

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

**Volume 1
Sockeye Salmon**

Northern Natural Resource Services Ltd.

April 1978

Memorandum Report

**Salmonid Enhancement Program
Project No. 34**



**Fisheries
and Environment
Canada**

**Peches
et Environnement
Canada**

TABLE OF CONTENTS

VOLUME 1:

Covering Letter	i
Table of Contents	i
1. Introduction.....	1
2. Methods.....	1
2.1. Collection of Information.....	1
2.2. Analysis of Information.....	2
3. Results.....	3
3.1. General Results.....	4
Table 1. (Appendix Table A-VII, Aro and Shepard, 1967) List of "major" salmon streams in British Columbia. The "major" stocks present in each stream are indicated.....	15
3.1.1. Discussion.....	28
- Tagging and Recovery Methods.....	29
- Interpreting the Results.....	31
- Physical and Statistical Limitations.....	31
- Costs of Salmon Tag-Recovery Programs.....	32
- Interpretive Limitations.....	33
- Statistical Limitations.....	34
- Limitations Introduced by Human Behaviour.....	36
- The Extension of Knowledge to Management and Enhancement.....	36
3.1.2. References.....	38
3.2. Results by Species (Extracted Material).....	49
3.2.1. Sockeye Salmon.....	49
Table 2. Sources of information, location of tag-recovery programs and associated information extracted for sockeye salmon.....	50

VOLUME 2:

3.2.2. Pink Salmon.....	260
Table 3. Sources of information, location of tag-recovery programs and associated information extracted for pink salmon.....	261

VOLUME 3:

3.2.3. Chum Salmon.....	541
Table 4. Sources of information, location of tag-recovery programs and associated information extracted for chum salmon.....	542

Table of Contents (Continued)

<u>VOLUME 4:</u>	3.2.4. Coho Salmon.....	679
	Table 5. Sources of information, location of tag-recovery programs and associated information extracted for coho salmon.....	680
<u>VOLUME 5:</u>	3.2.5. Chinook Salmon.....	813
	Table 6. Sources of information, location of tag-recovery programs and associated information extracted for chinook salmon.....	814

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.

Tables 2 to 6, for each of the salmon species in Volumes 1 to 5, identify the source material, the year of publication, the sampling locations, the types of information extracted, and the page number in the text of the report.

NORTHERN NATURAL RESOURCE SERVICES, LTD.

3535 East 45th Avenue
Vancouver, B. C. V5R 3G2

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

TABLE OF CONTENTS

VOLUME 1:

Covering Letter	
Table of Contents	
1. Introduction	1
2. Methods	1
2.1. Collection of Information	1
2.2. Analysis of Information	2
3. Results	3
3.1. General Results	4
3.1.1. Discussion	28
- Tagging and Recovery Methods	29
- Interpreting the Results	31
- Physical and Statistical Limitations	31
- Costs of Salmon Tag-Recovery Programs	32
- Interpretive Limitations	33
- Statistical Limitations	34
- Limitations Introduced by Human Behaviour	36
- The Extension of Knowledge to Management and Enhancement	36
3.1.2. References	38
3.2. Results by Species (Extracted Material)	49
3.2.1. Sockeye Salmon	49

VOLUME 2: 3.2.2. Pink Salmon

VOLUME 3: 3.2.3. Chum Salmon

VOLUME 4: 3.2.4. Coho Salmon

VOLUME 5: 3.2.5. Chinook Salmon

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1. Introduction

Northern Natural Resource Services, Ltd. (N.N.R.S.) was engaged on March 1, 1978 by the Department of Fisheries and the Environment (D.F.E.) to prepare a report designed to integrate Pacific salmon ocean tagging data gathered from studies conducted since approximately 1920 in various locations off the coast of British Columbia. The term of engagement of N.N.R.S. was subsequently extended to April 30, 1978.

The responsibility of N.N.R.S., as identified by contract, was "to assemble, analyze and integrate all available salmon tagging data as drawn from published and unpublished reports (including memorandum reports) into a baseline catalogue to be prepared indicating the state of knowledge concerning salmon migration along the coast of British Columbia.

"Specifically,

1. To review, extract and assemble all pertinent information located in files, libraries and obtained from interviews with appropriate members from the following government departments:
 - a) Fisheries and Marine Service, Vancouver, B. C.
 - b) International Pacific Salmon Fisheries Commission (I.P.S.F.C.) New Westminster, B. C.
 - c) Pacific Biological Research Station, Nanaimo, B. C.
2. Compilation and integration of all information obtained into the standardized biological format of the Fisheries and Marine Technical Report Series."

2. Methods

2.1. Collection of Information

Literature Review:

Data related to Pacific salmon tag-recovery programs were extracted from several sources of existing literature:

- a) Published documents and scientific papers of the Fisheries and Marine Service concerning tag-recovery programs in coastal waters of British Columbia.
- b) Files of the Fisheries and Marine Service in Vancouver containing unpublished memorandum and letter reports of Pacific salmon tagging studies.
- c) Files of the Pacific Biological Research Station in Nanaimo, British Columbia, containing unpublished memorandum and letter reports appropriate to the project.
- d) Published information of the International Pacific Salmon Fisheries Commission in New Westminster, B. C.

Interviews:

To obtain further opinion as to the treatment of the collected data appropriate to the terms of reference of contract between N.N.R.S. and D.F.E., interviews were conducted with representatives of Fisheries and Marine Service in Vancouver, I.P.S.F.C. in New Westminster, and Pacific Biological Research Station in Nanaimo, B. C. The purpose of these interviews was to obtain impressions from researchers more intimately associated with the studies than representatives of N.N.R.S. as to the gross relative values of different segments of the tag-recovery studies, the purposes to which the results of previous tagging studies had been put, and to obtain impressions as to the preferred direction that further studies should take.

2.2. Analysis of Information

A preliminary stage in the interpretation of the collected data was to read and critically analyze the relative value of segments of the mass of literature available concerning tag-recovery programs conducted in British Columbia coastal waters since the inception of these studies. The information collected for B. C. waters, believed to be nearly complete for purposes of this report, represents only one segment of the total available literature for the entire Pacific coast from Alaska to California, and since salmon do not recognize geographical boundaries, and intermix in international waters, the problems of interpretation and analysis of data become magnified. In addition to tag-recovery studies in British Columbia coastal waters, various agencies are now, and have been, involved in similar programs in the North Pacific Ocean and in coastal waters of the states of Washington, Oregon, California and Alaska. This report in the main does not include information available from non-Canadian agency sources, excepting as such information has been represented in Canadian fisheries documents relative to the topic. Some information is included regarding salmon tagging programs conducted in Southeast Alaska. Some of the U. S. and international fisheries agencies engaged in a treatment of migration problems of Pacific salmon are as follows:

- a) International North Pacific Fisheries Commission
- b) Alaska Department of Fish and Game
- c) Washington State Department of Fisheries
- d) Oregon Department of Fish and Wildlife
- e) California Department of Fish and Game.

After a preliminary interpretation of the available data had been achieved by reading as much of the available literature as time constraints of the contract allowed, the next step was to decide on the best method of presenting the appropriate material to its greatest advantage for purposes of this report. It was decided that any process of selection determined by

N.N.R.S. personnel as to the relative importance of specific tag-recovery information to be presented in this report would, in some areas, be subject to errors of judgment in interpreting the author's intent. To avoid the probability of culling potentially important data from this report as a result of using an ill-conceived selection process, it was decided to extract all key information in the form of figures and tabular data together with some supporting textual material taken directly from the specific reports. It is very important to realize that the information presented in this report represents only the "bare bones" of the many tagging studies which have been conducted in British Columbia coastal waters. The dangers of using information as presented here as a basis for development of management strategy should be obvious. We believe, however, that this report has substantial value in providing an expanded reference to the mass of literature concerning tag-recovery programs conducted off the B. C. coast.

3. Results

The results are presented in two sections, general and specific. The general section includes a discussion of the biological complexities of interpreting migration patterns of Pacific salmon in British Columbia coastal waters. Also included is some background information in the form of figures and tables to indicate the locations of spawning grounds for Pacific salmon in British Columbia and the location of statistical areas as a guide to areas of harvest intensity.

The specific section of the results is composed of direct extractions from the available literature presented in order by year for each of the five species of Pacific salmon. The specific results include:

- a) summaries, extractions and migration route maps drawn from or developed from the manuscripts and published literature available on salmon tag-recovery programs;
- b) pertinent information from the conclusions and results of reports as they apply to each of the five Pacific salmon species.

The specific information is presented in five separate sections as extracted from numerous sources. Tables have been developed as a cross-reference for faster identification of the source material. All references from which information has been extracted are numbered by year and the table identifies the type of information extracted for each species. At the beginning of the section on each species some background information has been provided for that species. The source of this background information is Aro and Shepard (1967) (reference no. 26), and includes:

- a) a general statement concerning the species;
- b) a figure illustrating the location of the documented spawning grounds and some estimate of escapements based on data collected from 1951 to 1962;

- c) tabled information on escapement and spawning times;
- d) a figure illustrating the timing of harvest which is an indication of the timing of migration.

It is hoped that the general information as presented will provide the reader with some concept of the magnitude and extensive distribution of the spawning populations and enable him to evaluate the relative importance or significance of migration routes and timing charts as extracted from the literature.

3.1. General Results

An understanding of ocean migration routes and timing of migration of each of the five species of Pacific salmon is inseparable from some basic conception of the distribution and behaviour of each species in the fresh-water phase. Many variables interact in the homing migrations of spawning populations of Pacific salmon to compound the problems of interpretation of migration routes and timing as determined by tag-recovery studies. Most of these variables are concerned with the types and intensities of harvest methods and the times of migration of various individual stocks of migrating fish within the general population. Historically, tag-recovery programs were conducted on homing populations within the areas of most intense commercial fishing. Most of these initial studies were conducted without the benefit of recent information concerning ocean distribution of Pacific salmon as shown in Figure 1. The statistical areas of the British Columbia coast are shown in Figure 2. Tagging locations in some statistical areas on the B. C. coast may result in recoveries both north and/or south of the international boundaries (Figures 3-10), and the interpretation of such internationally collected data often becomes very complicated.

Aro and Shepard (1967) (reference no. 26) have published an excellent review of the general status of salmon spawning populations within freshwaters of British Columbia. Table 1 (from Aro and Shepard, 1967) lists the major salmon spawning streams and the species accommodated by each stream for each statistical area within coastal waters of British Columbia. An appraisal of the many spawning streams and the numerous individual stocks distributed in these spawning streams at different times may provide a preliminary conception of the multitude of problems related to establishment of routes and times of migration for each individual stock on its homing migration. More accurate escapement data for each salmon spawning stream related to statistical area is presently being compiled into stream catalogues by the Fisheries and Marine Service, Vancouver. It may be stressed here that because of the combination of several spawning populations in streams, it is possible to have as many migration routes and timing charts as there are individual stocks. If this is realized, it becomes obvious that the state of knowledge of specific salmon migration is at a low level of development.

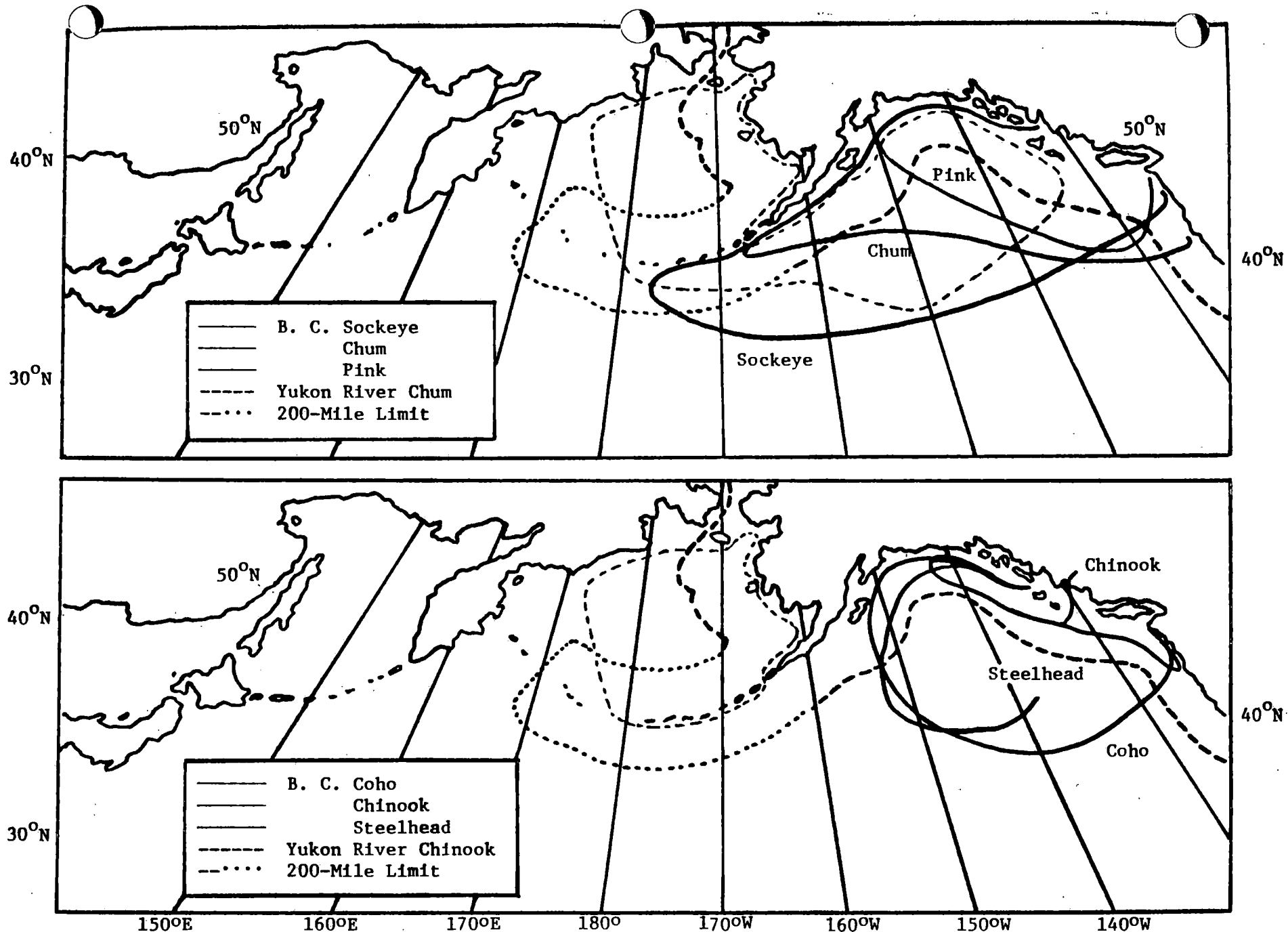


Figure 1. Approximate ocean distribution of British Columbia and Yukon River salmon in relation to the approximate location of 200-mile fishing limits off the west coast of North America. (From U. S. and Canada Negotiations, 1971.)

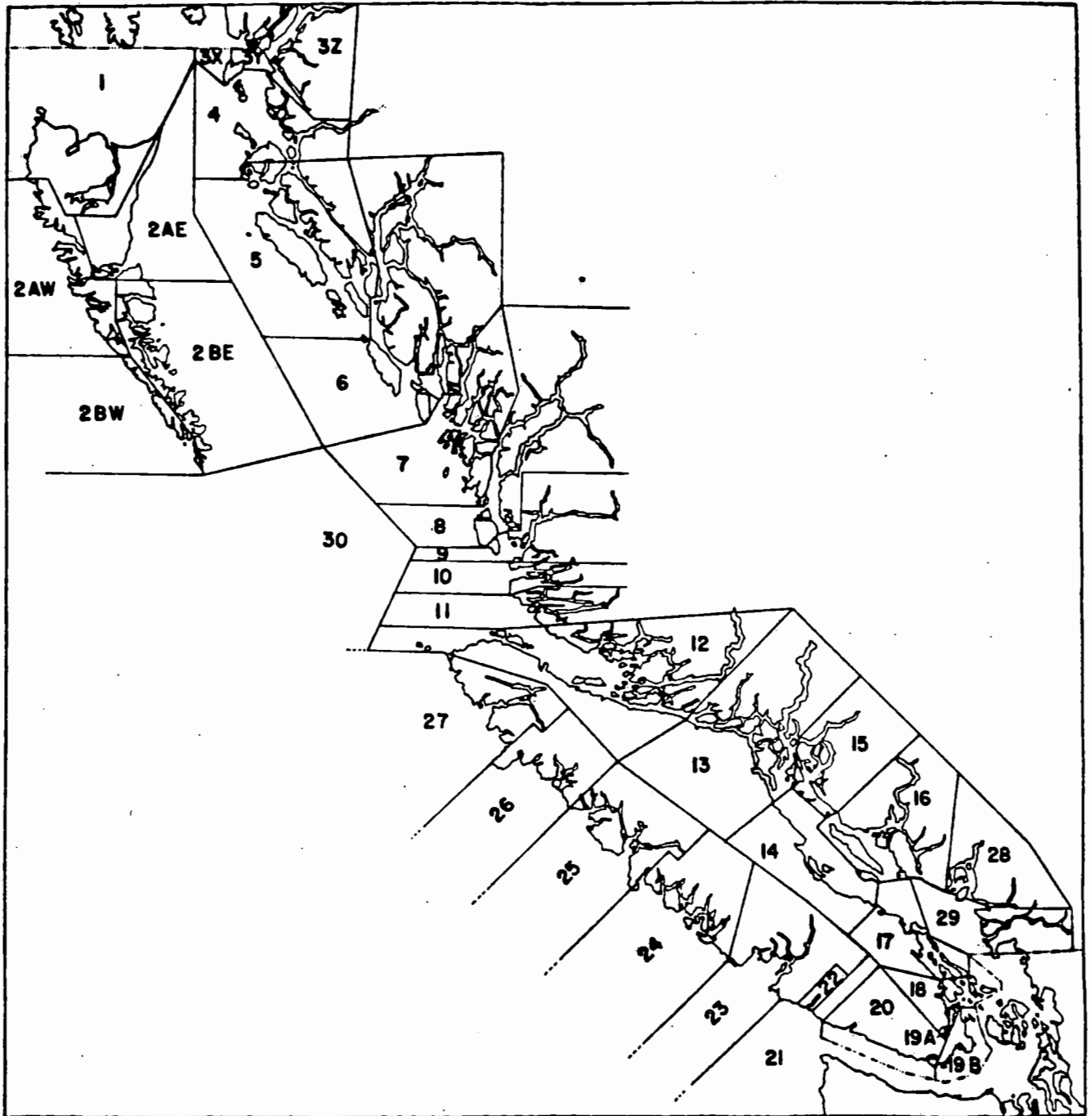


Figure 2. British Columbia Statistical Areas. (From U. S. and Canada Negotiations, 1971.)

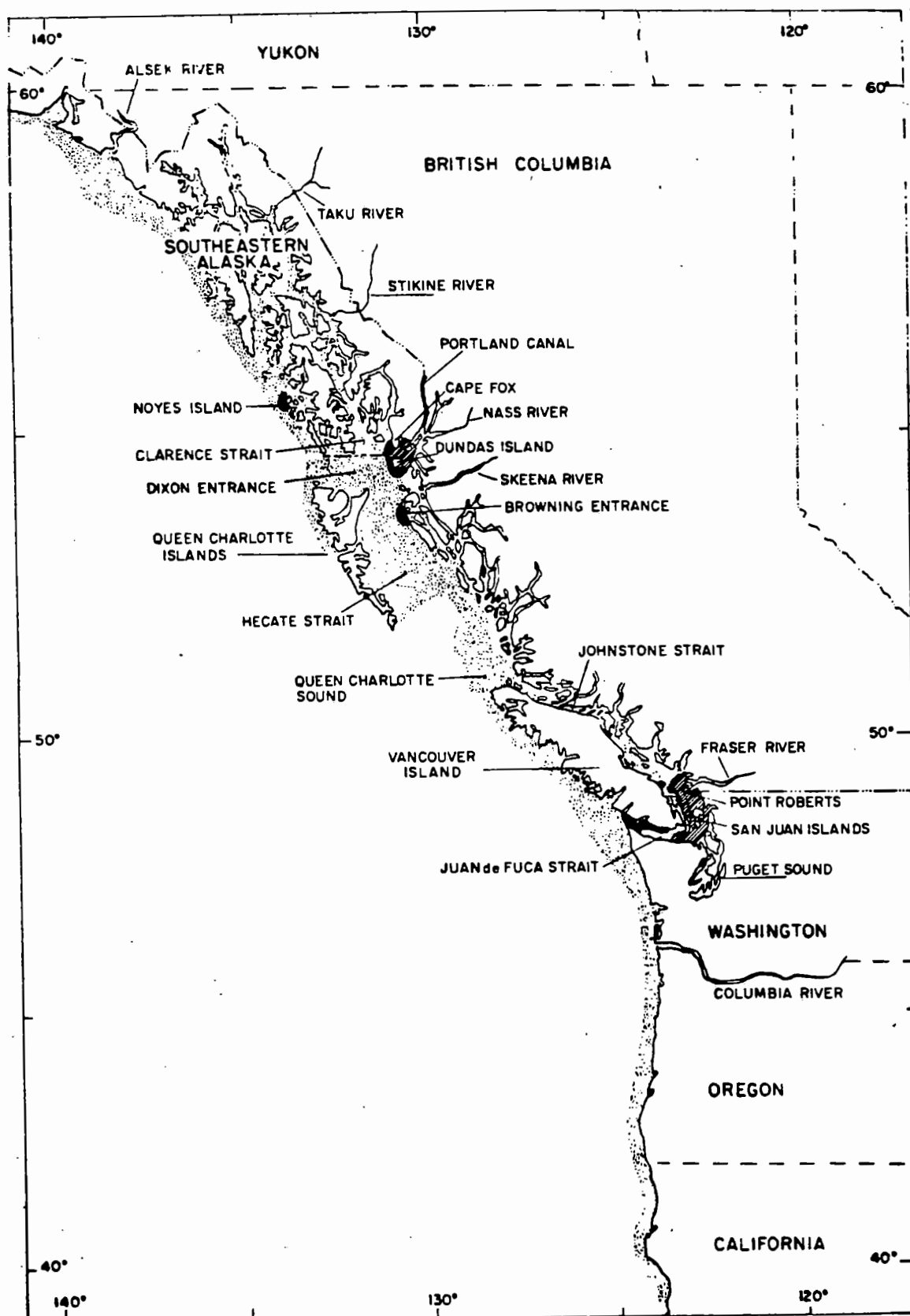


Figure 3. The coasts of Southeastern Alaska, British Columbia, Washington, Oregon, and California showing places named in the text. Stippled area indicates where trolling occurs. Hatched areas indicate major areas of interception in net fisheries. (From U. S. and Canada Negotiations, 1971.)

