264
66	G 02 317	STUART-TRINCOMALI	10/18 to 11/18	611	143	266
68	G 01 118	SATELLITE CHANNEL	05/15 to 05/16	41	7	269
68	G 02 118	SATELLITE CHANNEL	10/11 to 10/16	303	7	271
68	G 01 218	SAANICH INLET	10/13 to 10/16	9*	1	274
69	G 01 218	SAANICH INLET	03/30 to 04/01	8	1	275
63	G 02 218	SAANICH INLET	06/25 to 06/27	24	9	276
64	G 01 128	ENTRANCE HOWE SOUND	06/27 to 06/29	12*	7	279
68	F 01 119	SOOKE-VICTORIA	05/01 to 05/14	13	3	282
69	F 01 119	SOOKE-VICTORIA	03/04 to 04/21	26	1	283
68	F 02 119	SOOKE-VICTORIA	05/23 to 07/11	95	10	284
69	F 03 119	SOOKE-VICTORIA	10/04 to 10/10	4*	1	286
68	F 01 120	PORT SAN JUAN	05/23 to 07/11	189*	36*	288

* Starred numbers indicate a change in these totals from tables in Argue and Heizer (MS 1971) and Heizer and Argue (MS 1972).



NB: 1 chinook was recaptured in Area 61 of Southeastern Alaska.



SAMPLING CODE	<u>G 02 317</u>
SPECIES	<u>CHINOOK</u>
YEAR	<u>1966</u>
SAMPLING LOCATION	<u>STUART-TRINCOMALI</u>
SAMPLING DATES	<u>OCT 18-NOV 18</u>
WASHER TAGGED	<u>611</u>
NUMBER RECOVERED	<u>143</u>

NB: Several fish were captured in tributaries to Puget Sound.

The following information was extracted from reference no. 44 (Ginetz, 1976):

"Introduction

"Concern over the status of chinook salmon on the Pacific Coast, and particularly the north (Fig. 1), has become more prevalent in recent years due to an apparent decline in stock size. This concern emphasizes the need for better conservation, improved management techniques and stock enhancement where feasible. However, prior to recommending measures for better control of the resource, it is appropriate that all information on chinook salmon stocks be assembled into readable and applicable manuscript reports. This report focuses on one area of the Pacific Coast - the North Coastal Branch, comprising Statistical Areas 1 to 5."

Table 29: Timing of chinook salmon to tributaries of the Nass River. (Data collected from Fisheries and Marine Service spawning ground reports).

Stream	Initial Arrival	Spawning		
		Begin	Middle	End
Chambers	July 1	July 5	Aug. 1	Aug. 30
Cranberry	July 5	July 15	July 30	Aug. 5
Damdochax	July 5	Aug. 5	Aug. 20	Sept. 15
Donahue	June 25	July 1	Aug. 1	Aug. 31
Georgia	July 1	July 25	Aug. 20	Sept. 1
Ishkinnish				
Khutzemateen	Aug. 1	Aug. 15	Aug. 25	Sept. 5
Kincolith	June 1		June 15	July 15
Kiteen	July 5	July 20	Aug. 15	Sept. 1
Kitsault	July 10	July 25	Aug. 15	Sept. 1
Kwinnigeese	Aug. 1	Aug. 10	Aug. 25	Sept. 20
Meziadin	July 2		Aug. 20	Sept. 15
Quinimass	July 15		Aug. 10	Sept. 1
Seaskinnish	Aug. 1		Aug. 30	Sept. 25
Tseax	June 25		Aug. 30	Sept. 15

Table 30: Timing of chinook salmon to tributaries of the Skeena River. (Data collected from Fisheries and Marine Service spawning ground reports).

Stream	Initial Arrival	Spawning		
		Begin	Mid	End
Babine	July 15	Aug. 25	Sept. 20	Oct. 15
Bear		Sept. 5	Sept. 15	Oct.
Bulkley				
Cedar River	July 15		Aug. 30	
Clear	Aug. 7		Sept. 15	
Ecstall	Aug. 10		Sept. 10	Oct. 1
Johnson	Aug. 15	Aug. 25	Sept. 15	
Kispiox	Aug. 1		Sept. 1	
Kitsumkalum	July	Aug. 15	Sept. 15	
Kitwanga	Aug. 1	Aug. 15	Sept. 1	
Kloiya	Aug. 1	Sept. 1	Sept. 15	Sept. 30
Lakelse	Aug. 1	Aug. 15	Aug. 30	Sept. 15
Morice				
Khyex	Aug. 15		Sept. 7	
Nitchyeskwa	Aug. 1		Sept. 20	
Exchamsiks	Aug.		Sept. 1	
Big Falls	Aug. 15	Sept. 1	Sept. 15	
Deep	Aug.		Sept. 15	Sept. 30
Diana	Sept. 25		Oct. 15	
Fiddler	Aug. 1	Aug. 15	Aug. 30	Sept.
Gitnadoix	July		Aug. 15	Sept.
Grouse	Aug.		Sept. 1	
Kasiks				
Zymagotitz	July	Aug. 15	Aug. 30	Sept.
Zymoetz	Aug.	Aug. 15	Aug. 30	Sept.
Salmon				
Stevens	Aug.	Aug. 15	Sept. 1	
Suskwa	Aug. 1	Aug. 15	Sept. 8	Sept. 30
Sustut				
Nilkitkwa		Aug. 28		
Reiseter				

The following information was extracted from reference no. 39 (Farwell, 1977):

"Adult Tagging - Bella Bella, 1976

"Chinook:

"Tagged 69 mostly at St. John's Harbour, Aldrich and Day Pts. There were only four returns, none of which were very exciting (Goose Grounds, Day Pt., Hope I. (12), Berry Inlet (Seaforth))."