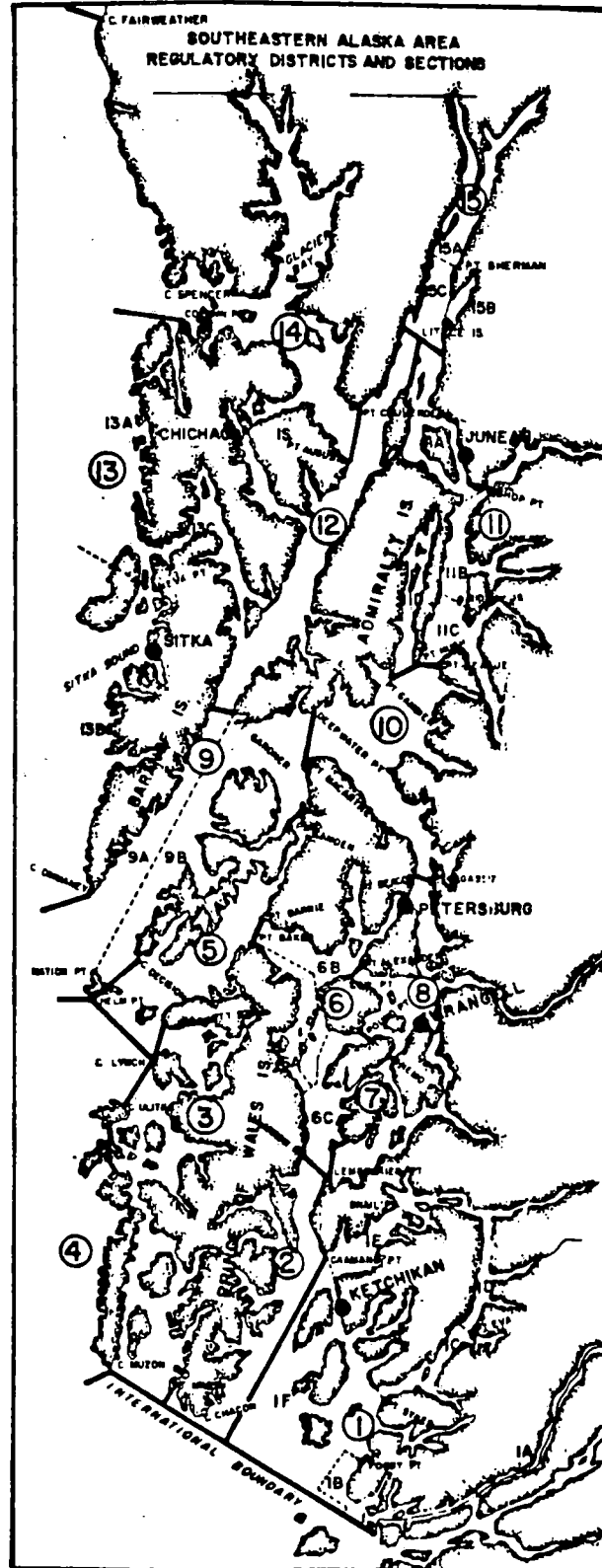


Figure 5. Regulatory districts and sections in Southeastern Alaska.
(From U. S. and Canada Negotiations, 1971.)

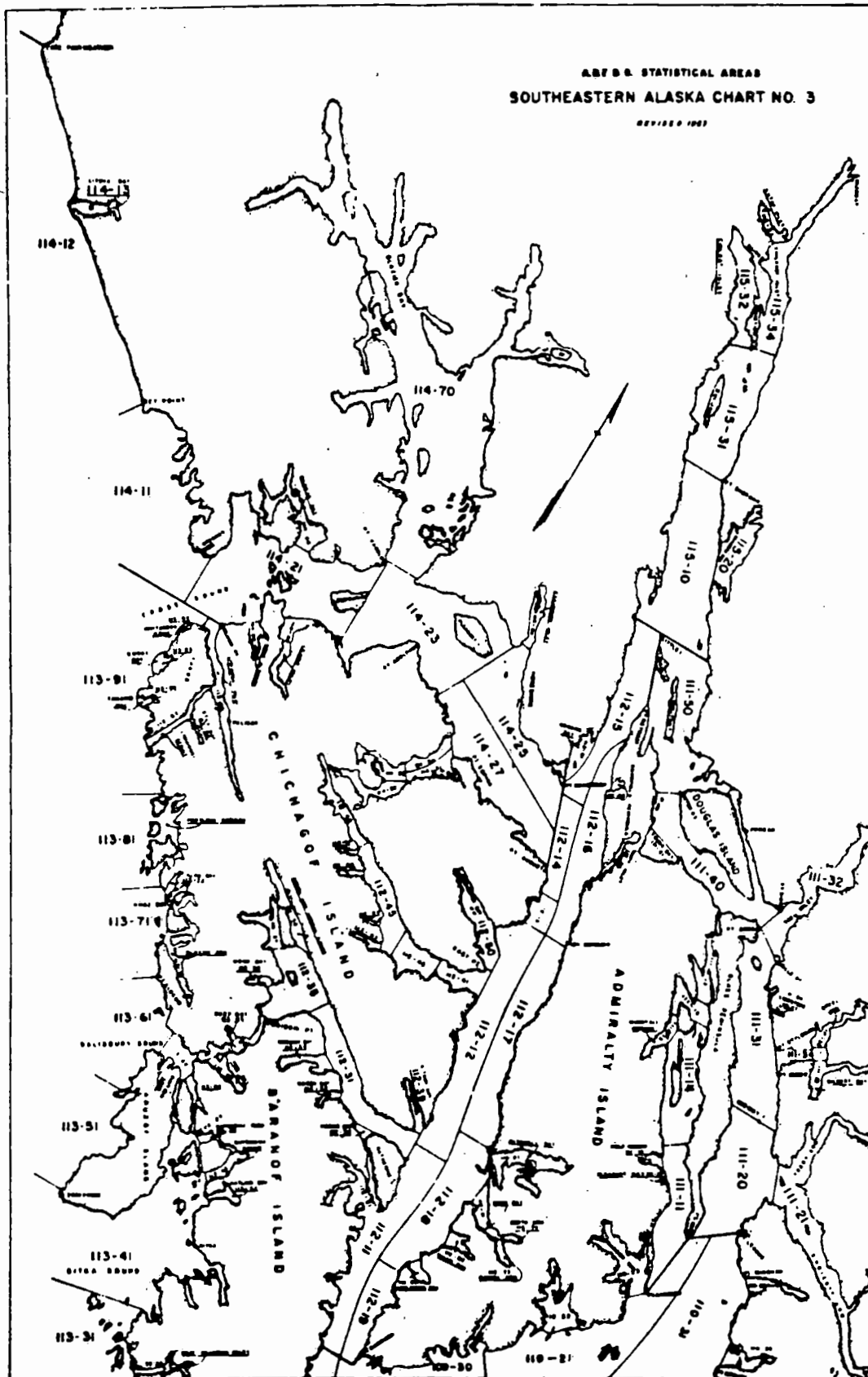


Figure 6. Upper Southeast Alaska statistical areas. (From Argue and Heizer, 1971.)

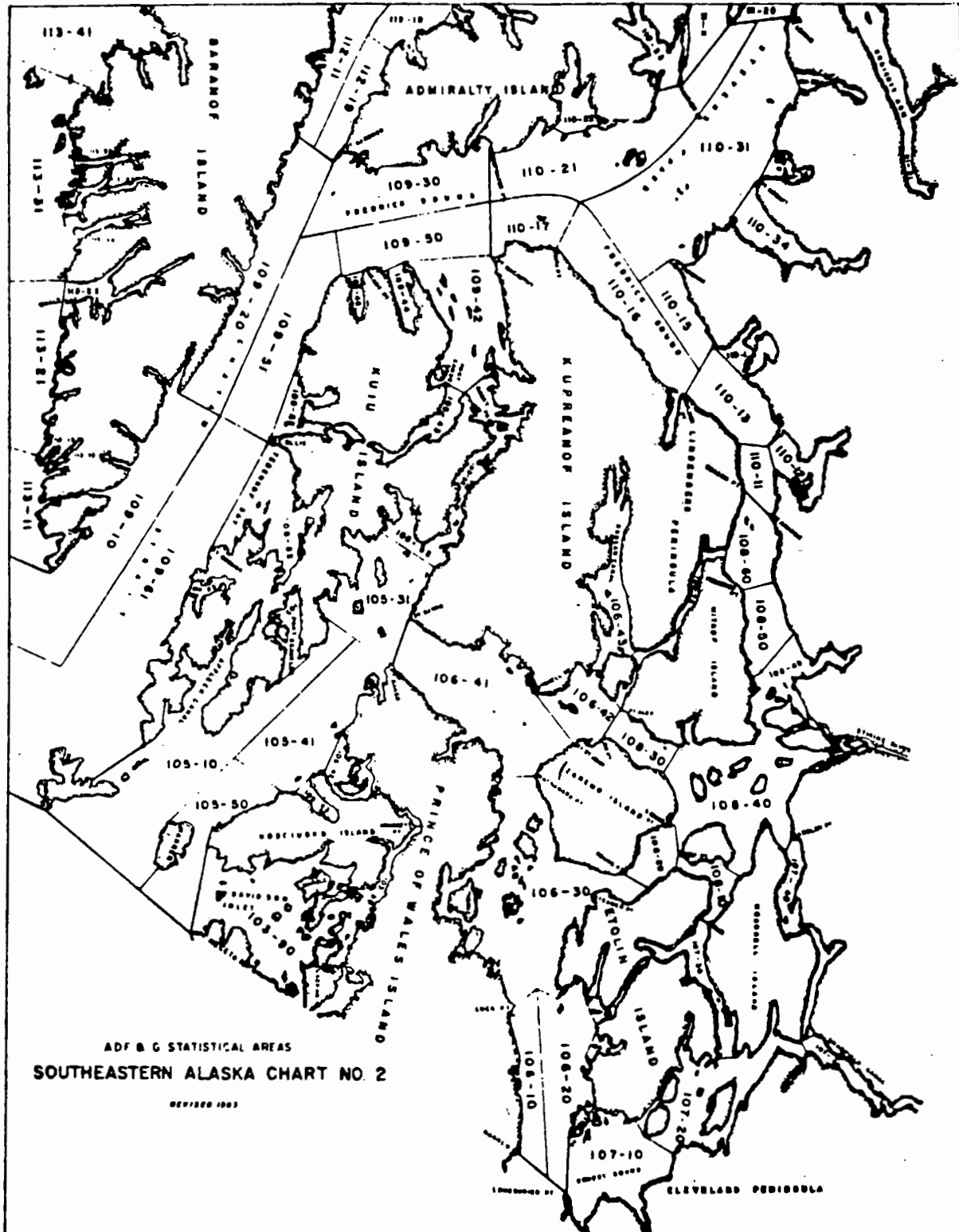


Figure 7. Mid Southeast Alaska statistical areas. (From Argue and Heizer, 1971.)

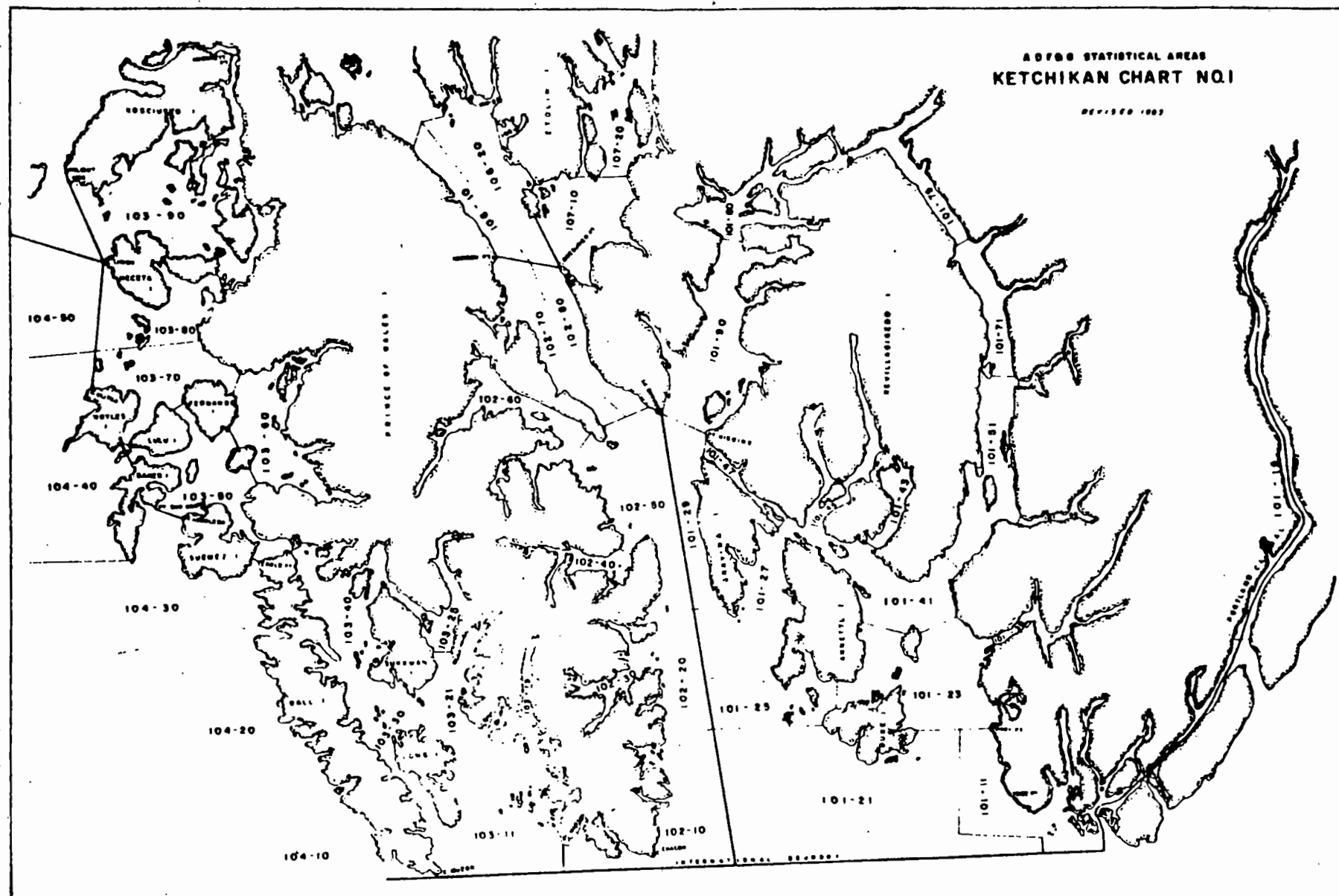


Figure 8. Lower Southeast Alaska statistical areas. (From Aruge and Heizer, 1971.)

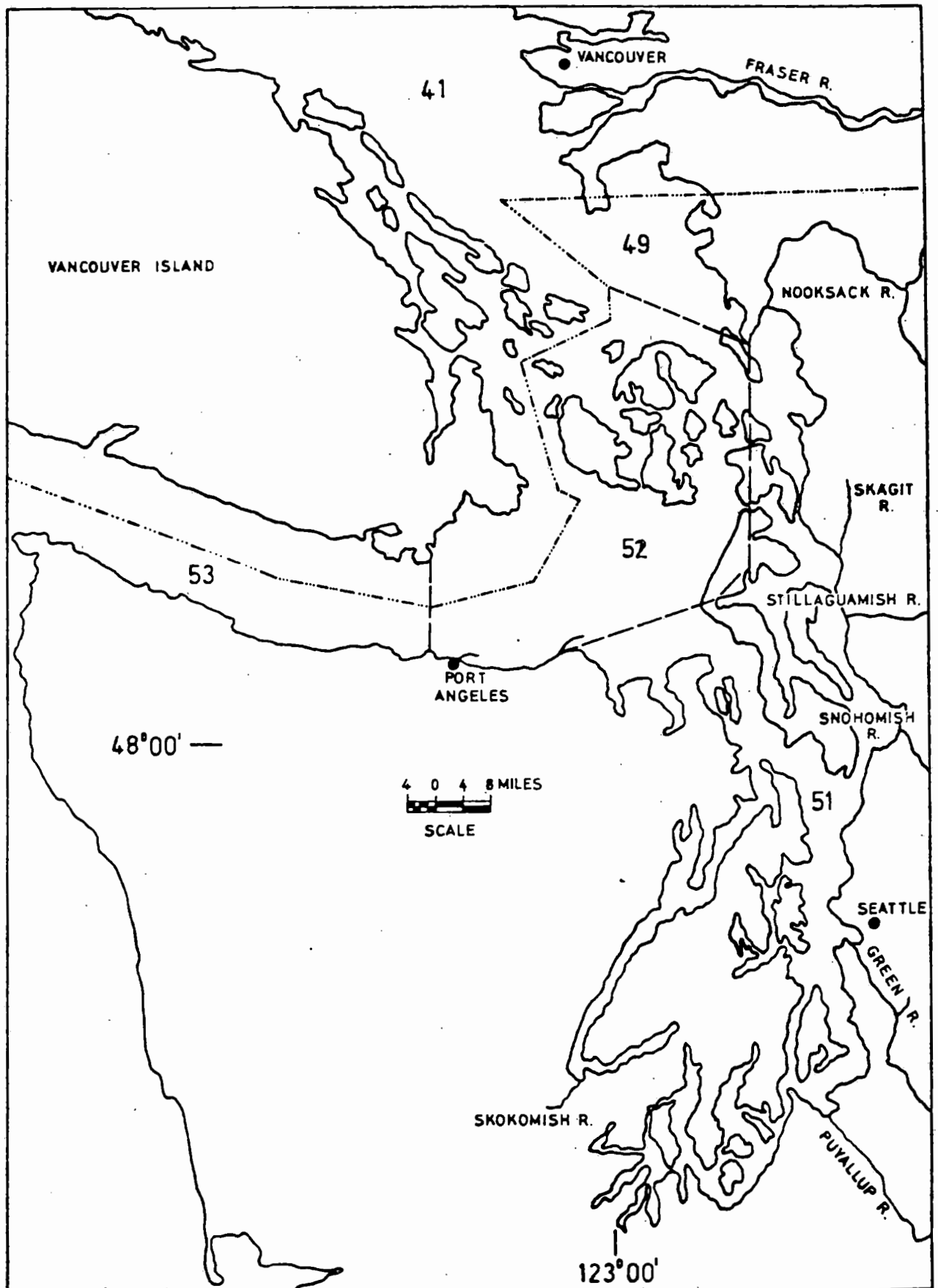


Figure 9. Puget Sound and contiguous United States waters assigned recovery areas. (From Argue and Heizer, 1971.)

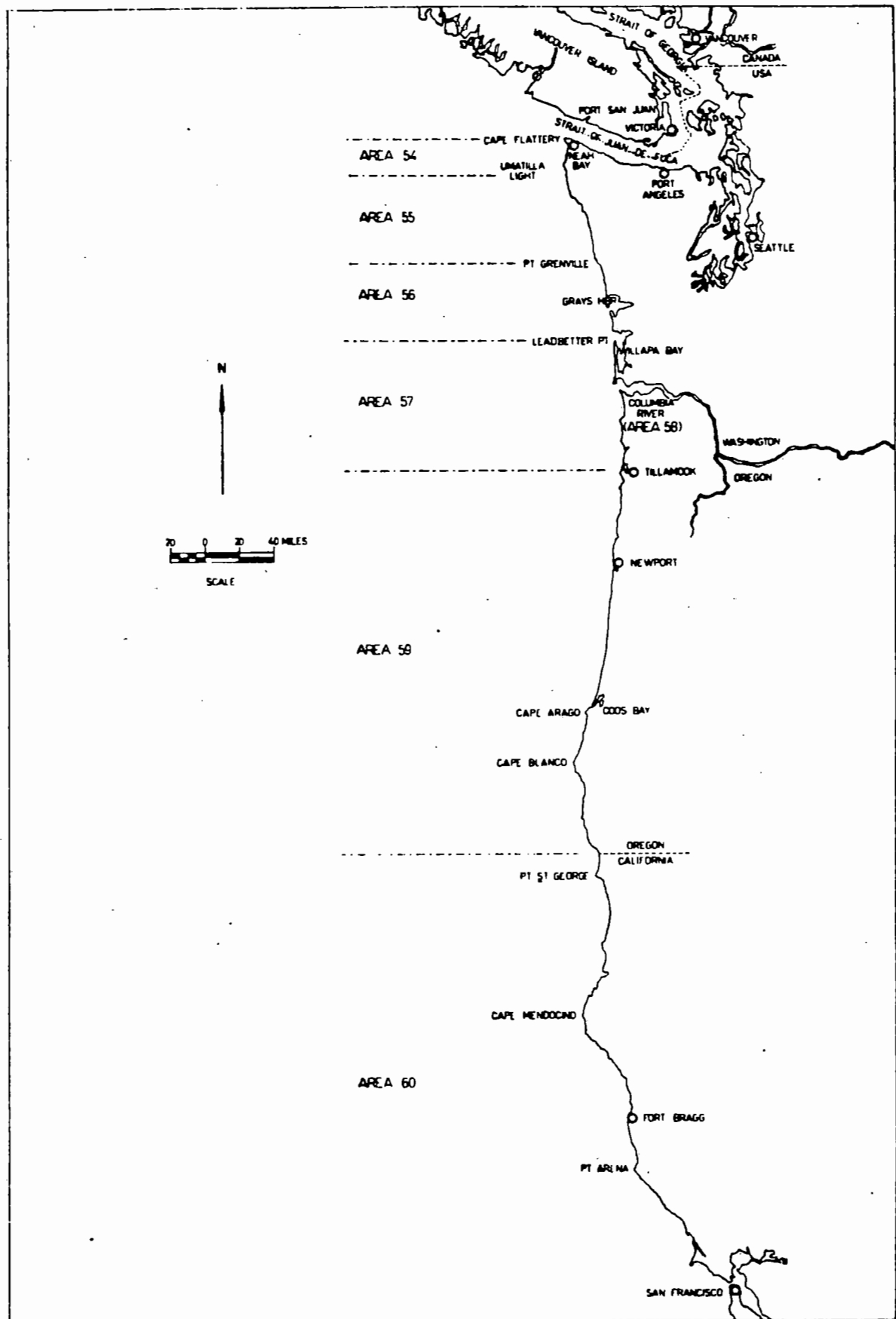


Figure 10. West coast United States south of Cape Flattery assigned recovery areas. (From Argue and Heizer, 1971.)

Table 1. (Appendix Table A-VII, Aro and Shepard, 1967.) List of "major" salmon streams in British Columbia. The "major" stocks present in each stream are indicated.

Statistical area	Stream	Map index number (App. Figs. A-1—A-6)	Sockeye	Pink		Chum	Coho	Chinook
				Odd years	Even years			
1	Ain River	1				x	x	
	Awun River & Lake	2				x		
	Datlamen Creek	3			x			
	Mamin River	4			x			
	Naden River & Lake	5	x		x	x	x	
	Yakoun River & Lake	6	x		x		x	x
2A	Athlow Creek	7				x		
	Browns Cabin Creek	8			x			
	Canoe Point Creek	9				x		
	Copper Creek	10	x	x	x		x	
	Deena River	11			x	x	x	
	Honna River	12				x		
	Kaisun Creek	13			x			
	Long Arm River	14				x		
	Mercer Creek	15	x			x		
	Otard Creek	16			x			
	Peel Inlet Stream (head)	17				x		
	Riley Creek	18			x			
	Seal Inlet Stream	19				x		
	Security Inlet Stream (left)	20			x			
2B	Tlell River	21			x		x	
	Bag Harbour Creek	22				x		
	Big Goose Bay Creek	23				x		
	George Bay Creek	24				x		
	Harriet Bay Creek	25				x		
	Lagoon Bay Creek	26				x	x	
	Mathers Creek	27			x		x	
	Oyster Cove Creek	28				x		
	Pallant Creek	29			x	x	x	
	Salmon River	30				x		
	Sedmond River	31				x		
	Skedans Creek	32			x			
	Windy Bay Creek	33			x			
	3	Bowser Lake	34	x				
Damdochax Lake		35	x					
Dogfish Bay Creek		35A		x				
Gingit Creek		36	x					
Illiance Creek		37				x	x	
Kitsault River		38						x
Kwinagase Lake		38A	x					
Meziaden Lake		39	x					
Nass River		40		x	x	x	x	x
Kwinamass River		41		x	x			x
Seaskinnish River		42						x
Toon River		43				x		
Tsax River		44					x	x
4		Alastair Lake	45	x				
	Babine River (lower)	46	x	x			x	x
	Babine River (upper)	47	x				x	
	Bear Lake	48	x					
	Bear River	49						x
	Bulkley River (upper)	50					x	x
	Bulkley River (lower)	51					x	

Continued ...

Table 1. (Continued)

Statistical area	Stream	Map index number (App. Figs. A-1—A-6)	Sockeye	Pink		Chum	Coho	Chinook
				Odd years	Even years			
4 (cont.)	Cedar River	52						x
	Cloyah River	53						x
	Diana Creek	54	x				x	
	Ecstall River	55				x		x
	Falls Creek	56	x					
	Pinkut Creek	57	x					
	Four Mile Creek	58	x					
	Fulton River	59	x					
	Gitnadoix River	60					x	
	Gosnell Creek	61					x	
	Grizzly Creek	62	x					
	Kasiks River	63					x	
	Kispiox River	64		x	x		x	x
	Kitwanga River	65		x	x			
	Lakelse River	66		x	x		x	
	McDonell Lake	67					x	
	Moore Cove Creek	68		x	x			
	Morice River	69					x	x
	Morrison River	70	x					
	Nanika River	71	x					
	Oona River	72			x			
	Pierre Creek	73	x					
	Skeena River (main channel)	74		x	x	x		
	South-end Creek	75	x					
	Tacheek Creek	76	x					
	Tahlo Creek	77	x					
	Twin Creek	78	x					
	Williams Creek	79	x					
5	Foot Creek	80					x	
	Kingdown Inlet Creek	81	x				x	
	Curtis Inlet Creek	82	x					
	Endhill Creek	83					x	
	Keecha Lake	84	x					
	Hevenor Inlet Creek	85					x	
	Kumcalon Creek	86		x	x			
	Lowe Lake System	87					x	
	Pa-aat River	88					x	
	Port Stephens Creek	89					x	
	Survey Bay River	90	x				x	
6	Turn Creek	91			x	x		
	Union Pass Lake System	92					x	
	Mussel River	93		x	x	x	x	
	Bish Creek	94			x			
	Dala River	95					x	x
	Deer Creek	96					x	
	Douglas Creek	97					x	
	Eagle Creek	98					x	
	Evelyn Creek	99			x		x	
	Flux Creek	100					x	
	Gilttoyres Creek	101					x	
	Canooona River	102		x			x	
	Kemano River	103				x	x	x
	Khutze River	104						x
	Kildala River	105			x	x		x

Continued ...

Table 1. (Continued)

Statistical area	Stream	Map index number (App. Figs. A-1—A-6) — Sockeye	Pink		Chum	Coho	Chinook
			Odd years	Even years			
6 (cont.)	Kiltuish River	106			x	x	
	Kiskosh River	107	x	x			
	Kitimat River	108		x	x	x	x
	Nalbeelah Creek	108A		x			
	Kitkiata River	109	x	x		x	
	Kitlope River	110	x		x	x	x
	Kowesas River	111				x	
	Price Creek	112			x	x	
	Quaal River	113	x	x		x	
	Kwakwa Creek	114	x				
	Salmon Creek	115				x	
	Scow Bay Creek	116	x	x			
	Stannard Creek	117				x	
	Tsaytis River	118				x	
	Wale Creek	119				x	
	Weeteeam Bay Creek	120				x	
	West Creek	121				x	
7	Gullchuck Head Stream	122			x		
	Howyet Creeks	123			x		
	Kainet River	124	x	x	x		
	Kakushdish Creek	125				x	
	Clatse River	126	x	x	x		
	Kwakusdis River	127			x		
	Neekis River	128	x	x	x		
	Noota River	129			x		
	Salmon Bay Creek	130		x	x		
	Tinkev River	131	x				
8	Atnarko & Bella Coola Rivers	132	x	x	x	x	x
	Cascade Inlet River	133			x		
	Dean River	134	x		x	x	x
	Elcho Harbour River	135			x		
	Hook Nose Creek	136		x			
	Jenny Bay Streams	137		x			
	Kimsquit River	138	x		x	x	x
	Köeye River	139	x	x	x	x	
	Kwatna River	140	x	x	x	x	
	Martin River	141				x	
	Nootum River	142		x			
9	Amback Creek	143	x				
	Ashlulm Creek	144	x				
	Clyak-Young-Neil Rivers	145					
	Dallery Creek	146	x				
	Genesee Creek	147	x				
	Inziana River	148	x				
	Johnston Creek	149		x			
	Kilbella River	150				x	
	Machmell River	151	x				
	Neechanz River	152	x				
	Sheemahant River & Flats	153	x				
	Tzeo River	154	x				
	Wannock River & Flats	155	x		x	x	x
	Washwash River	156	x				
10	Canoe Creek	157	x				
	Docce River	158					x

Continued ...

Table 1. (Continued)

Statistical area	Stream	Map index number (App. Figs. A-1—A-6)	Sockeye	Pink		Chum	Coho	Chinook
				Odd years	Even years			
10 (cont.)	Smokehouse Creek	159	x					
	Nekite River	160			x			
11	Pack Lake River	161					x	
	Seymour River	162					x	
	Taaltz River	163				x	x	
12	Adam River	164		x			x	
	Ahnuhati River	165				x	x	x
	Ahta Valley Creek	166				x	x	
	Bughouse Creek	167					x	
	Cluxewe River	168					x	
	Embley Lagoon River	169					x	
	Franklin River	170						x
	Fulmore River	171					x	
	Glendale Creek	172		x	x	x	x	
	Kakweiken River	173	x	x	x	x	x	
	Keogh River	174		x	x	x	x	
	Kingcome River	175			x	x	x	x
	Klinaklini River	176	x			x	x	x
	Kokish River	177					x	
	Kwalate Point River	178					x	
	Mackenzie Sound River	179	x					
	Nimmo Bay Creek	180					x	
	Nimpkish River system	181	x			x	x	x
	Quatse River	182			x	x	x	
	Shoal Harbour Creek	183					x	
	Shushartie River	184			x		x	
	Sim Creek	185					x	
	Thiemer Creek	186					x	
	Tsitika River	187					x	
	Viner Sound River	188				x	x	
	Wakeman River	189		x		x	x	x
	Waterfall Creek	190		x	x	x		
13	Amor de Cosmos Creek	191			x			
	Campbell River	192						x
	Cumsack Creek	193						x
	Heydon Creek	194	x			x		
	Homathko River	195				x	x	x
	Orford River	196				x		x
	Phillips River	197	x	x		x		x
	Quatum River	198		x				
	Quinsam River	199					x	
	Salmon River	200				x	x	x
	Southgate River	201				x	x	x
	Village Bay Creek	202					x	
14	Black Creek	203					x	
	Englishman River	204				x		
	French Creek	205					x	
	Little Qualicum River	206				x	x	x
	Oyster River	207			x		x	
	Puntledge River	208				x	x	x
	Qualicum River	209				x	x	x
	Tsable River	210				x		
	Tsolum River	211		x	x		x	
15	Brem River	212		x			x	

Continued ...

Table 1. (Continued)

Statistical area	Stream	Map index number (App. Figs. A-1—A-6)	Sockeye	Pink		Chum	Coho	Chinook
				Odd years	Even years			
15 (cont.)	Klite Creek	213					x	
	Sliammon Creek	214				x		
	Theodosia River	215				x	x	
	Toba River	216		x		x	x	x
16	Deserted River	217				x	x	
	Lang Creek	218					x	
	Sakinaw Lake System	219	x					
	Skwawka River	220		x				
17	Tzoonie River	221				x	x	
	Bonsall Creek	222					x	
	Bush Creek	223				x		
	Chemainus River	224				x	x	
18	Holland Creek	225				x		
	Nanaimo River	226				x	x	x
	Cowichan River	227				x	x	x
	Koksilah River	228				x	x	
19	De Mamiel Creek	229				x		
	Goldstream River	230				x		
	Sooke River	231				x		
	Gordon River	232					x	x
20	San Juan River	233					x	
	Hobiton River	234	x					
	Nitinat River	235				x	x	x
	Anderson River	236	x				x	x
23	Maggie River	237					x	
	Nahmint River	238				x		x
	Sarita River	239				x		x
	Somass River System	240	x				x	x
24	Toquart River	241				x	x	
	Toquart River, left fork	242				x		
	Bedwell River	243						x
	Clayoquot River	244	x				x	
	Cold Creek	245	x					
	Cypre River	246					x	x
	Hesquiat Lake System	247					x	
	Kennedy Lake	248	x					
	Lower Kennedy River	249						x
	Megin River	250				x	x	x
	Moyeha River	251				x	x	x
	Tranquil Creek	252				x	x	x
25	Upper Kennedy River	253	x					
	Burman River	254				x	x	x
	Conuma River	255					x	x
	Gold River	256					x	x
	Inner Basin Rivers	257				x		
	Tahsis River	258				x		x
	Zeballos River	259				x		
	Artlish River	260					x	x
26	Clanninick River	261				x		
	Jansen Lake System	262					x	
	Kaooinch River	263						x
	Kaouk River	264					x	x
	Malksope River	265				x		
	Power River & Lake	266					x	

Continued ...

Table 1. (Continued)

Statistical area	Stream	Map index number (App. Figs. A-1—A-6)	Sockeye	Pink		Chum	Coho	Chinook
				Odd years	Even years			
26 (cont.)	Tahish River	267				x	x	x
27	Buck Creek	268					x	
	Colony Creek	269					x	
	Fisherman River	270					x	
	Klaskish River	271					x	
	Koprino River	272			x		x	
	Kwatleo Creek	273			x		x	
	Macjack River	274					x	
	Mahatta River	275	x				x	
	Marble River	276					x	x
	San Josef River	277					x	
28	Capilano River	278					x	
	Cheakamus River	279		x		x	x	x
	Indian River	280		x		x	x	
	Seymour River	281					x	
	Squamish River	282				x	x	x
29	Ankwill Creek	283	x					
	Big Silver River	284	x					
	Birkenhead River	285	x				x	x
	Bivouac Creek	286	x					
	Bowron River	287	x					x
	Chehalis River	288		x		x	x	x
	Chilcotin River	289						x
	Chilko River	290	x					x
	Chilliwack River	291		x		x	x	x
	Clearwater River	292					x	x
	Coldwater River	293						x
	Cultus Lake	294	x					
	Deadman River	295					x	x
	Driftwood River	296	x					
	Dust Creek	297	x					
	Eagle River	298					x	x
	Finn Creek	299						x
	Forsythe Creek	300	x					
	Fraser River at Tête Jaune Cache	301						x
	Fraser River below Hope	302		x		x		
	Forfar Creek	303	x					
	Gluske Creek	304	x					
	Harrison River	305	x	x		x		x
	Horsefly River	306	x					
	Kazcheck Creek	307	x					
	Kuzkwa Creek	308	x					
	Kynoch Creek	309	x					
	Lemieux Creek	310					x	
	Leo Creek	311	x					
	Little River	312	x					
	Louis Creek	313					x	x
	Lower Adams River	314	x				x	x
	Lower Shuswap River	315	x				x	x
	McGregor River	316						x
	Middle River	317	x					
	Nadina River	318	x					
	Narrows Creek	319	x					
	Nechako River	320						x

Continued ...

Table 1. (Continued)

Statistical area	Stream	Map index number (App. Figs. A-1—A-6)	Sockeye	Pink		Chum	Coho	Chinook
				Odd years	Even years			
29 (cont.)	Nicola River	321						x
	Nicomekl River	322					x	
	North Thompson River	323						x
	Okanagan River	324	x					
	Quesnel River	325						x
	Raft River	326	x					x
	Rosette Creek	327	x					
	Sakeniche River	328	x					
	Salmon River (lower Fraser River)	329					x	
	Salmon River (Shuswap Lake)	330					x	
	Seton Creek	331		x				
	Seymour River	332	x					
	South Thompson River	333	x					x
	Spius Creek	334						x
	Stellako River	335	x					
	Stuart River	336						x
	Sweltzer Creek	337				x		
	Tachie River	338	x					
	Taseko River	339	x					x
	Thompson River	340		x				x
	Upper Adams River	341					x	
	Upper Pitt River	342	x				x	x
	Upper Shuswap River	343					x	x
	Weaver Creek	344	x				x	

The timing of salmon migration as indicated by harvest for general salmon populations is illustrated in Figure 11. The saltwater migration phases occur prior to and throughout the frequency distributions.

Figures 12 to 14 illustrate the harvest trends (on a logarithmic scale) from 1945 to 1970. Regression lines for 1945 through 1966 are noted as a solid line. Average catches for 1967 to 1970 are shown by dotted lines. Figure 15 illustrates how gear type and associated change in fishing methods may influence the seasonal trends. All of these variables in turn can be influenced by the regulation of opening and closures of the fishery along the British Columbia coast.

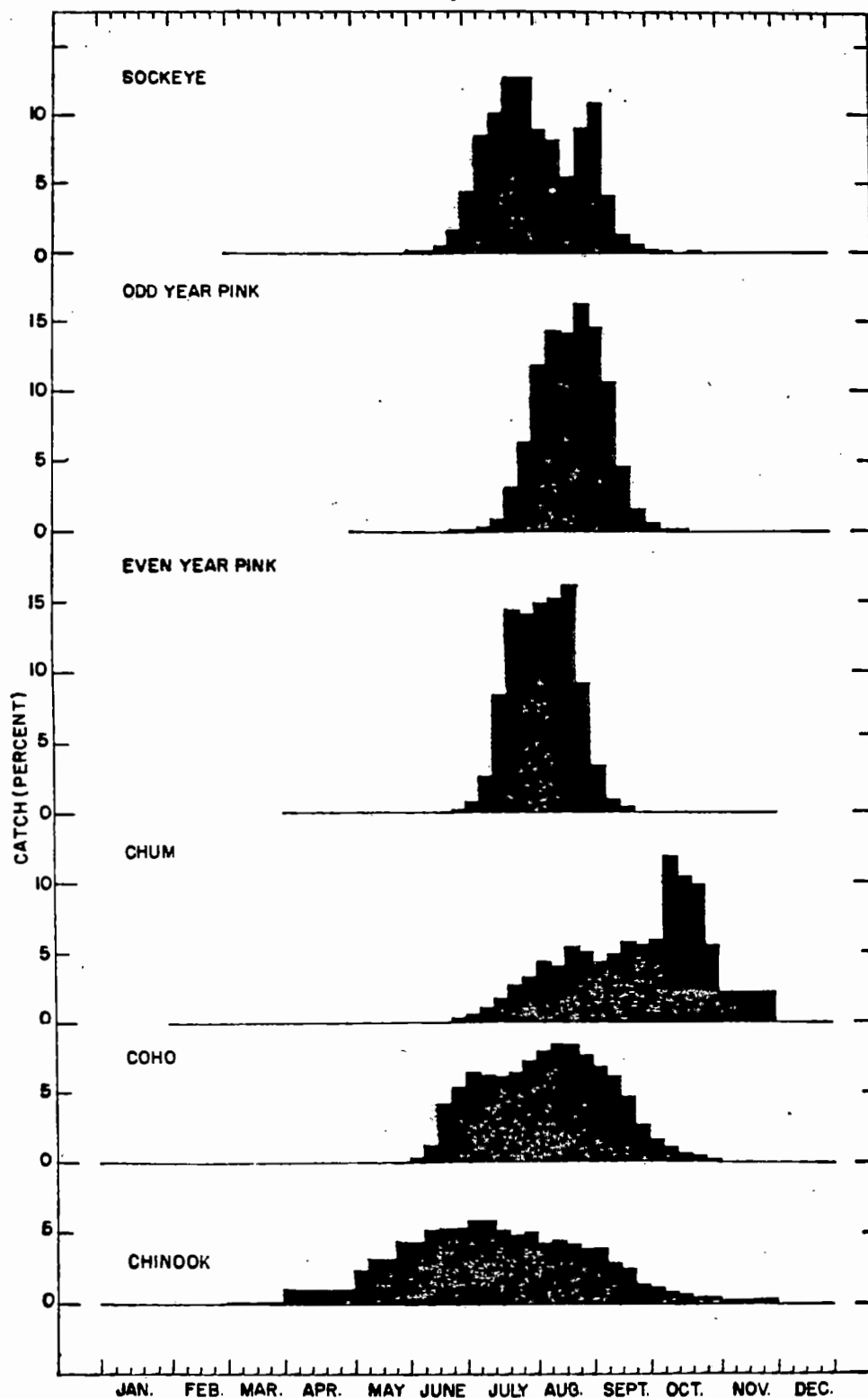


Figure 11. Average weekly catches (expressed as percentages of the total seasonal catch) of the five species of Pacific salmon in British Columbia waters during the period 1951 to 1963. For sockeye and odd-year pinks, catches made in the United States section of the Fraser River Convention Area have been included. (From Aro and Shepard, 1967.)

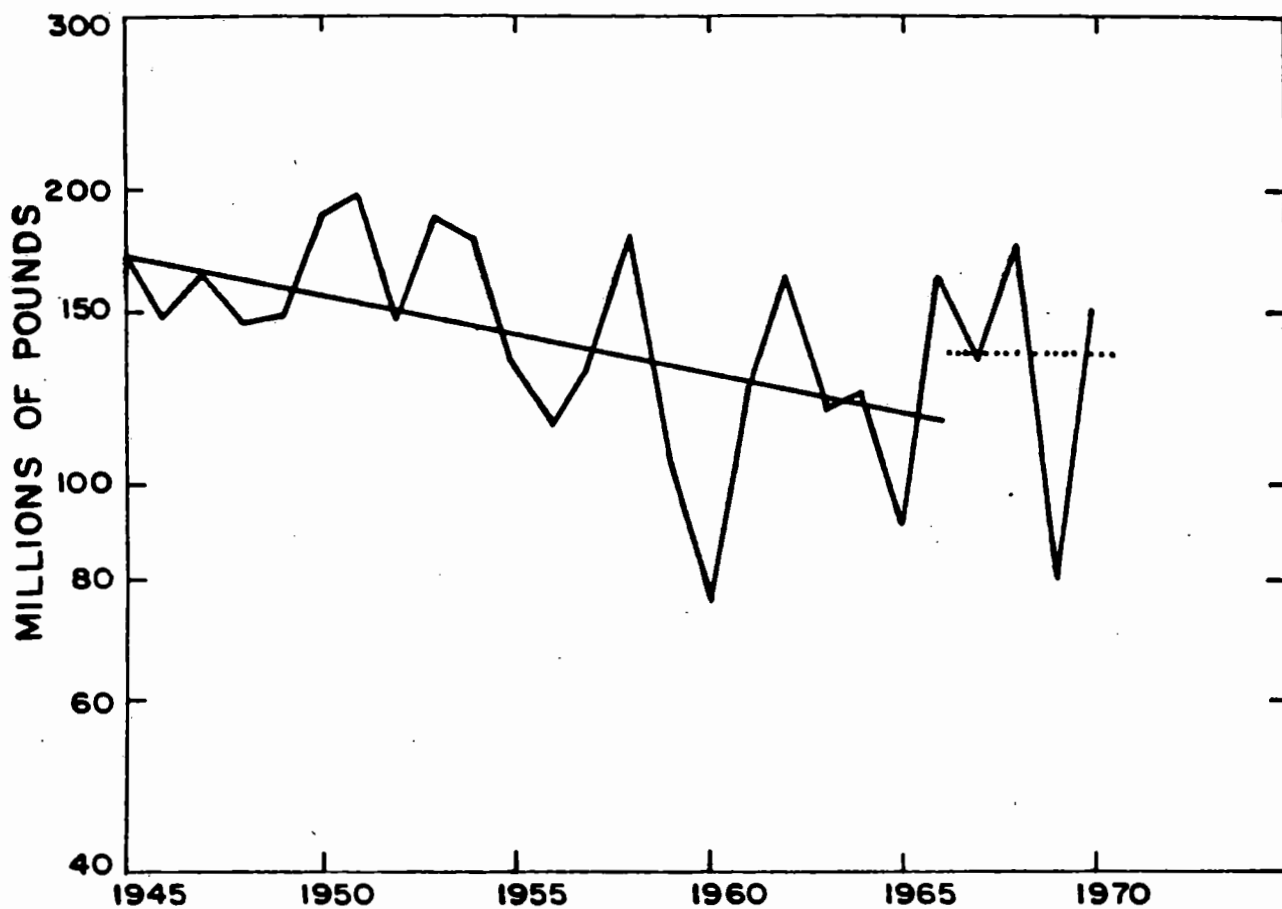


Figure 12. Total landings of salmon in British Columbia, 1945-70 (logarithmic presentation). (From Shepard and Aro, 1972.)

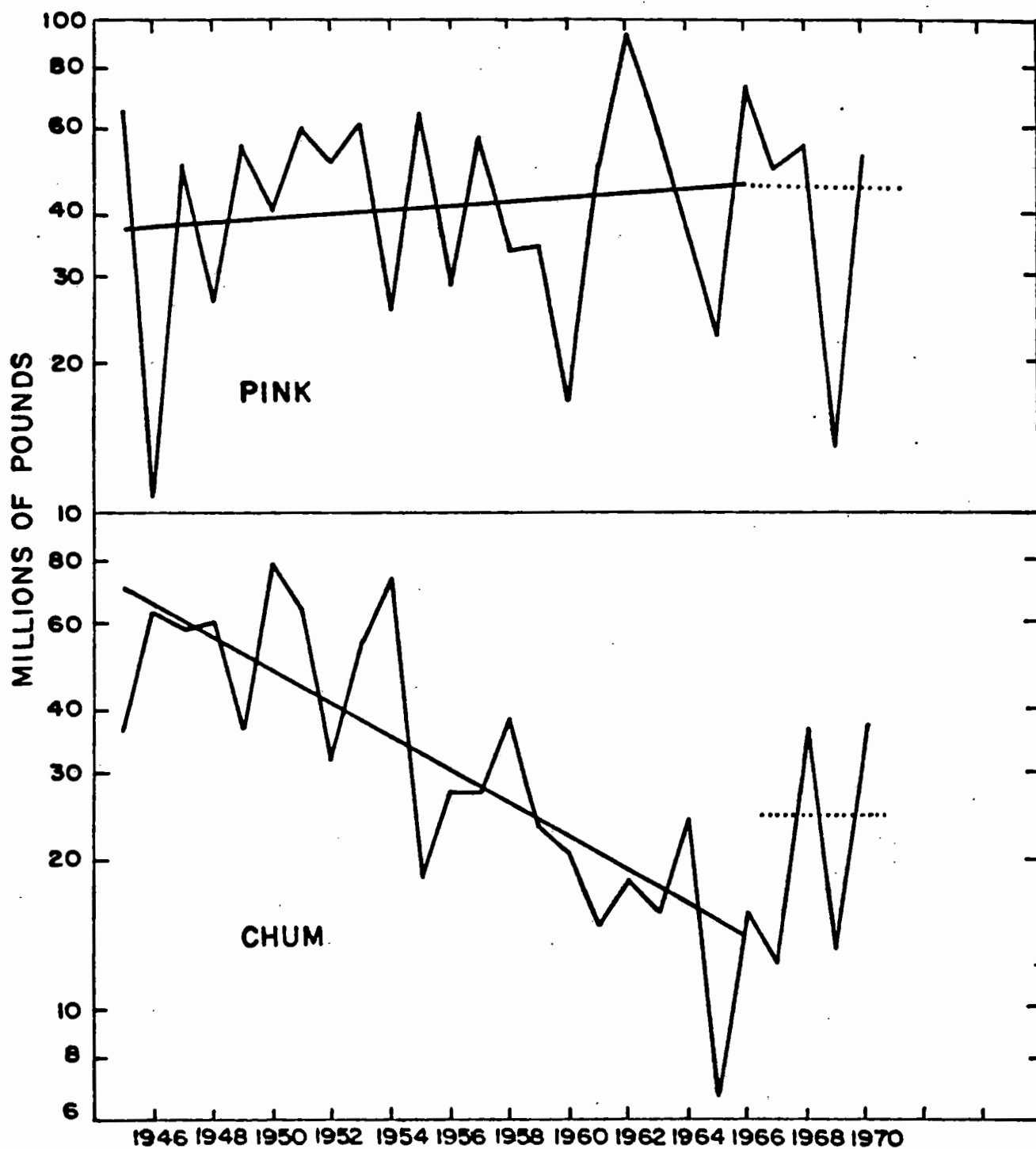


Figure 13. British Columbia landings of pink and chum salmon, 1945-70 (logarithmic presentation). (From Shepard and Aro, 1972.)

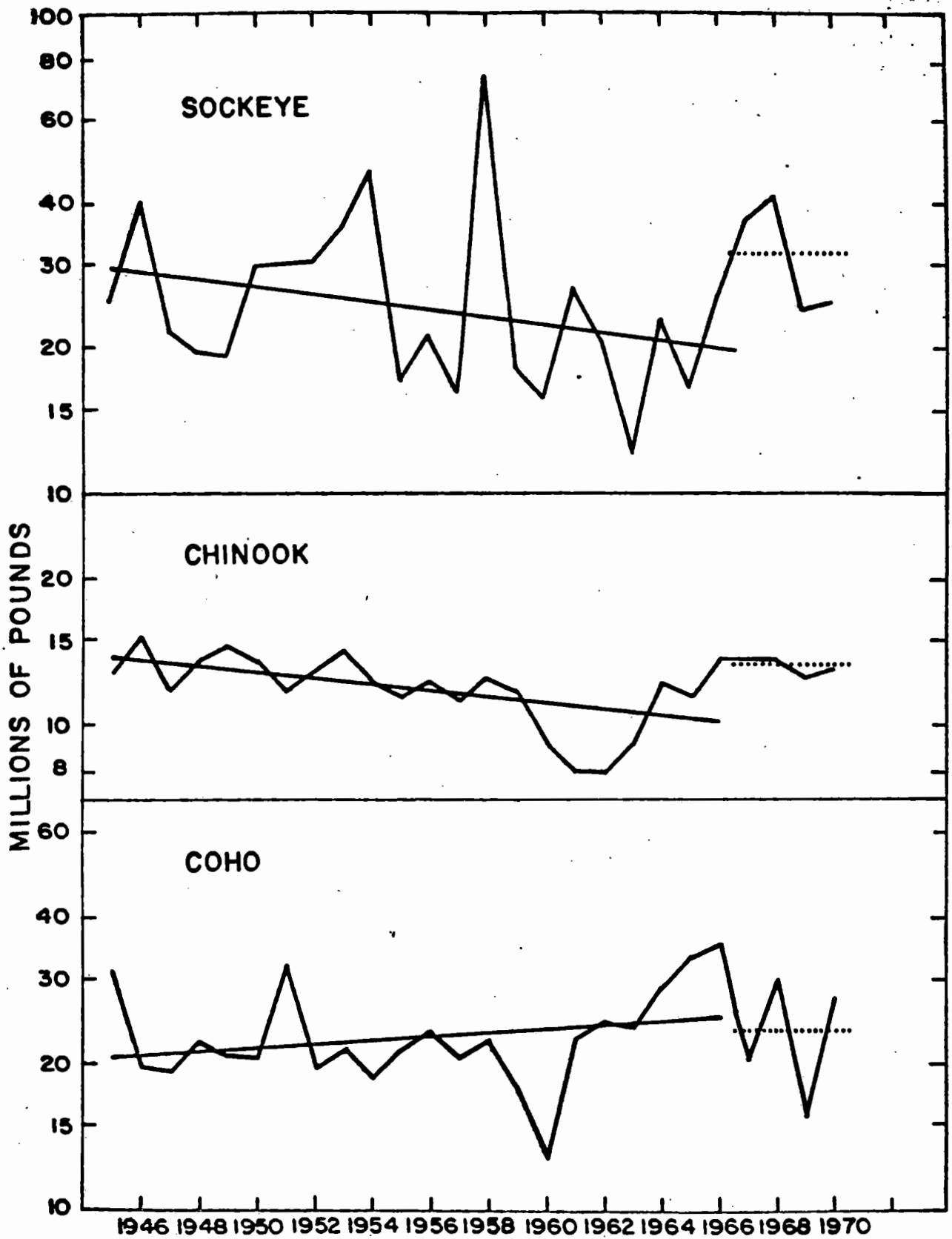


Figure 14. British Columbia landings of sockeye, chinook and coho salmon, 1945-70 (logarithmic presentation). (From Shepard and Aro, 1972.)

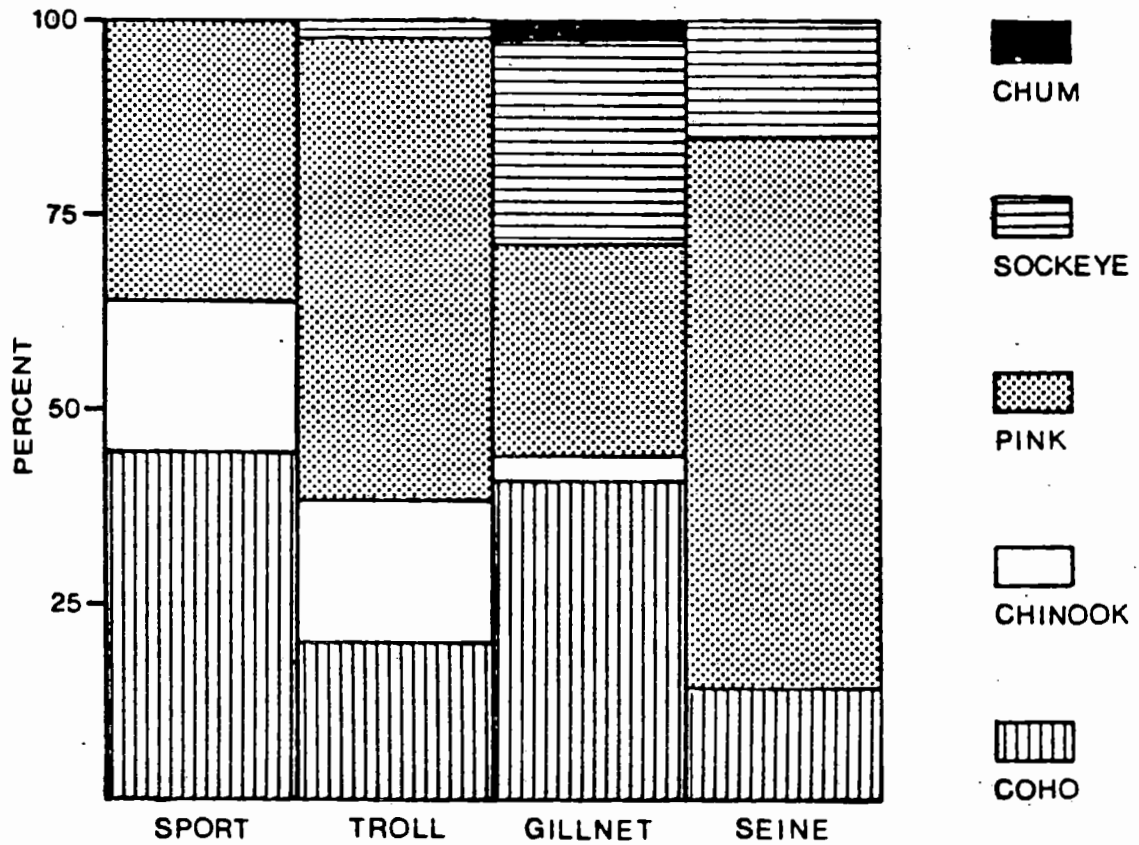


Figure 15. Species composition (per cent) of the annual catch by each Juan de Fuca gear type. (From Argue, 1970.)

The following section constitutes an essay in general terms developed by N.N.R.S. personnel concerning the value of previous tagging, some of the interpretive problems, and recommendations on the direction which further tag-recovery programs might take.

3.1.1. Discussion

As noted previously, the sheer bulk of the available literature concerned with tag-recovery programs in British Columbia coastal waters and the limited time and means available for completion of this report necessitated abbreviation of data presentation. This section has been developed by analysis of authoritative publications to isolate important facts and observations concerning tag-recovery programs in general. The aim of this report at the outset was considered to be the provision of assistance in the management and enhancement of the salmon resource of British Columbia. Since management and particularly enhancement must be accomplished with individual stocks of salmon, it is highly important to differentiate these populations. Salmon populations are distinct at the reproductive stage, and more dispersed during other phases of their life cycle. The dispersion of salmon populations is a function of variables including specific behaviour, habitat utilization, oceanographic conditions, and many more biological criteria. The degree of dispersion relates to management directly since the fishery is concentrated in areas selected to intercept either homing adults or maturing fish concentrated on feeding grounds. Enhancement techniques will necessarily be applied principally while populations are separated for reproductive purposes. The effects of successful enhancement may influence the degree of ocean dispersion as well as other characteristics of population dynamics during the oceanic phase of the life cycle. Because management and enhancement are directly related, an adequate knowledge of ocean migrational behaviour during the full life cycle at sea is the ultimate goal of tag-recovery programs. Tag-recovery programs, however, can only provide this knowledge if they are conducted in a manner which is efficient in terms of technical precision and interpretation. The demands inherent in an enhancement program may result in technical improvements in the tagging procedures and in increases in the number and effectiveness of tagging programs. The first steps toward improvement in techniques and evaluation of results must be a comprehensive evaluation of the state of present knowledge. Evaluation and assessment of the basic data on tag-recovery programs conducted in British Columbia coastal waters, beyond gross comparisons, is not within the scope of this report. Initial efforts have been expended (Argue and Heizer, 1971) in compilation and addition of the available raw data by the use of a computer program. The program could be used as a storage facility and as a printout for data, maps and related raw material. In general, the process of literature review is efficient in terms of time and serves to collect the evaluations of numerous researchers. In the preparation of this report, the problems of evaluating the work of previous researchers were magnified by the time constraints imposed, especially in the areas of judgment, interpretation and summary. The means by which the decisions of evaluation are accomplished consist of assessment

of the data base, review of the relevant material for inconsistencies or agreement, and a component of judgment derived from experience.

As mentioned previously, the dangers of using this report as a direct management tool are obvious. Some aspects of the report, however, may prove of value in preliminary approaches to further literature evaluation to extend the tagging programs. The general sections such as those providing description of tagging programs and their limitations, the bibliography and the reference tables for each species will certainly be of some value. The specific sections of the report may be subdivided into populations and areas where necessary or desirable, but it is inescapable that this document can be used only as a first step. Future researchers must be prepared to spend considerable time in reading and conducting their own analysis of the material which we have treated in this report.

In reading the material for preparation of this report, it appears that often the literature does not consider the underlying assumptions basic to the researcher's tagging program. Some of these assumptions may have critical bearing on the results and interpretation of the study so that in the following paragraphs the authors of this report have endeavored to elucidate some of these assumptions.

Tagging and Recovery Methods

Several different methods have been used in tagging adult salmon in British Columbia coastal waters, but by far the most commonly used tag has been the Petersen disc tag. The application of this tag involves the insertion of a steel pin through the dorsal musculature of the fish in the region of the dorsal fin and the affixing of two plastic discs, one on each side of the fish. Other types of tags employed with varying degrees of success include an oval disc tag (Atkin), tail tags, Floy and spaghetti tags.

Recently, immature salmon have been tagged using a small coded wire tag inserted in the head cartilage of the fish. These fish are additionally marked by removal of the adipose fin. The potential for information gathering throughout the life cycle is greater for head tagged juvenile salmon, but larger numbers of fish must be marked because of the high mortalities occurring before recovery. Interpretation of the data requires extensive manpower, and numerous agencies along the Pacific Coast utilize similar tagging procedures, magnifying the problems of data analysis.

The bulk of recovery of tagged adult Pacific salmon from all tagging programs conducted in British Columbia waters has been facilitated by informed commercial and sport fishermen, and in fact the relative success of any tagging program is dependent on cooperation of the fishermen. Some small relative number of recoveries are also made on the spawning grounds. The limitations of recovery are dependent on the commercial fishing intensity, cooperation of the fishermen and the effort expended during spawning ground surveys. The limitations of recovery on or near the spawning grounds

cannot be totally overcome unless examination is possible of a large segment of the spawning fish. This examination can sometimes be accomplished where fishways, ladders or fences are in place and tended throughout the spawning period. In many situations attempts to recover tagged fish on the spawning grounds are futile because of water turbidities, velocities or other stream characteristics.

Tagging programs of varying intensity of effort have been conducted since the 1920's in coastal waters of British Columbia. The trend has been to new programs such as the head tagging program. An underlying assumption in evaluating older tag-recovery data is that fish behaviour and relative strength of individual stocks have not altered extensively through time. However, many populations have been severely reduced and therefore some assumptions may be significantly in error and may require modification when dealing with new populations introduced by enhancement techniques. It is also impossible to predict behaviour patterns which may develop from enhanced populations.

Much of the tagging effort has been concentrated in convention waters of the International Pacific Salmon Fisheries Commission and in northern British Columbia and Southeast Alaska. There are several reasons for this concentration of effort, including the abundance and importance of salmon stocks in these areas, their accessibility and vulnerability to capture, and because of the dual interest in and exploitation of the stocks by Canadian and American fisheries. In most of the tag-recovery programs, recoveries have often concentrated adjacent to the area of tagging. The life stage at time of tagging and recovery appears to exert a significant bearing upon the oceanographic range of the studies.

Certain salmon species are more suitable candidates for tag-recovery programs than others. Species such as chinook and coho are often tagged after capture on troll gear, while pink, chum, and sockeye salmon are usually captured by purse seine. In the important tagging studies conducted on sockeye salmon by the I.P.S.F.C., capture was accomplished by means of traps. The relative degree of success of any tagging program is dependent upon numbers of fish involved in the experiment, and therefore when dealing with species which are amenable to capture for tagging in large numbers, more information can be expected to accrue. An example of the effects of facilitated capture is the abundance of data on pink and sockeye salmon from the Fraser system, but it should be noted that the bulk of tagging effort has also been expended in this area. It can be expected that as exploitation of salmon stocks in an area increases, the available information on the stocks will also increase, largely because of the increased effort extended to tag-recovery programs. The relationship between increased exploitation and information availability has been largely produced by the needs for management information within territorial and international fisheries. Knowledge gained from tagging programs plays a very important part in international negotiations which are concerned with catch allotments, stock origins and other areas of dispute.

Perhaps one must look to the future to fully assess the importance of tagging programs. The risks of overexploitation have been demonstrated in numerous world-wide fisheries; the sea is not the inexhaustible source of food it was once considered. Increases in human population and technological development will continue to exert severe pressures on fish stocks. Salmon, because of its superior quality, can be expected to remain in high demand despite cost. In the future, a comprehensive knowledge of ocean migrations of salmon will be necessary to assure the maintenance and enhancement of the resource.

Interpreting the Results of Tag-Recovery Programs

It is easy to become bewildered when examining documents containing information gathered from salmon tagging programs reviewed in preparation for this report. Many publications are mere presentations of data without adequate discussion or justification of the results. All tag-recovery programs are subject to limitations of a general sort in addition to variables which are unique to each program. These conditions may be naturally occurring consequences of the aquatic environment or those produced as a result of human disruption of that environment. The following discussion is an attempt to elucidate to a minor extent the nature of some of these conditions in order to clarify the results of some tag-recovery programs.

Physical and Statistical Limitations

Numerous limits are inherent in the ocean-tagging of salmon. Most fisheries are positioned to minimize time loss due to vagaries of the weather, or are limited to certain areas by weather constraints. In general, the commercial fishery is positioned to intercept the largest biomass available, for example salmon on spawning migrations. The ocean range of Pacific salmon is of course much larger than the range of the fishery. Some uncertainties arise in tagging programs due to the range of the subject species related to weather conditions which may preclude or curtail fishing and tagging efforts. Fortunately, much of the tagging and recovery is accomplished at a life stage of the species when the fish is readily available, i.e. on spawning migrations. Actual and estimated population size assumed in any tagging program has implications in the results. Basic statistical calculations involved in the conversion of raw data generally employ estimates of population, and tagged to untagged fish ratios. The multi-directional radiation of tagged fish from the tagging location (in some cases) and the dispersion of tagged fish within the total population have at least some statistical bearing. It is generally assumed that the larger the populations, the greater the number of tagged fish must be to ensure precision. This factor is compounded when fish are tagged at an early life stage, because of dispersion during the ocean feeding migrational stages.

When dealing with small populations of salmon the ratio of tagged to untagged fish must be high to assure that an adequate statistical popula-

tion of tagged fish is available for recovery. Often, when the subject species is chinook or coho, the difficulties of initial capture and later recovery, small populations, tag loss, mortality (natural or tagging-induced) and dispersion to widespread habitats compound to make some assessments based on tagging information empirically and statistically unsound.

Also, it should be pointed out that fishing effort is usually concentrated on large populations of fish, but not necessarily near the spawning grounds. This concentration of effort expedites tag recovery and associated information. Races or sub-populations within a run impose further problems. In the best case, tag-recovery programs are able to reveal how sub-populations behave with respect to the total population, the precise spawning locations, rates and routes of migration and other elements of the life history. However, in the worst case, serious errors can be made unless sub-populations are distinguished and recognized. For example, if tagged fish of sub-population X are recovered in stream X exclusively, one might make the assumption that the total population spawns in stream X. The actual situation could be that fish from population X migrate with sub-population Y and Z through the fishery. Fish from the X sub-population were tagged almost exclusively because they passed through the fishery during a 3-day fishing closure while the tagging was taking place. Conclusions drawn from a situation such as this can be very misleading and potentially destructive due to overestimation of population X.

In the Fraser system sub-populations of sockeye and pink salmon have been recognized. Identification of sub-stocks or races can be expected to improve for other areas as more information becomes available. The consideration of sub-populations becomes very important when enhancement techniques and consequent increased harvest are implemented.

Costs of Salmon Tag-Recovery Programs

The costs of salmon tagging programs represent a major practical barrier to full implementation, and therefore impose a potential limitation at the outset. The cost-benefit analysis of many tagging programs may not warrant their implementation. Perhaps in the past, cost-benefit analyses have not been conducted, or were poorly conceived. In cases where older information has proven adequate toward the goal of maintaining a sustained yield (such as in the Fraser River pink and sockeye populations), the heavy expenditures necessary for implementation of new tagging programs may not be justifiable. Under the stimulation of salmon enhancement, new tagging programs could be more easily justified if accurate cost-benefit analyses could predict their value in advance. The measurement of success, formulation of new management policies and provision of information will become goals for future tagging programs. Potential benefits sufficient to offset the costs of initiation of tagging programs may favour their inclusion as an integral part of enhancement. The costs may

be greatly reduced in some enhanced situations where smolts can be tagged in large numbers. The overall value of tagging returning adults, except for management purposes within a particular river, may be questionable.

Another limitation inherent in the use of data from tagging programs is the degree of extension or transferability between stocks and generations. Information gathered in the short term may become invalid when projected to the long term because of the fluctuations in abundance exhibited by Pacific salmon from generation to generation.

The migration routes of salmon bound for the Fraser River has been shown to fluctuate in strength between the northern and southern approaches in different years. Inevitably, similar phenomena will be documented from other areas and these phenomena will not be revealed until an adequate data base of tagging information has been amassed over several generations of salmon stocks homing to a particular river.

Accurate extrapolation of information from one salmon stock to another is dependent on many factors, but most importantly on the degree of intermixing. At best, one might say that extensions of information from one stock to another form a good first approximation until enough knowledge has accumulated to enable qualification or rejection of the assessment. This approach can lead to significant errors. For example, one would have an anomalous understanding of Fraser River sockeye if the entire population was assumed to behave similarly to the Adams River stock. However, in many cases extensions can be justified. Chinook salmon from Oregon appear to behave in a similar manner to those from Washington or British Columbia. The differences in behaviour may be more important than the similarities associated with intermixing stocks such as in the example of chinook salmon.

Interpretive Limitations in Assessment of Tag-Recovery Results

Many problems associated with the interpretation of tag-recovery program results are rooted in the biological complexity of Pacific salmon. Anadromous species exhibit variations in timing of development both in their freshwater and marine environments. Tagging programs have been concentrated either on homing adults or on young salmon bound for the ocean. Most tag recoveries are made during the maturing stage. Important life stages characterized by rapid growth and feeding migrations are therefore largely excluded from the recoverable information, and this often results in weaknesses in the value of information gained from tagging programs. Tagging of fish at an early life stage has distinct advantages with respect to the ultimate amount of data which can be recovered. The disadvantages lie in the dispersion and dilution of the recoverable data.

In general, tagging programs which have a specific goal, such as confirmation of a migration route for maturing fish are likely to be most successful. The degree of definition of the problem may expedite the

solution. When the aims of the tagging program are clearly defined it is possible that some of the biological complexities can be eliminated. A corollary to this rule is that the biological complexity of Pacific salmon is reduced as they mature to the reproductive stage when the migratory and reproductive urge becomes more imperative. Therefore, the importance of the results of tag-recovery programs is concentrated on the most simple and important phases of the salmon resource, harvesting and reproduction. In the future, knowledge of salmon behaviour in the earlier marine stages may become more important. An example to illustrate how this new importance may become tenable may be drawn from the international status of the fishery. The availability of harvest by Canadians of abundant salmon populations in international waters is dependent on the life cycle of the stock. The goal of enhancement would therefore seem to be to increase the availability of mature fish to the Canadian fishery while excluding harvest by other nations as much as possible. Therefore, stocks which mature in areas subject to intensive international fisheries become less desirable for enhancement purposes than exclusively Canadian fish. Recognition of such stocks could become a goal of future tagging programs. A practical example of the above discussion is available regarding Fraser River salmon populations. If salmon stocks preferentially using the Johnstone Straits northern entry could be developed, they become more suitable candidates for enhancement than stocks which utilize the southern passage, because of the intense international fishery operating in the southern approach route. Similar arguments could be advanced for other areas of the British Columbia coast.

In the long range, one might postulate that salmon stocks be developed (enhanced) which utilize areas of the Pacific Ocean which are now under-utilized. If such a situation could be developed, ocean productivity would obviously be increased. Ocean tagging and recovery of wide-ranging and disperse stocks seems somewhat impractical. Methods may be devised in the future using new technology to overcome biologically complex problems.

Statistical Limitations

Analysis of data generated by tag-recovery programs is subject to certain mathematical constraints. Commonly these factors are outweighed by other complexities. The dominant necessity is to collect an adequate sample to ascertain statistical validity. Secondarily statistical oversimplification of the data must be avoided. Oversimplifications are common in the literature surveyed in preparation of this report due largely to the two-dimensional constraints of the media.

Biological phenomena commonly exhibit characteristic distributions according to well known relationships such as the normal curve, logarithmic functions, etc. These parameters reflect characteristics of normal behaviour in salmon populations. Tagged fish are "abnormal" to some degree, but it has been shown that the largest percentage behave in a

normal fashion. Statistical constraints must be exercised so that tagged fish which exhibit abnormal behaviour can be culled from the data. Factors which could influence fish behaviour in nature such as tides, currents, lunar and solar cycles commonly exhibit periodicity which may complicate non-related fish behaviour, and these factors may operate in a direct or indirect fashion. A classic example of this is the correlation of sockeye salmon migration through Johnstone Strait with the sun spot (solar radiation) cycle.

Statistical oversimplification due to reduction of variables may be more common in the literature than one might expect. The generation of data from tagging and recovery programs is subject to variable degrees of uncertainty based upon location, timing of migration, fishing closures and numerous other situations which are both natural and artificial. These complications may distort or mask fish behaviour and its portrayal in the data. These complications represent variables in the data statistics which may be unaccountable. The phenomenon of cyclic dominance is well recognized in specific runs of Pacific salmon. But it appears to be poorly explained by the independent consideration of variables involved with the salmon life cycle. The potential importance of recognition of the causes of cyclic dominance is very great in terms of enhancement. Tagging programs involving these stocks could be a basic step toward understanding the phenomenon of cyclic dominance.

Many of the manipulations involving data statistics involve assumptions. These assumptions must be carefully evaluated in order to assure accuracy in the derived data. Bias produced in a tagging program can be evaluated by modifying or regrouping assumptions and statistics when calculating and deriving data. For example, to determine the ratio of tagged to untagged fish one might evaluate the ratio of tagged fish caught in troll, seine and gill net fisheries independently. This evaluation might be carried out in several areas for the sake of comparison. If one finds that near the point of tagging the tagged to untagged ratio for troll recaptured fish is high or low relative to areas more removed from the tagging location the assumption might be made that tagged fish have dispersed and/or are a reflection of change in the catch/unit effort. In any tagging program, Chatwin (1953) determined that four factors tend to make the estimated rate of recovery too low:

- 1) Tags recovered are not reported.
- 2) Tagging mortality.
- 3) Loss of tags because of improper tagging.
- 4) The fact that the fish tagged have already been subject to fishing pressure, and in general are not taken at the time they begin to enter the fishery.

Factors which tend to make the estimate too high include:

- 1) Extra vulnerability because the tag catches in the net twine.

Factors whose effect cannot be predicted in advance include:

- 1) Abnormal fish behaviour because of the tagging operation.
- 2) Failure to tag fish in proportion to their abundance each week and seasonal variations in rate of recovery.
- 3) Failure to tag fish every day of the week because of fishing closures which may be variable.

In general, when one is dealing with small fractions of a population, minor errors in data can lead to major errors in results.

Limitations Introduced by Human Behaviour

Tagging programs are subject to distortions caused by the activities of man. These distortions can influence the principal results of tagging programs, population estimation and migrational behaviour to a high degree. The cooperation of fishermen, fish companies and government agencies among others is necessary for a successful program. Fishing effort will necessarily be concentrated so that data collection is limited in extent. Illegal fishing, disasters of natural and human cause and human error could conceivably distort data recovered from tag-recovery programs. In any report concerning a tagging program, it is highly important to note possible problems, anticipated or documented, encountered during a tagging program, otherwise they will be forgotten.

To achieve the best results, coordination of tagging programs on an international and inter-agency basis is necessary. Political significance is often associated with tagged salmon recoveries. The interpretation of data may also be influenced by politics. The use of the same information to present widely variant points of view is clearly visible in some documents reviewed for this report. The vintage of the data used and its relationship with the derived argument is also often not made clear in international negotiation documents, and new information is required continually to ensure currency and validity of argument.

The Extension of Knowledge Gained from Tagging Programs to Management and Enhancement

The escalation of management programs and enhancement techniques of the salmon resource will necessitate and facilitate increases in the state of knowledge. Since tagging represents identification of fish it is an essential step in correlating knowledge of fish behaviour with the parent stock. Identification of enhanced stocks and the selection of stocks for enhancement will be of particular importance since management techniques may deviate from those employed with natural stocks.

The most valuable and logical program would seem to be to concentrate tagging of young fish as part of an enhancement program. If costs were not prohibitive, mature natural populations would be tagged at sea. The

distinction between natural and cultured or enhanced stocks could then be readily made on the spawning grounds. Decisions regarding openings, quotas and gear limitations could be made at the time of harvest to optimize the yields of salmon stocks. This assumes that the escapement requirements of enhanced and natural stocks will be different. The identification of sub-populations which may bear the impact of enhancement and consequent harvesting patterns must be accomplished at least in the preliminary stages of the enhancement program. Careful monitoring may prove that these stocks are not endangered as originally assumed. One might envision a system in which harvest quotas are variable depending upon the degree of stock isolation.

3.1.2. References

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VOLUME 1

3.2. Results by Species (Extracted Material)

3.2.1. Sockeye Salmon

Table 2. Sources of information, location of tag-recovery programs and associated information extracted for sockeye salmon.

Refer- ence No.	Page No	Year of Publi- cation	Location	Tag-Recovery Date	Migration Routes	Migration Timing
86	72	1927	Haystack Island (Nass River)	Text, Table	Figure	Text, Table
29	77	1930	Fraser River	Text	Text	
87	79	1932	Quatsino, Kyuquot Sound	Text		
33	80	1959	S.E. Alaska	Tables, Figs.		
51	82	1960	S.E. Alaska, Northern B. C.	(Information included for other species)		
43	123	1960	Fraser River	Text	Figure	Text
2		1960	S. E. Alaska	(See summary in extracted material for pink salmon)		
52	124	1961	S. E. Alaska, Northern B. C.	Text	Text (by inference)	
80	131	1962	Fraser River	Text, Tables, Figure	Figures	Figure 5
16	142	1963	Johnstone Strait	Text		Figures
56	144	1963	Fraser River	Text		Text, Figs, Tables
71	146	1965	Northern B.C., S. E. Alaska	Text, Figs., Tables	Figures, Tables	Figures
19	180	1966	Johnstone Strait	Text		Text, Figs.
63	184	1966	Johnstone Strait			Text, Figs.
26	52	1967	B.C. Coast	(General information-follows Table 2)		
53		1967	S.E. Alaska, Northern B. C.	(See pink section for details)		
27	186	1968	S.E. Alaska, Skeena River	Text, Figs.		Text
64	199	1968	Johnstone Strait			Text
4a	202	1968	S.E. Alaska	Text, Tables	Text	Text

Table 2 (continued)

Refer- ence No.	Year of Publi- cation	Location	Tag-Recovery Data	Migration Routes	Migration Timing
35a ²⁰⁹	1969	Dixon Entrance	Text, Figs., Tables		
78 ²¹⁶	1970	Nass River	Text	Text	
90 ²¹⁹	1970	Rivers Inlet	Text	Text, Figs.	Text, Figs.
88	1970	Rivers Inlet	(General information - in ref. no. 90)		
89 ²³⁰	1970	Smith Inlet		Text, Figs.	
73 ²³²	1970	Johnstone Strait			Text, Figs.
22 ²³⁴	1970	Juan de Fuca Strait			Text, Figs.
49 ²⁴¹	1970	Dixon Entrance, Hecate Strait	Text, Figs., Table		
91	1971	Rivers Inlet	(in reference no. 90)		Figures
93 ²⁴⁴	1971	Johnstone Strait			Text, Figs.
47	1972	Strait of Georgia, Johnstone Strait	(Refer to chinook section for details)		
57 ²⁴⁷	1974	Rivers Inlet, Smith Inlet	Text, Figs., Tables		Figures
46 ²⁵²	1974	Skeena River	Text	Figs, Text	Text
7 ²⁵⁶	1975	Johnstone Strait			Text, Figs.
39 ²⁵⁹	1977	Bella Bella	Text	Text	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 superseded by more recent publications (research papers and stream catalogues), however, it provides an excellent foundation for future studies.

SOCKEYE SALMON

"Traditionally, sockeye are the most highly prized of the five species of Pacific salmon found in Canada. The first commercial fisheries, beginning in the latter part of the nineteenth century, and the native food fisheries which were in existence for hundreds of years prior to that time, depended almost entirely on sockeye. From 1951 to 1963 the annual catch of sockeye in British Columbia and adjacent waters in Washington has averaged 6.44 million fish weighing 39.64 million pounds.

"In British Columbia most sockeye spawn at the outlets or in the tributaries to lakes in the late summer or autumn. The young, emerging from the gravel the following spring, usually spend one year in the lake (in a few areas the sockeye typically spend two years in the lake) before migrating to sea (Ricker, 1966).

"Four drainage areas support most of Canada's sockeye (Figures 7 and 8). These are (in order of importance) the Fraser River (one of the world's largest sockeye-producing systems), Owikeno and Long Lakes (tributary to Rivers and Smith Inlets), the Skeena River, and the Nass River. Since 1951, fisheries in the Fraser estuary and in the approaches to the Fraser River have provided annual catches averaging 4.34 million sockeye, 67% of the total Canadian and Washington State sockeye catch. During the same period, catches of sockeye bound for Rivers and Smith Inlets tributaries (made mainly in British Columbia Statistical Areas 9 and 10) aver-

aged 1.06 million sockeye, 16% of the total, whereas catches in the vicinity of the Skeena (Area 4) averaged 485,500, 8% of the total. Figures for the latter two areas are low because some sockeye bound for Rivers-Smith Inlets and the Skeena are intercepted in adjacent areas. The catch in the Nass area has averaged 205,700 sockeye, 3% of the total. The remaining areas have provided in toto an average catch of 358,300, only 6% of the total.

"Combining catch data for all Canadian areas plus the State of Washington for the period 1951-1963, sockeye are caught in substantial numbers from mid-June through to the end of September with July being the month of peak catches (Figure 9). A second peak in late August reflects the dramatic appearance every four years of the very large run to the Shuswap Lake area of the Fraser system (see later section describing the Fraser sockeye in detail).

"Fraser River Sockeye

"Most maturing sockeye bound for the Fraser system approach the river through Juan de Fuca Strait, passing eastward through the Gulf Islands and Georgia Strait. Along this route, the sockeye are exploited by a series of United States and Canadian net fisheries (Figure 2). Occasionally, a substantial number of the Fraser sockeye also approach from the north through Queen Charlotte and Johnstone Straits, but usually this fraction is small.

"Sockeye forming the Fraser River run originate in some 20 lakes scattered widely throughout the 89,000 square miles of the Fraser drainage (Figure 10). Of these the most important sockeye-producing systems are situated upstream from Hell's Gate Canyon. In all these upriver areas the vast majority of the adult sockeye return to spawn as four-year-olds. Thus in any one year the returning runs are almost exclusively dependent on the spawning that occurred four years previously. Although spawners from two succeeding broods do not intermix to any extent, the success of reproduction in a single year may be greatly affected by the abundance of the run utilizing the same spawning and rearing area in the other three years; as discussed extensively by Ricker (1950) one cycle may actively suppress the other three, with the result that, in individual spawning areas, one cycle out of four greatly exceeds all the rest. Prior to 1914, for as far back as historical records exist, the stocks of all the major pro-

ducing areas exhibited dominance and had their dominant year in the same cycle, in 1901, 1905, 1909, etc., termed the '1901 cycle' (Figures 11 and 12). During this period the Fraser was the greatest single area of sockeye production in the world, yielding average annual packs of about eight million sockeye. In 1913 a disastrous rock slide in the canyon of the Fraser destroyed a large part of the escapement and in the following cycle year (1917) a very intensive fishery allowed only a small part of the resulting run to reach the spawning grounds. Evidence of dominance disappeared and the 1901 cycle was reduced to a status no greater than that of the other cycles. Between 1913 and 1921, the average catch of Fraser River sockeye decreased by about 80%. In recent years points of difficult passage in the upriver migration route have been eased by construction of fishways and escapements have been increased through regulation of the fisheries. Associated with these measures, some of the depleted upriver areas have begun to produce at a high level once more. During the 1956 to 1963 period the average annual yield of the Fraser increased to about half the pre-slide level. In some areas substantial runs are produced in three or even in all four years during each four-year period, whereas in others dominance has reappeared with large runs being produced in only one year out of four. In the latter, unlike in the pre-1914 period, the dominant cycle year appears in different years in different areas. Each year, therefore, the stock composition of the Fraser run tends to differ, with consequent differences in the abundance and timing of the runs.

"In Table I, estimated escapements to the different Fraser systems are listed for the period 1938 to 1963. These figures are for sockeye four years old and older (i.e., three-year-old precocious males or jacks are omitted) and are derived from data presented in annual reports of the International Pacific Salmon Fisheries Commission. Data for the earlier years are more approximate and less complete than those for the more recent years. The data have been arranged by cycle.

"The '1901 cycle' (1901, 1905, ..., 1957, 1961) was the largest of the four during the pre-slide period. Recently it has provided the second highest yield of the four cycles (Figure 12), with an average annual catch in the Convention Area during the 26-year period 1938-1963 amounting to 2.87 million sockeye. Currently this cycle is supported mainly by the late-

run to the Stuart Lake system and by a substantial run to Chilko Lake. Together the Stuart system (both early and late runs) and Chilko have accommodated, on the average, about 65% of the total escapement in this cycle. Spawners utilizing the tributaries of the famous Shuswap system number only a few thousand; the run to the once productive Quesnel system is becoming increasingly important.

"The '1902 cycle' (1902, 1906, ..., 1958, 1962) is currently the largest, providing an average yield in the Convention Area of 6.12 million sockeye during the 1938-1963 period (Figure 12). The run is supported mainly by the dominant Adams River run to the Shuswap system, accommodating 85% of the average total escapement in this cycle. An important run which occurs in the Francois Lake area supports a substantial fishery in the early part of the season and recently Chilko Lake has received an increased number of spawners in this cycle. The Adams River run is very late, passing through the coastal fishing areas during late August and early September. In the 1902 cycle this lateness results in a catch pattern in southern British Columbia waters very different from that in the intervening three-year periods (Figure 13).

"The '1903 cycle' (1903, 1907, ..., 1959, 1963) has recently been the smallest of the four cycles, providing average annual catches in the Convention Area in the years 1938 to 1963 of 1.73 million sockeye. Recently the Chilko has been the most important area but the Shuswap also has produced significant numbers of sockeye in this cycle.

"The '1904 cycle' (1904, 1908, ..., 1956, 1960) is the third largest of the four cycles, with an average annual catch in the Convention Area during the 1938-1963 period of 1.92 million sockeye. It is supported mainly by a large run to Chilko Lake. The runs to the other upriver areas are small.

"Rivers and Smith Inlets Sockeye

"In the central part of the British Columbia coast, sockeye production is concentrated in two relatively small lake systems, Owikeno Lake (30 square miles or 77.7 square kilometers) and Long Lake (7.5 square miles or 19.4 square kilometers), which flow into Rivers and Smith Inlets, respectively. Despite their small size, considering production per unit area these two areas are among the most productive in the world, providing

an average annual yield from 1951 to 1963 of 1.06 million sockeye, 16% of the British Columbia-Washington State total (Figures 7 and 11). Unlike those of the Fraser, many Rivers and Smith Inlets sockeye mature as five-year-olds and over the years the average numbers of four- and five-year-olds have been about equal. There has been no evidence of dominance in this area and the yield over the 70-year history of intensive fishing has been rather constant from year to year (Figure 11). The fishery for Rivers and Smith Inlets sockeye begins in late June and ends early in August. The peak catch is usually made in the third or fourth week of July (Figure 14).

"Skeena River Sockeye

The Skeena River system is the main sockeye producing area in northern British Columbia, having provided in the period 1951 to 1963 an average annual yield to the fishery of 485,500 sockeye, 8% of the total (Figures 7 and 11). The commercial catch in some of these years was reduced because of severe fishing restrictions imposed in an attempt to build up the runs to Babine Lake following a disastrous rock slide which severely depleted the 1951 and 1952 spawning runs. Skeena-bound sockeye are present in the commercial fishing area (Area 4) from mid-June to mid-August, with peak catches occurring in late July or early August (Figure 14). Tagging experiments indicate that in some years large numbers of Skeena River sockeye may be caught in adjacent Area 3 and that lesser numbers of Skeena sockeye may be caught in Ogden Channel in Area 5 (Aro and McDonald, MS 1967). Taggings carried out in southeast Alaska have indicated that in some years substantial numbers of Skeena-bound sockeye have been caught in the west coast district of southeast Alaska (Shepard et al., 1962).

"Some 20 lake systems in the Skeena drainage (Figure 15) support sockeye but by far the most important is the Babine system which accommodates approximately 89% of the total Skeena sockeye spawners (Table II).

"Nass River Sockeye

The Nass is the smallest of British Columbia's four main sockeye-producing areas, providing annual yields since 1951 averaging 205,700 sockeye, 3% of the total (Figures 7 and 11). Tagging has shown that some Nass-bound sockeye are intercepted

in adjacent Area 4 and in southeast Alaska, but on the other hand many of the sockeye caught in Area 3, especially during July, are Skeena-bound fish and in some years some Alaska-bound sockeye are also taken in the outside part of Area 3.

"In the Nass drainage five tributaries (Figure 15) support significant numbers of sockeye. The most important is Meziadin Lake which probably accommodates about 100,00 sockeye spawners annually.

"The Nass sockeye run is the earliest on the Canadian coast (Figure 14), peaking in late June or early July. As mentioned above it is likely that many sockeye taken in July in Area 3 are bound for the adjacent Skeena area rather than the Nass.

"Other Sockeye Runs

"The remainder of the areas in British Columbia have provided annual yields since 1951 averaging 358,300 sockeye, 6% of the total (Figure 7). Most of these sockeye are produced in numerous local streams but some of them may have been destined for the four major sockeye-producing areas.

"Several sockeye runs spawn in Canada in rivers which drain into the sea through the United States. In northern British Columbia and the Yukon Territory small runs spawn in drainages of the Alsek, Chilkat, Taku, and Stinkine Rivers. In southern British Columbia a moderate run spawns above Osoyoos Lake in the Okanagan River, a tributary of the Columbia River."

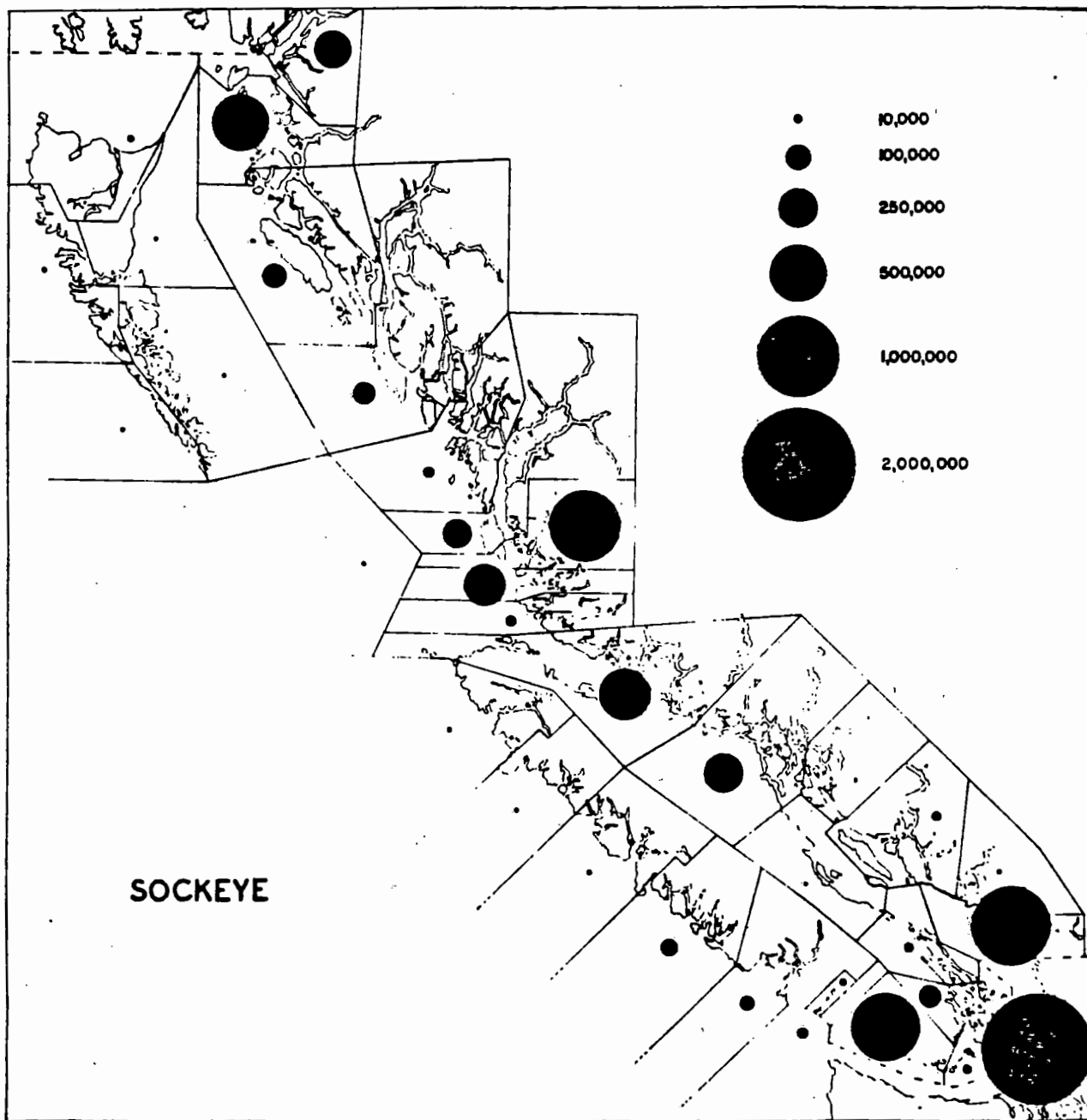


Figure (Figure 7, Aro and Shepard, 1967.) Average catches of sockeye salmon in the various British Columbia Statistical Areas and in the United States section of the Fraser River Convention Area in the period 1951 to 1963, inclusive.

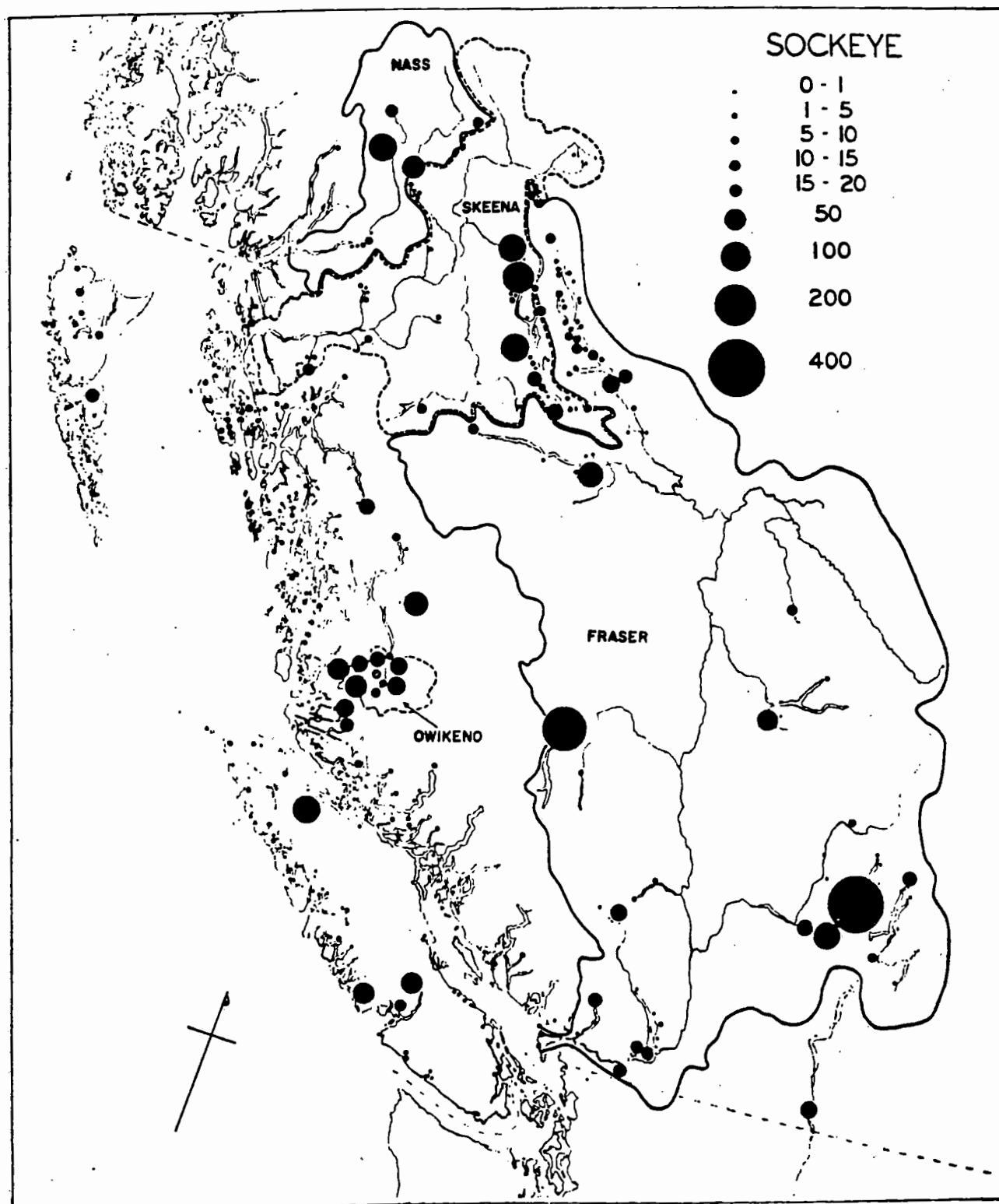


Figure (Figure 8, Aro and Shepard, 1967.) Estimated average annual numbers, in thousands, of sockeye salmon spawners in British Columbia streams from 1951 to 1962. Major drainage areas are labelled.

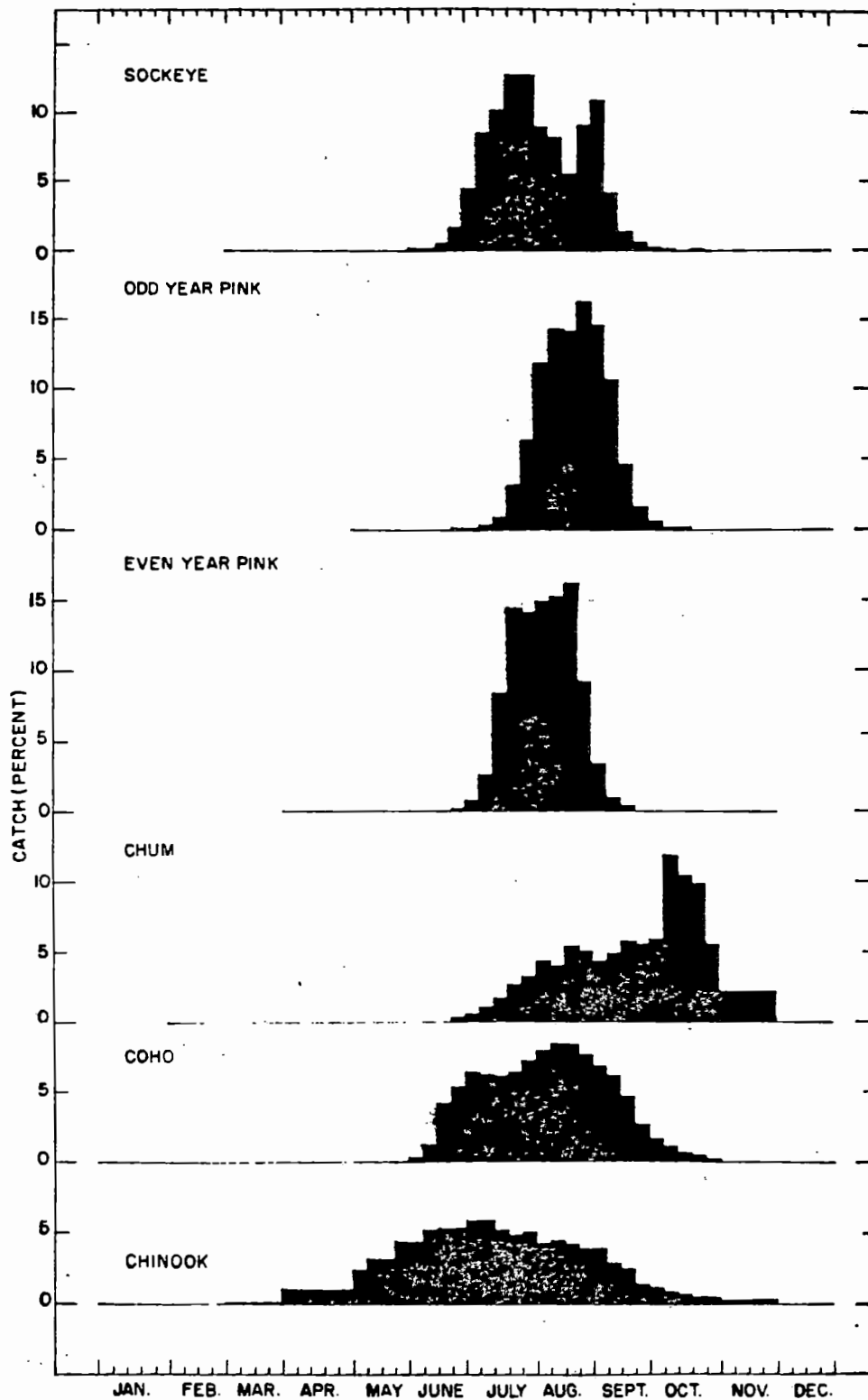


Figure (Figure 9, Aro and Shepard, 1967.) Average weekly catches (expressed as percentages of the total seasonal catch) of the five species of Pacific salmon in British Columbia waters during the period 1951 to 1963. For sockeye and odd-year pinks, catches made in the United States section of the Fraser River Convention Area have been included.

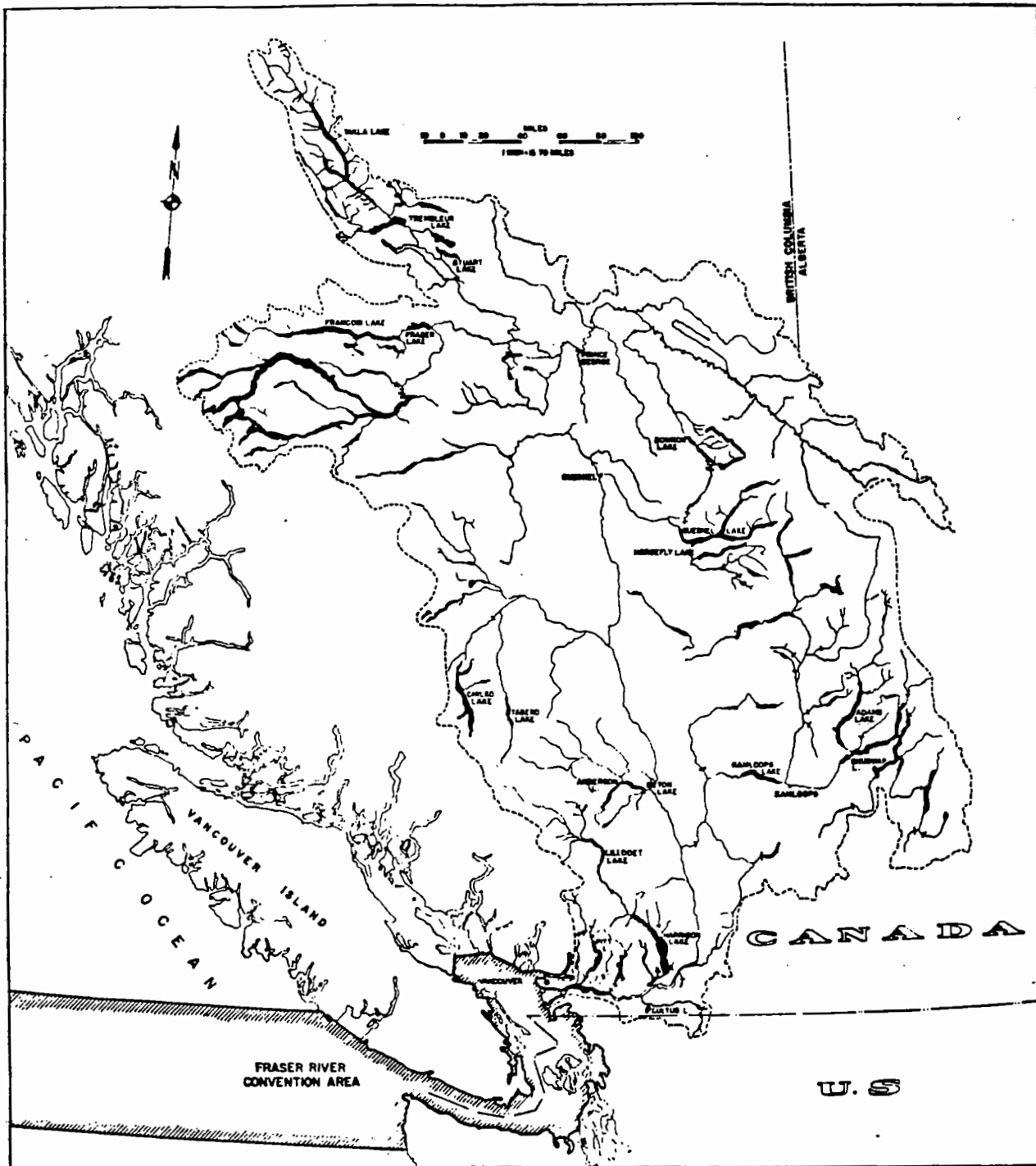
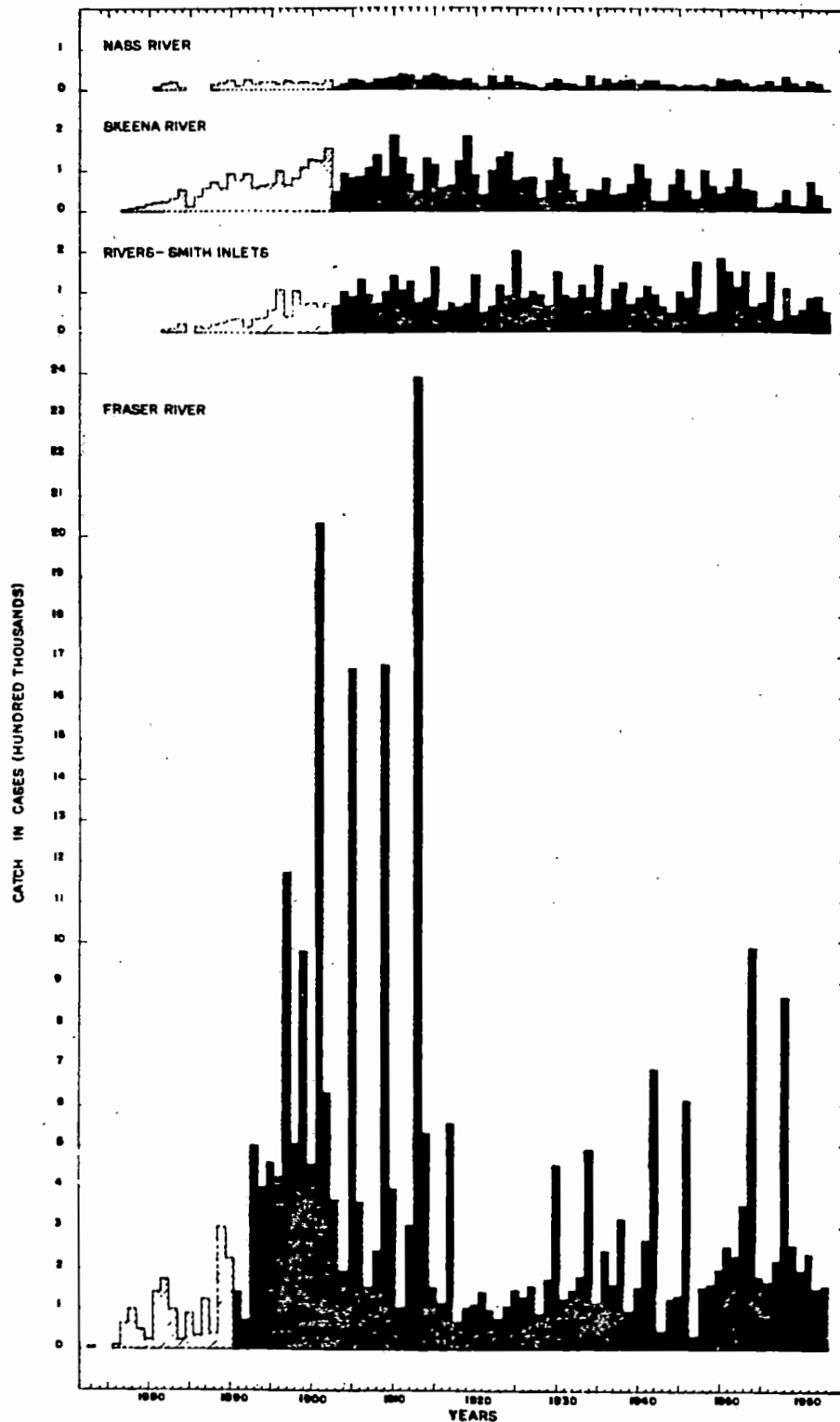


Figure (Figure 10, Aro and Shepard, 1967.) The Fraser River Convention Area and the Fraser River drainage.



Figure

(Figure 11, Aro and Shepard, 1967.) Pack of sockeye salmon from 1873 to 1963 in the four major sockeye-producing areas of British Columbia. Pack figures for the Fraser River prior to 1891 (indicated by cross-hatching) do not include catches of Fraser River sockeye made in United States waters. Pack figures for the Nass and Skeena Rivers, and for Rivers-Smith Inlets, prior to 1903 (indicated by cross-hatching) include some salmon of other species.

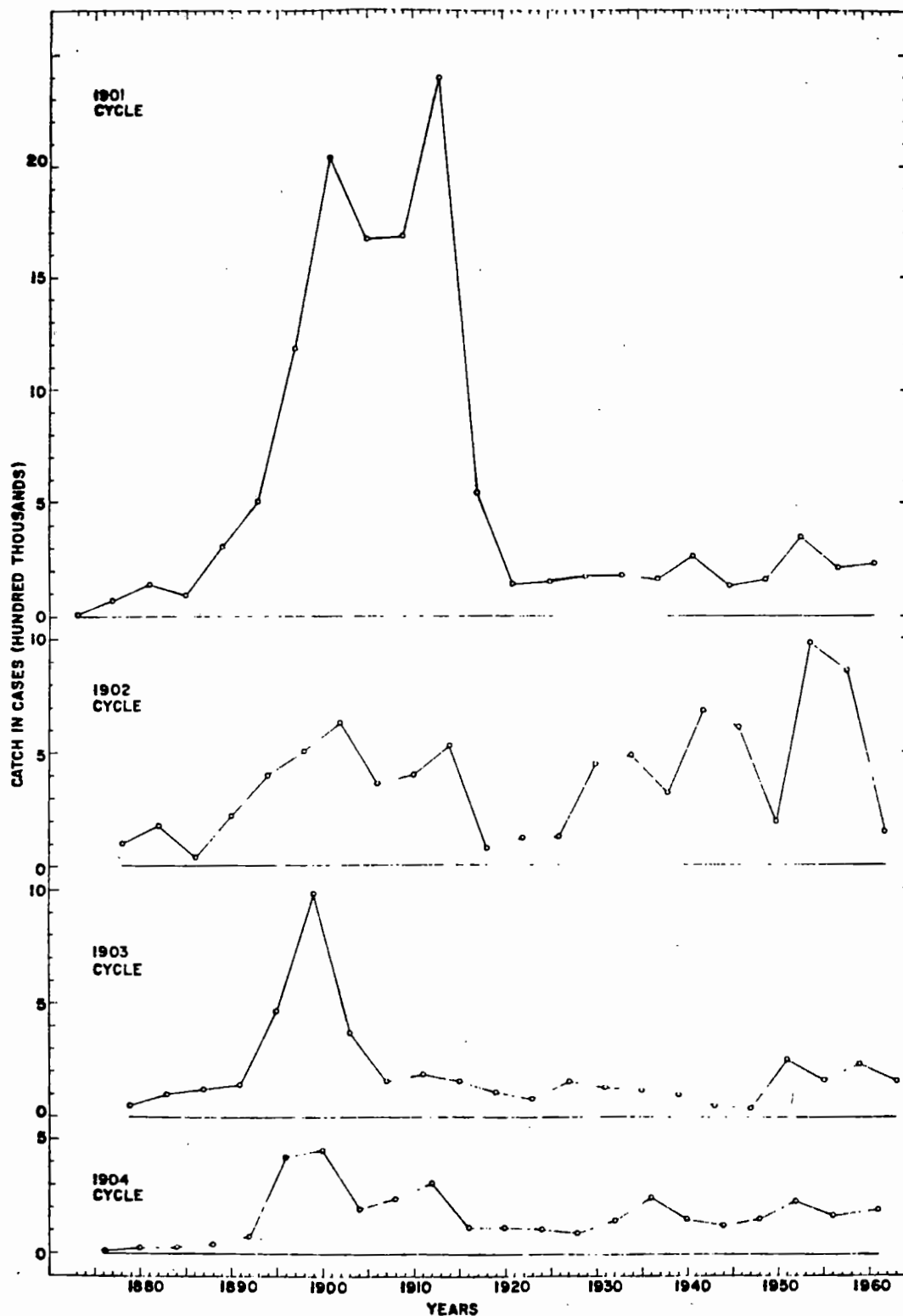


Figure (Figure 12, Aro and Shepard, 1967.) Fraser River sockeye salmon pack, 1876 to 1963, plotted by cycles. Pack figures prior to 1891 do not include catches of Fraser River sockeye made in United States.

Table (Table 1, Aro and Shepard, 1967.) Average estimated escape-
ments of sockeye (four-year-olds and older) to different
Fraser River spawning grounds, 1938 to 1963. From annual
reports of the International Pacific Salmon Fisheries Com-
mission.

Run	1901 cycle		1902 cycle		1903 cycle		1904 cycle	
	No.	%	No.	%	No.	%	No.	%
Lower Fraser	22.9	2.5	41.3	1.8	53.8	8.9	52.1	7.6
Harrison	37.0	4.1	41.9	1.8	23.0	3.8	37.5	5.5
Lillooet	48.0	5.3	43.8	1.9	40.3	6.6	49.3	7.2
Shuswap	8.4	0.9	1932.2	84.8	129.4	21.3	9.8	1.4
North Thompson	5.5	0.6	5.5	0.2	6.8	1.1	9.0	1.3
Seton-Anderson	0.3	<0.1	2.9	0.1	1.1	0.2	3.6	0.5
Chilko	152.5	16.7	52.1	2.3	256.6	42.3	476.6	69.4
Quesnel	110.6	12.1	0.5	<0.1	<0.1	<0.1	0.2	<0.1
Francois	71.1	7.8	118.9	5.2	64.2	10.6	24.1	3.5
Early Stuart	202.6	22.2	25.3	1.1	12.5	2.1	13.6	2.0
Late Stuart	242.5	26.6	7.2	0.3	2.7	0.4	0.6	0.1
Bowron	10.1	1.1	8.3	0.4	16.9	2.8	10.8	1.6
Total escapement	911.5	99.9	2279.9	99.9	607.3	100.1	687.2	100.1

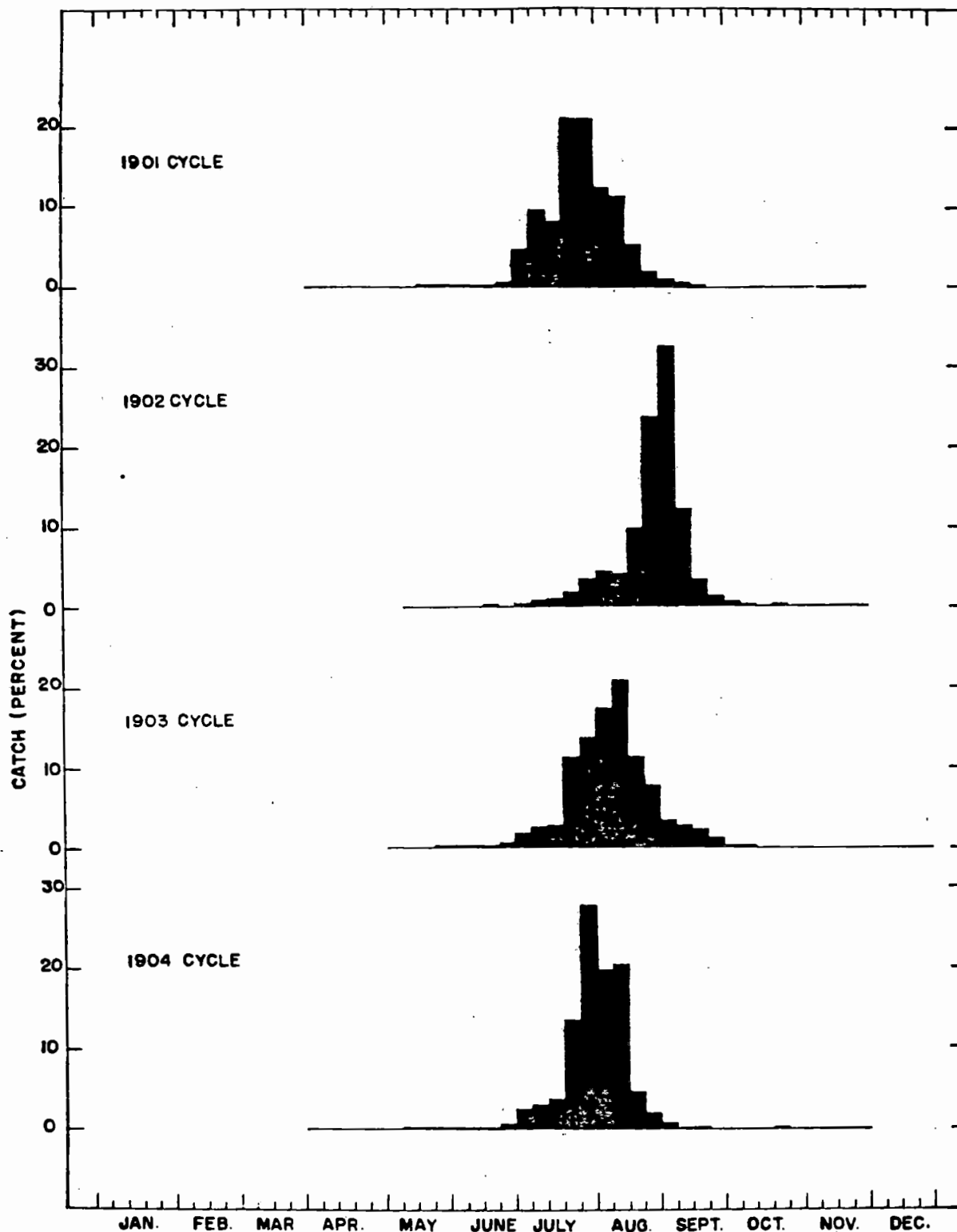


Figure (Figure 13, Aro and Shepard, 1967.) Average weekly catches (expressed as percentages of the total seasonal catch) of sockeye in the Fraser River Convention Area, 1951 to 1963, plotted by cycles.

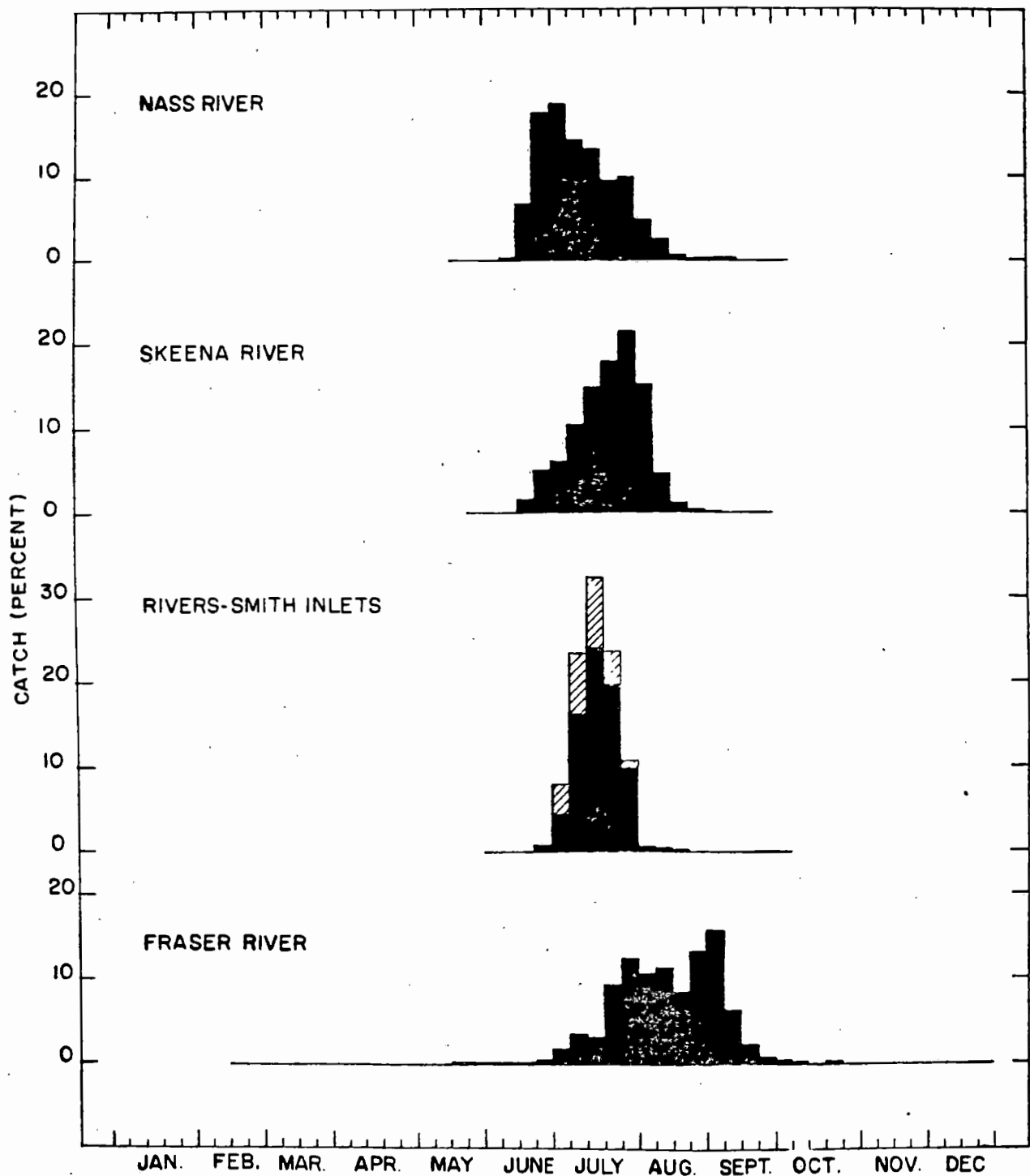


Figure (Figure 14, Aro and Shepard, 1967.) Average weekly catches (expressed as percentages of the total seasonal catch) of sockeye in the four major sockeye-producing areas of British Columbia, 1951 to 1963. For Rivers-Smith Inlets, the solid portion of the histogram indicates catch in Rivers Inlet and the cross-hatched portion indicates catch in Smith Inlet.

Table (Table II, Aro and Shepard, 1967.) Average estimated escapements (in thousands of fish) of commercial-sized sockeye (four-year-olds and older) to various tributaries of the Skeena River, 1950 to 1963 (excluding figures for 1951 and 1952 when a slide in the Babine River destroyed a large fraction of the spawning stock).

Lake system	Escapement	%
Babine	505.0	88.6
Alastair	21.9	3.8
Morice	13.6	2.4
Lakelse	7.7	1.4
Bear	7.4	1.3
Swan }		
Stephens }	4.9	0.9
Club }		
Kitsumkalum	3.3	0.6
Kitwanga	3.3	0.6
McDonell	1.6	0.3
Sustut }		
Johanson }	0.9	0.1
Asitka }		
Johnston	0.2	0.0
Total	569.8	100.0

Table (Appendix Table A-I, Aro and Shepard, 1967.) Estimated average escapements of sockeye salmon to British Columbia streams (excluding the Fraser River system) which supported "major" stocks of sockeye salmon, 1951 to 1962.

Statistical area	Stream	Map index number (App. Fig. A-1)	Average escapement (thousands)	Spawning times		
				Start	Peak	End
1	Naden River and Lake	5	5-10	July	Aug.	Sept.
	Yakoun River and Lake	6	5-10	July	Aug.	Sept.
2	Copper Creek	10	20-50	Aug.	Sept.	Sept.
	Mercer Creek	15	2- 5	Aug.	Sept.	Sept.
3	Bowser Lake	34	.. *	Sept.		
	Damdochax Lake	35	12.5 ^b	Aug.		
	Gingit Creek	36	5-10	July	Aug.	Aug.
	Kwinageese Lake	38A	60.0 ^b	Aug.		
	Meziaden Lake	39	97.5 ^b	Aug.	Sept.	Sept. (stream)
				Sept.	Oct.	Oct. (lake)
4	Alastair Lake	45	2- 5	Aug.	Sept.	Oct.
	Babine River (lower)	46	84.0	Sept.	Oct.	Oct.
	Babine River (upper)	47	116.0	Sept.	Oct.	Oct.
	Bear Lake	48	5-10	Sept.	Oct.	Oct.
	Diana Creek	54	2- 5	Sept.	Sept.	Oct.
	Falls Creek	56	2- 5	Sept.	Sept.	Oct.
	Pinkut Creek	57	29.0	Aug.	Sept.	Oct.
	Four Mile Creek	58	2.3	Aug.	Aug.	Sept.
	Fulton River	59	86.0	Aug.	Sept.	Oct.
	Grizzly Creek	62	9.9	Aug.	Sept.	Oct.
	Morrison River	70	10.9	Aug.	Sept.	Oct.
	Nanika River	71	10-20	Sept.	Sept.	Oct.
	Pierre Creek	73	23.7	July	Sept.	Sept.
	South-end Creek	75	10-20	Aug.	Sept.	Oct.
	Tacheek Creek	76	2.2	Aug.	Aug.	Sept.
	Tahlo Creek	77	7.0	Aug.	Aug.	Sept.
	Twin Creek	78	7.9	July	Aug.	Sept.
	Williams Creek	79	5-10	Aug.	Aug.	Sept.
5	Kingkown Inlet Creek	81	2- 5	July	Aug.	Sept.
	Curtis Inlet Creek	82	5-10	July	Aug.	Sept.
	Keecha Lake	84	2- 5	Aug.	Sept.	Oct.
	Survey Bay River	90	2- 5	Aug.	Sept.	Oct.
6	Kitlope River	110	20-50	Aug.	Aug.	Sept.
	Kwakwa Creek	114	2- 5	Sept.	Sept.	Oct.
7	Tinkey River	131	2- 5	July	Aug.	Aug.
8	Atnarko and Bella Coola Rivers	132	1 yr >100 11 yr 50-100	Aug.	Sept.	Oct.
	Kimsquit River	138	5-10	Aug.	Sept.	Oct.
9	Amback Creek	143	20-50	Sept.	Oct.	Nov.
	Ashlulm Creek	144	10-20	Sept.	Oct.	Oct.
	Dallery Creek	146	3 yr >100 9 yr 20-50	Sept.	Oct.	Oct.
	Genesee Creek	147	5-10	Sept.	Oct.	Oct.
	Inziana River	148	20-50	Aug.	Sept.	Oct.
	Machmell River	151	no estimates	Sept.	Oct.	Oct.
	Neechanz River	152	10-20	Aug.	Sept.	Oct.
	Sheemahant River and Flats	153	20 50	Aug.	Sept.	Oct.
	Tzeo River	154	5-10	Sept.	Sept.	Oct.
	Wannock River and Flats	155	1 yr >100 9 yr 20-50	Sept.	Oct.	Nov.
	Washwash River	156	2 yr >100 9 yr 20-50	Aug.	Sept.	Oct.

Continued ...

Table (Continued)

Statistical area	Stream	Map index number (App. Fig. A-1)	Average escapement (thousands)	Spawning times		
				Start	Peak	End
10	Canoe River	157	20-50	Sept.	Oct.	Oct.
	Smokehouse Creek	159	20-50	Sept.	Oct.	Oct.
12	Kakweiken River	173	2- 5	Aug.	Aug.	Sept.
	Klinaklini River	176	2- 5	Aug.	Sept.	Oct.
	Mackenzie Sound River	179	5-10	Aug.	Sept.	Oct.
	Nimpkish River System	181	5 yr >100 7 yr 50-100	Aug.	Sept.	Oct.
13	Heydon Creek	194	1- 2	Aug.	Sept.	Oct.
	Phillips River	197	2- 5	Aug.	Sept.	Oct.
16	Sakinaw Lake System	219	2- 5	Sept.	Oct.	Oct.
22	Hobiton River	234	2- 5	Oct.	Oct.	Nov.
23	Anderson River	236	10-20	Oct.	Oct.	Nov.
	Somass River System	240	2 yr >100 9 yr 20-50	Aug.	Oct.	Nov.
	Clayoquot River	244	2- 5	Oct.	Nov.	Nov.
24	Cold Creek	245	5-10	Oct.	Nov.	Nov.
	Kennedy Lake	248	10-20	Oct.	Nov.	Nov.
	Upper Kennedy River	253	5-10	Sept.	Oct.	Oct.
	Mahatta River	275	2- 5	Sept.	Oct.	Oct.

^a Surveys carried out by the Resource Development Service of the Department of Fisheries have indicated that a "major" run of sockeye spawns in Bowser Lake:

^b These estimates are based on surveys carried out by the Resource Development Service of the Department of Fisheries in 1956, 1957, and 1958.

Table (Appendix Table A-II, Aro and Shepard, 1967.) Estimated average escapement of sockeye in the four cycle years to tributaries of the Fraser River which supported "major" stocks of sockeye salmon, 1951 to 1962.

Stream	Map index number (App. Fig. A-1)	Cycle years										Peak time of spawning		
		1901			1902			1903			1904			
		'53	'57	'61	'54	'58	'62	'51	'55	'59	'52		'56	'60
<i>Lower Fraser</i>														
Cultus Lake	294	15,100			27,000			28,800			16,400			late Nov.
Upper Pitt River	342	14,100			14,900			23,700			35,200			mid Sept.
<i>Harrison</i>														
Big Silver Creek	284	400			300			100			5,600			mid Sept.
Harrison River	305	22,500			17,200			17,100			15,400			mid Nov.
Weaver Creek	344	11,200			26,800			14,200			16,400			late Oct.
<i>Lillooet</i>														
Birkenhead River	285	28,900			20,200			27,700			47,000			late Sept.
<i>South Thompson</i>														
Seymour River	332	6,700			54,100			28,700			3,900			late Aug. & early Sept.
Lower Adams River	314	2,300			1,411,800 ^a			100,400			5,000			late Oct.
Little River	312	300			316,200			13,000			500			late Oct.
South Thompson River	333	200			76,700			300			<100			late Oct.
Lower Shuswap River	315				19,300			0						late Oct.
<i>North Thompson</i>														
Raft River	326	7,600			9,500			8,000			10,300			late Aug.
<i>Chilcotin</i>														
Chilko River	290	124,900			77,500			226,800			518,100			late Sept.
Taseko River	339	2,700			3,900			7,100			2,700			early Sept.
<i>Quesnel</i>														
Horsefly River	306	209,100			1,000			<100			200			late Aug.
<i>Nechako</i>														
Nadina River	318	44,600			1,700			600			1,300			late Aug. & late Sept.
Stellako River	335	43,100			126,400			75,800			39,200			late Sept.
<i>Stuart—early</i>														
Ankwill Creek	283	10,900			300			<100			<100			early Aug.
Bivouac Creek	286	6,500			100			<100			<100			early Aug.
Driftwood River	296	45,300			900			<100			<100			early Aug.
Dust Creek	297	14,200			1,700						100			early Aug.
Forfar Creek	303	16,500			6,300			4,600			4,600			early Aug.
Forsythe Creek	300	5,600			<100						<100			early Aug.
Gluske Creek	304	14,500			2,900			1,300			4,100			early Aug.
Kynoch Creek	309	15,400			11,100			11,600			8,900			early Aug.
Leo Creek	311	6,200			100									early Aug.
Narrows Creek	319	14,900			1,700			200			700			early Aug.
Rosette Creek	327	6,100			4,200			3,600			3,900			early Aug.
Sakeniche Creek	328	5,600			200						<100			early Aug.
<i>Stuart—late</i>														
Kazchek Creek	307	14,400			200			100			<100			mid Sept.
Kuzkwa Creek	308	31,000						1,200						mid Sept.
Middle River	317	248,300			7,800			1,800			400			mid Sept.
Tachie River	338	134,200			7,300			2,200			1,800			mid Sept.
<i>Bowron</i>														
Bowron River	287	10,900			10,500			20,100			11,100			late Aug.

^a Does not include 1,066,177 sockeye which were diverted in 1958.

The following information was extracted from reference no. 86 (Williamson, 1927). Additional tagging data on coho and chinook tagged in the area are included in the appropriate sections of the report.

C. THE TAGGING OF SOCKEYE SALMON (*ONCORHYNCHUS NERKA*) AT HAYSTACK ISLAND, AUGUST, 1925

The sockeye were obtained from the trap of the Canadian Fishing Company, permission having been courteously granted by the proprietors. The tagging staff consisted of the writer and Mr. C. Sayer.

On arrival at Haystack Island on August 2nd, we were informed that the run of sockeye was already taking off. This species had been most numerous in July. The majority of the fish now captured were pinks, and chums (*Oncorhynchus keta*) with a fair number of sockeye, some coho and spring salmon.

Several sockeye were secured by means of a dip-net from the trap before the spiller was raised. This was, however, a difficult matter, as the fish were free to escape down out of sight. When the spiller was raised in the operation of emptying the trap of its catch a considerable number of sockeye were picked out of the mass of struggling fish. The removal of the fish from the spiller to the packer was delayed in order to afford us an opportunity of securing the sockeye. When the fish were brailed out and dumped on the packer a further supply of specimens was obtained. The trap was emptied once in two days. The sockeye were very lively and as soon as they were tagged they were put into the sea, at the sea side of the end of the trap. Although not wounded as the spring salmon were, some of them were somewhat exhausted before they were set at liberty.

659 sockeye were tagged, and 135 were recaptured, i.e. 20 per cent.

The general distribution of the recaptured fishes is shown in the accompanying map. A line is drawn from Haystack Island to the place of recapture. It indicates roughly the shortest route. The route actually followed by the fish is unknown.

The recaptured fishes were recovered in the following regions:

Naas River.....	80
Observatory Inlet.....	1
Portland Inlet.....	0
Wark Inlet.....	3
Dundas Island.....	1
Skeena River.....	13
Union Passage.....	1
Alaskan Waters.....	27

The greatest number were caught in the Naas River and neighbouring waters. One salmon was taken in Union Passage, Grenville Channel, 50 miles south of the Skeena.

*John N. Cobb—Pacific Salmon Fisheries, Washington, D.C., 1921.

The sockeye netting season closed in this district on August 21st and very few fish were returned after the end of August. Of those caught in September, 3 were taken on the troll at Wark Canal, 1 was captured at Dundas Island, 2 in the Naas, and 2 in the Skeena. One of the Skeena fish had reached Babine Lake within 37 days. One fish was taken in the Naas in November at Meziadin Falls, 100 miles above the mouth of the river.

The fish liberated at Haystack and recaptured afterwards distributed themselves along widely diverging lines, viz., (a) East to the Portland Inlet and Naas River. (b) West, into Dixon Entrance and thence north into Revill Channel and Clarence Strait, Alaska. A third component (c) went to the Skeena.

The distribution of the recaptured individuals of each day's lot of tagged fish was as follows:—

Liberated	Regions of recapture
Aug. 3	Naas River, and Alaskan waters
" 5	" " Skeena River and Alaskan waters
" 7	" " " " " "
" 10	" " " " " "
" 12	Naas River, Skeena River, Grenville Channel and Alaskan waters
" 14	Naas River Skeena River and Alaskan waters
" 17	" " " " " "
" 19	Naas River and Skeena River
" 21	" " and Alaska

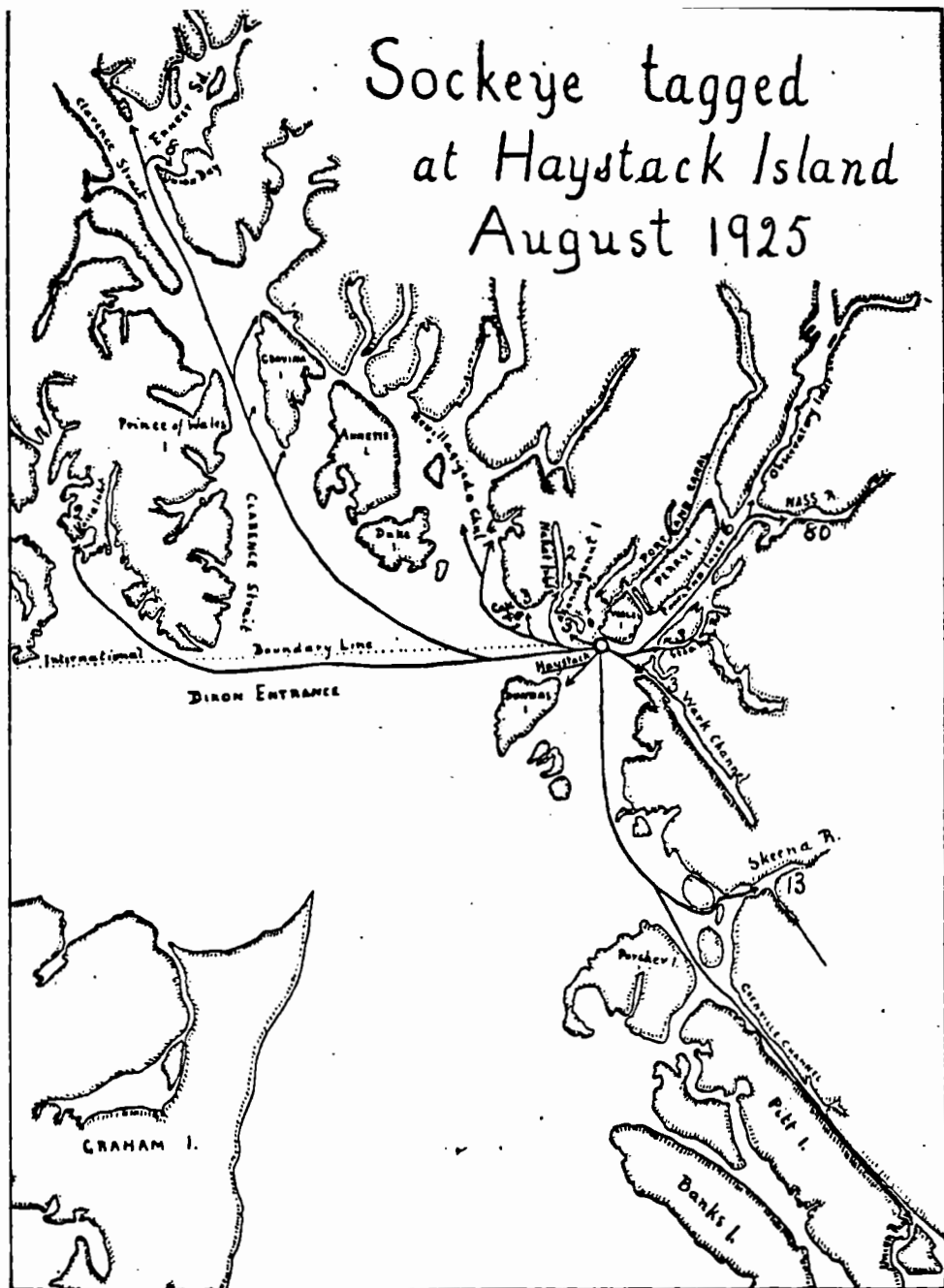
The table shows that Haystack Island is a meeting point, from which the salmon sort themselves out for different spawning grounds. The eastward and westward movements may not have been begun on the day of liberation.

It is possible that some of the salmon remained for a time in the vicinity of Haystack Island, but on the other hand the early recapture of some of the fishes indicates that they left the neighborhood on the day of liberation. One fish had reached the Naas River within one day. Two reached Ernest Sound, Alaska, in one day.

It might be suggested that the diversion of the salmon to the east and west might be influenced by the currents, and that factor would no doubt work in both directions each day. It was noticed that the salmon imprisoned in the spiller of the trap were never at rest; they kept in a shoal swimming continually round the apartment. They were attracted to the side where the current entered the net. They rested there momentarily and resuming or reversing their route returned to the same spot in their steady procession. It was evidently their desire to stem the current, but probably the water itself attracted them through its low salinity, or some other quality. It is possible then that the currents vary not only in direction but in the quality of the water. In one region the water of both the flood and ebb might be attractive to the salmon, at another place the water of one of the currents might be more attractive than the other. One salmon may be more exhausted than another after the operation of tagging, and it might be languid and inactive for a longer period. Meantime the environment which influences the direction of migration may change. So far it is not known from what directions the salmon came to Haystack Island.

Of the 135 sockeye recaptured 108 were found in British Columbia waters and 27 in Alaskan waters. The former were taken in gill-nets and seines, principally, but 3 had been caught on the troll; the fish taken in Alaskan waters were captured in traps. The netting season for sockeye ended on August 21, at which time the catch of all kinds of salmon in the trap had greatly declined. There seems no doubt that the close of the netting operations militated against a higher return of tagged fish.

20 per cent. of the tagged fish were recaptured but as high a percentage as 30 were recovered of the lot tagged on August 7th.



Map III—Showing the distribution of the recaptured sockeye salmon tagged at Haystack Island.

The following table gives the percentage returns from each day's tagging:

Date	Percentage recaptured
Aug. 3	28
" 5	16
" 7	30
" 10	20
" 12	24
" 14	25
" 17	16
" 19	6
" 21	8

95 fish were captured in the first	week after liberation
21 " " " " " second	" " "
2 " " " " " third	" " "
3 " " " " " fourth	" " "
3 " " " " " sixth	" " "
2 " " " " " seventh	" " "
2 " " " " " eighth	" " "
1 " was " " " thirteenth	" " "

The majority, viz., 116, were retaken within 14 days of liberation, and mainly in the region of the Naas River. But 80 per cent. of the tagged fish are unaccounted for. Have the survivors succeeded in running the gauntlet of the nets and traps and reached the spawning grounds? If that were so it would mean that only 20 per cent. of the sockeye in the waters at Haystack Island are captured by the nets in British Columbia waters and traps in Alaskan waters. That may mean that only a portion of the salmon at Haystack Island enter netted regions during the fishing season; or it may mean that there is a large escapement of fish through netted regions into the rivers. There are, however, several unknown factors. (1) It is necessary to make an allowance for the death of a number of the tagged fish, through injury sustained in the operation or through their weakened condition, rendering them an easier prey to sharks, dogfish and seals. There was a large number of seals at the low islands, east of Haystack Island and these probably took a toll of the tagged salmon. (2) Some of the tags may have become detached. (3) Some of the sockeye may have remained in the sea until after the netting season closed. How many remained at sea for a long time after liberation cannot be conjectured. Some may have done so during the winter. Five were caught in the Haystack Island region five weeks after liberation.

RATE OF TRAVEL

A remarkably fast rate of travel is exhibited by several of the tagged sockeye. The following table gives particulars of the five fastest.

Tag number	Date tagged	Date of recapture	Distance travelled	Time spent on the journey	Rate of travel
2559	Aug. 12	Aug. 12	30 miles	6 hours	5 miles per hour
2933	" 21	" 22	100 "	24 "	4 " " "
2563	" 12	" 13	95 "	24 "	4 " " "
2623	" "	" "	95 "	24 "	4 " " "
2621	" "	" 14	95 "	48 "	2 " " "

The sockeye were all tagged in the evening between 6 and 9 p.m., so that the journey of No. 2559 must have been done in 6 hours at the most.

The rate of 4 miles per hour indicated by four of the salmon is not an impossible one but that the long journey of 100 miles was performed in 24 hours is remarkable. The returns justify the statement that the sockeye may travel 95 miles in 24 hours.

THE INSTINCT OF ASSOCIATION IN THE SALMON

The instinct of association which leads fishes to keep in company is well marked in various species, including the salmon. How far does this habit rule the fishes in their migration? Do the salmon proceed in a more or less compact body under the guidance of one or more leaders or does each fish perform the journey by itself? That is, do the salmon remain in a school only so long as each individual reacts similarly to the environment? There are places in the coastal

waters where the salmon collect, and from which they eventually sort themselves out for different rivers. That indicates that in some cases at least the instinct of association does not rule them absolutely.

A small group of little fishes may be observed to exhibit a remarkable unity of movement. They dash off together in one direction, turn instantly and although packed closely together do so without confusion. They are then evidently acting under leadership. Every member of the shoal is not likely to perceive an impending danger at once, so that the other fishes must react to the sudden movements of the fish which becomes aware of the enemy. It would appear in such a case that every member of the shoal may be a leader. And still the fishes show a difference in psychology. It has been observed at the salmon trap that the salmon in the pot are often shy of entering the funnel leading into the spiller until one takes the lead, when the others follow. If a shadow is thrown across the funnel while they are entering they may turn back. A similar case was reported by an angler who observed a group of a dozen salmon in a river hesitate to proceed upstream under a bridge. The group swam upstream till they reached the place where the shadow of the bridge fell across the water. They turned and swam downstream again. This manoeuvre they repeated several times until one fish boldly entered the shadow when the others immediately followed it, and continued their upstream journey. The boldness of this fish might have led the others into danger; still the other salmon did not hesitate to follow the lead given them. They were able to recognize that the leader remained in safety, simply because it did not transmit fear to them by an excited movement. In this case each fish desired to proceed upstream and was hesitating before an apparent danger. But for the existence of this barrier they might not have been associated in a group. One fish realised there was no danger, or its desire to proceed upstream overcame its fear. Coho salmon have been known to accompany a hooked salmon as it was being hauled up to the boat. May it happen that some salmon require the guidance of other salmon in their migration? May a body of fish proceeding in one direction attract to it, fishes which, one might suppose, had lost their way?

The fact that several salmon tagged on the same date have been later on simultaneously captured in another region might be interpreted as indicating that the salmon associated together on their journey. Six salmon tagged at Haystack Island on August 13, were caught in the Naas River on August 17th. The conclusion seems warranted that in migration a fish reacts directly to the environment and as a result proceeds in a particular direction and it will associate with other fishes going that way. But all fishes do not react similarly to a particular environment. That a salmon will proceed on a direct migration under an impulse which rules it irrespective of the environment does not seem likely. If, however, it receives no guidance from the environment will the instinct of association lead it to accompany other salmon which have a definite direction?

SUMMARY OF RESULTS OF SOCKEYE TAGGED AT HAYSTACK ISLAND

The results of the experiment may be summarised as follows:— 659 sockeye, caught in the trap at Haystack Island were tagged and liberated beside the trap. 20 per cent. have been recaptured. Of the 135 tagged salmon returned, 108 were captured in British Columbia waters and 27 in Alaska waters; 80 per cent. of the tagged fish are unaccounted for. Some have probably succumbed to their injuries, or to the attacks of their marine enemies. In some cases the tag may have slipped off. Others have probably escaped the nets and traps and reached the spawning grounds during and after the closure of the netting season. Some may have remained in the sea.

The following information was extracted from reference no. 29 (Bolton, 1930, "Sockeye tagging on the Fraser River, 1928"):

INTRODUCTORY

A Sockeye salmon tagging programme was carried out on the Fraser river during the season of 1928. While the results obtained are not all that might be desired, they are far from disappointing. It was realized, even when planning the operations, that the work would be decidedly of a pioneering and experimental nature, and it is felt that, in addition to the returns obtained to date from the tagging itself, much information has been secured which will be of value in planning future tagging programmes for this river.

In figure 1 is given a map of the principal part of the area covered by the tagging experiments, consisting of the Fraser river and tributaries, and the portion of the gulf of Georgia in proximity to the mouth of the Fraser river.

GENERAL CONSIDERATION OF THE RETURNS

The returns indicate a general disinclination on the part of the fish to continue upstream from the point of their release. Of the 23 returns from fish tagged below, or within 2 or 3 miles above the New Westminster bridge (groups 1, 2, 3), 12 show no marked movement, 5 went upstream, 4 downstream, and 2 tagged at the mouth of the river moved away from the river; 33 returns from fish released at this point (groups 4, 5, 6), show 6 fish taken close to the point of tagging, 20 taken downstream, and 7 reported from higher upstream.

Of course, comparison should not be made of the number of fish taken upstream with the number of those recaptured downstream or close to the point of release, for it will readily be realized that, particularly in the cases of those fish tagged above or towards the upper end of the fishing area, the probability of recapture was infinitely greater for those which went downstream. The probability of recapture above the fishing limit (Mission bridge) was practically nil. The two fish taken at Agassiz were caught by Indians who are permitted to fish beyond the limit. The six tags returned from the Birkenhead river were collected by employees of the Pemberton hatchery. There is a significance, however, in the fact that so many fish did immediately turn and head downstream or remained for various lengths of time in the area where they were released (or returned to this area).

Two possible reasons why the fish did not continue upstream after being released at once present themselves:

First, the method of the experiment itself. The handling necessary to transfer the fish from the trap to the well of the boat was slight, but confinement for a number of hours in the boat with exposure during this time to the constant noise and vibration of a sixteen horsepower gas engine near at hand no doubt had a very disturbing effect. In addition to this, there was some handling incidental to affixing the tag, this usually being preceded by some minutes of pursuit around the well of the boat with a dip net, for the great amount of suspended material in the river made it impossible to see more than two or three inches below the surface. That the fish were considerably disturbed may be more or less confirmed by the statement of some of the fishermen to the effect that large numbers of fish "seemed to go crazy" in the vicinity of Mission this year.

Second, too rapid transfer from salt water to fresh. This is suggested by the fact that many of the fish which went downstream were recaptured close to, if not actually within, the brackish waters at the mouth of the river. At least one passed out of the mouth of the river, and two tagged at its mouth were retaken some miles seawards. The tendency of the fish to remain for some time close to the point where they were released suggests that they were not yet fully ready to continue their upstream migration, and normally spend a considerable length of time in making a gradual change from salt to fresh water.

Regarding the effect of the tide at the mouth of the Fraser river, Mr. S. C. Hayden of the Tidal and Current Survey informs me as follows: "During the freshet months on the Fraser, salt water does not extend above Steveston, as the tide is unable to reverse the river current. During the low stage of the river in the fall and winter months, salt water usually reaches Woodward's. . . . The rise and fall of the tide is felt as far up as Sumas, except in the freshet months." The freshet months are usually May, June, and July.

The six fish which reached the Birkenhead river deserve special consideration. They comprise one from each of groups 1 and 4 and two from each of groups 5 and 6. The information regarding these fish is summarised in table VII.

TABLE VII.—Fish recaptured in the Birkenhead river.

Tag no.	Date tagged	Place tagged	Date caught	Days free	Distance (miles)	Average miles per day
11080	Aug. 11	Hammond	Sept. 27	47	163	3.47
11189	" 15	Mouth of river	" 24	40	193	4.82
11283	" 25	Mt. Lehman	" 24	29	146	5.03
11298	" 27	"	" 29	33	146	4.42
11021	" 16	Matsqui	" 22	37	143	3.86
11325	" 28	"	"	(found dead on river bank 58 days later).		

As will be seen, these were all tagged within a period of 18 days. This period and the small number of returns are quite inadequate to show decisively any definite relationship between the time the fish first reach the river and their rate of travel upstream. That there is a definite relationship of this kind, however, may be hinted at by the fact that the average day's travel for the earliest fish tagged of those reaching the Birkenhead river is less than that of later fish. It is also noted that of the 5 fish whose time of arrival is known, the first and last tagged (17 days apart) arrived within 2 days of one another, and the whole 5 within an 8-day period. The average daily upstream movement for the 5 is 4.32 miles.

CONCLUSIONS

A general survey of the few returns on which this report is based suggests chiefly:

1. That the fish normally transfer from salt water to fresh in a gradual and rather leisurely manner.
2. That any attempt to hasten this transfer is, in general, likely to be unsuccessful, the fish tending either to return towards the sea or remaining where liberated for some time before proceeding upstream.
3. That the handling necessary for the transportation of live fish is also a disturbing factor.
4. That the normal rate of movement upstream is slow, the average being probably in the vicinity of four miles a day.

The following information was extracted from reference no. 87 (Williamson and Clemens, 1932). See reference no 87 in the chinook section for details.

"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."

The following information was extracted from reference no. 33 (Circular No. 100, The Coastal Tagging Group, 1959). The publication contains information on sockeye, pink, chum and coho salmon, but the emphasis is on information derived from tag-recovery programs on sockeye salmon. Tables indicating summaries of Alaskan and Canadian returns from salmon tagged in Southeastern Alaska, 1924 to 1958, for pink, chums, coho and sockeye were not extracted. Only the tagging locations and a figure are included.

REFERENCE LIST OF TAGGING LOCATIONS IN SOUTHEASTERN ALASKA
SHOWN ON ACCOMPANYING MAP

Reference Number	Tagging Location	Reference Number	Tagging Location
<u>Icy Strait Area</u>		<u>Clarence Strait Area</u> (Continued)	
1	Inian Island	33	Davison Point
2	Pleasant Island	34	Percy Islands
3	Gull Cove	35	McLean Point
4	Point Adolphus	36	Stone Rock Bay
5	Eagle Point	37	Cape Chacon
6	Neck Point	38	Hidden Bay
7	Point Sophia		
8	Spasski Bay		
<u>Chatham Strait Area</u>		<u>Revillagigedo Channel</u>	
9	Hawk Inlet	39	East Behm Canal
10	Tenakee Inlet	40	Ham Island
11	False Bay	41	Cone Point
12	Cube Point	42	Point Sykes
13	Marble Bluff	43	Slate Island
14	Parker Point	44	Foggy Bay
15	Point Augusta	45	Cape Fox
16	Wilson Cove	46	Duke Point
17	Whitewater Bay		
18	Killishnoo Island	<u>Outer Coast of Prince of Wales Island</u>	
19	Salisbury Sound	47	Point Desconocida
20	Douglas Island	48	Cape Ulitka
21	Point Hobart	49	Cape Addington
22	Cape Bendel	50	Granite Point
23	Kingsmill Point	51	Tranquil Point
24	Hourigan Point	52	McLeod Bay
25	Point Ellis	53	Ruth Bay
<u>Sumner Strait Area</u>		54	Kaigani Strait
26	Ruins Point	55	Cape Muzon
27	Point Colpoys		
28	Cape Decision		
<u>Clarence Strait Area</u>			
29	West Behm Canal		
30	Kasaan Bay		
31	Gravina Island		
32	Nichols Passage		

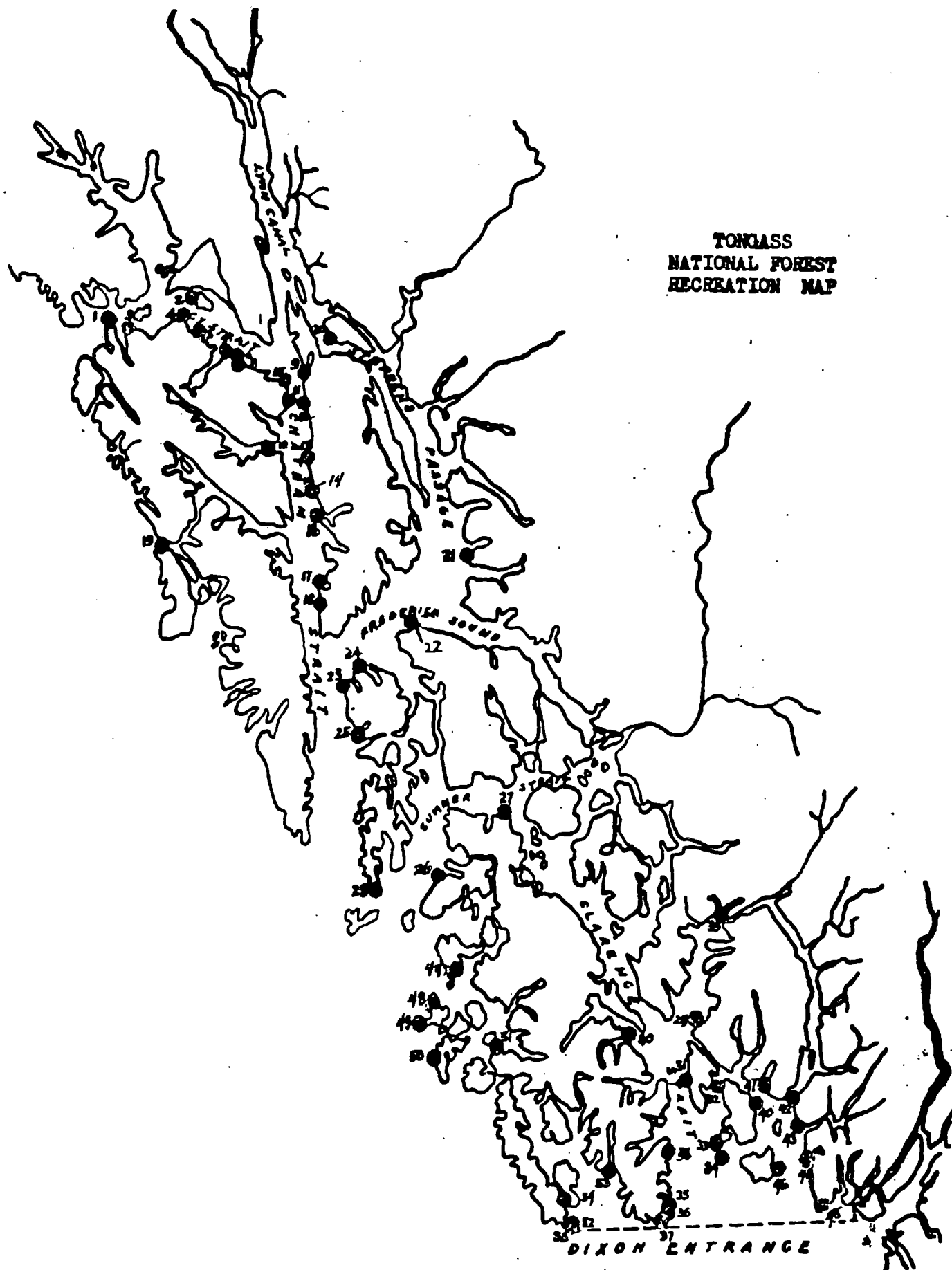


Fig. 1. Map of Southeastern Alaska showing tagging locations from 1924 to 1958.

The following information was extracted from reference no. 51 (Committee on Problems of Mutual Concern, in Informal Committee on Chinook and Coho, 1960). This report summarizes the results of 10 tagging programs conducted in northern British Columbia between 1925 to 1958. The following table lists the tagging programs (tagging location and year) and lists the salmon species tagged in each program. (NB: Tabular information listing the areas of individual recapture are available in the publication, but were not extracted for this report. Migration route maps can be drawn from the individual recapture data.)

Tagging Program	<u>Species</u>				
	Sockeye	Pink	Chum	Coho	Chinook
Hippa Island, 1925					X
Haystack Island, 1925	X				
Chatham Sound, 1944	X				
Chatham Sound, 1945	X	X	X	X	X
Chatham Sound, 1946	X	X	X	X	X
Chatham Sound, 1947	X	X	X	X	X
Chatham Sound, 1948	X	X	X	X	X
Chatham Sound, 1956	X	X	X	X	X
Chatham Sound, 1957	X	X	X	X	X
Chatham Sound, 1958	X	X	X	X	X

"COMMITTEE ON PROBLEMS OF MUTUAL CONCERN RELATED TO THE
CONSERVATION AND MANAGEMENT OF SALMON STOCKS IN
SOUTHEAST ALASKA AND NORTHERN BRITISH COLUMBIA

"RESULTS OF SALMON TAGGING EXPERIMENTS IN
NORTHERN BRITISH COLUMBIA - PRELIMINARY SUMMARIES

"Submitted by the Canadian Section, May 1960

"At the first meeting of the 'Committee on problems of mutual concern related to conservation and management of salmon stocks in southeast Alaska and northern British Columbia' (held in Ketchikan, January 27, 1960), it was agreed that:

(a) ".....the first step of the committee should be a full interchange of data and statistics for full study and to familiarize the respective sections with the fisheries in question....." (item 11 of the minutes).

(b) ".....the information interchanged should be on a broad basis and should include the following areas in Alaska and British Columbia:

Alaska

1. West coast
2. Portland Canal section
3. Southern Clarence Strait

British Columbia

1. Statistical areas 3, 4, 5
2. Queen Charlotte area

(item 12)

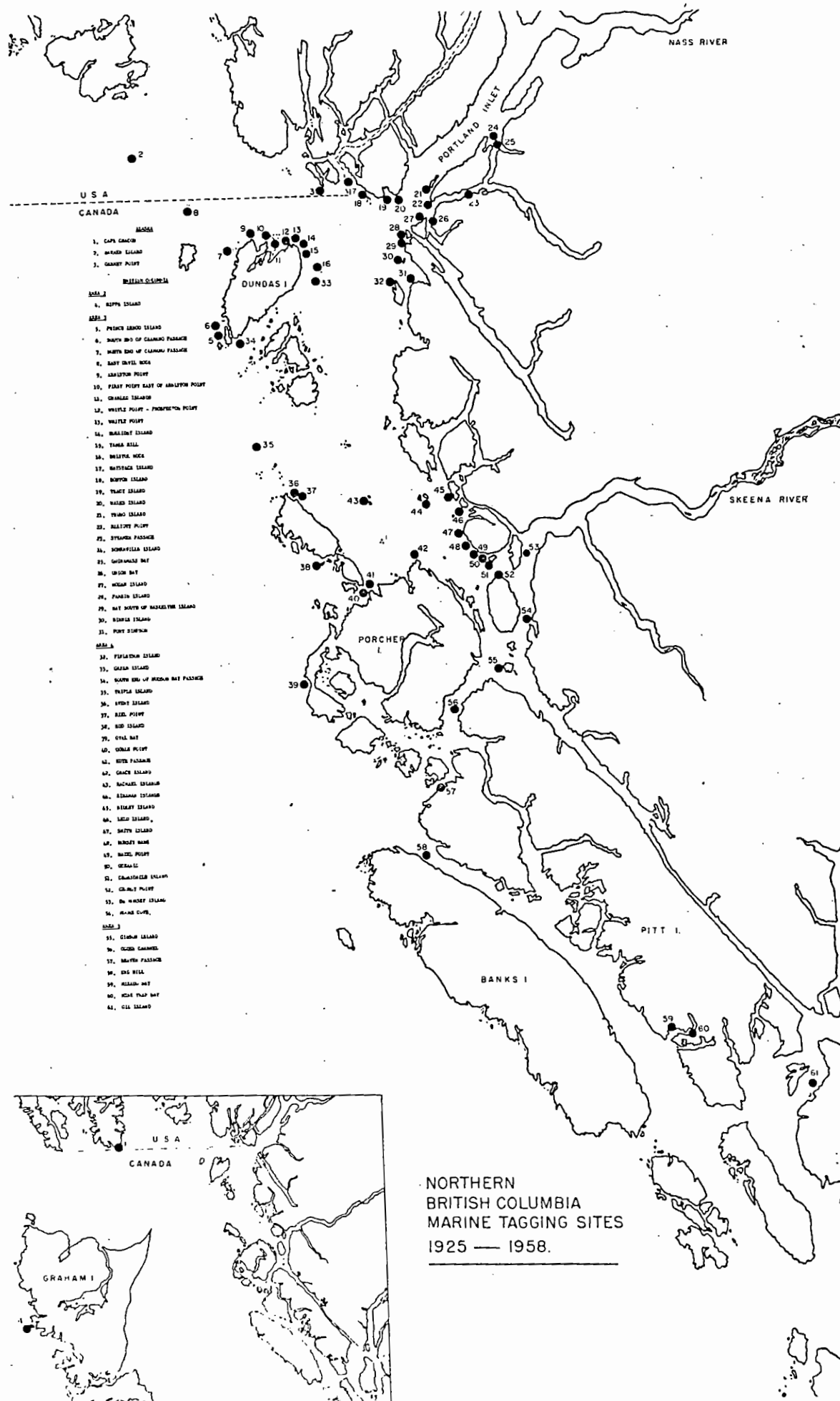
(c) ".....the initial exchange of tagging data should be in the form of a summary, in as much detail as possible, and as the need for a final analysis develops raw data should be exchanged. The interchange should also include reference and perhaps a summary of all recorded pertinent Alaskan and British Columbia tagging programs." (item 13)

The present report includes data on all pertinent taggings conducted in British Columbia waters. For each tagging program, the number of tags applied to each species at each tagging site are listed. The recoveries made in marine fisheries and on streams in the different statistical areas of British Columbia and in different sections of the regulatory districts of southeast Alaska are tabulated. A short summary of the percentage recovery of tags in different regions is provided for each program.

In all, 10 tagging programs have been conducted in the northern British Columbia region of interest. These are:

- (a) Hippa Island Spring Salmon Tagging, 1925
- (b) Haystack Island Sockeye Tagging, 1925
- (c) Chatham Sound Sockeye Tagging, 1944
- (d) Chatham Sound Salmon Tagging, 1945
- (e) Chatham Sound Salmon Tagging, 1946
- (f) Chatham Sound Salmon Tagging, 1947
- (g) Chatham Sound Salmon Tagging, 1948
- (h) Chatham Sound Salmon Tagging, 1956
- (i) Chatham Sound Salmon Tagging, 1957
- (j) Chatham Sound Salmon Tagging, 1958

The various sites at which salmon were tagged are shown in Figure 1. The different statistical areas and regulatory districts in which fish were recovered are shown in Figures 2, 3, and 4. (Figures 2 and 3 have been replaced by one figure.)



NORTHERN
BRITISH COLUMBIA
MARINE TAGGING SITES
1925 — 1958.

Table: Geographic names of sampling locations in Figure titled
 "Northern British Columbia Marine Tagging Sites 1925-1958."

<u>Number</u>	<u>Name</u>	<u>Location</u>
1	Cape Chacon	Alaska
2	Barren Island	Alaska
3	Garnet Point	Alaska
4	Hippa Island	B.C. Statistical Area 2
5	Prince Leboo Island	" " " 3
6	South Caamano Passage	" " " 3
7	North Caamano Passage	" " " 3
8	East Devil Rock	" " " 3
9	Arniston Point	" " " 3
10	East Arniston Point	" " " 3
11	Gnarled Islands	" " " 3
12	Whitly-Prospector Point	" " " 3
13	Whitly Point	" " " 3
14	Holliday Island	" " " 3
15	Table Hill	" " " 3
16	Bristol Rock	" " " 3
17	Haystack Island	" " " 3
18	Boston Island	" " " 3
19	Tracy Island	" " " 3
20	Wales Island	" " " 3
21	Truro Island	" " " 3
22	Elliott Point	" " " 3
23	Steamer Passage	" " " 3
24	Somerville Island	" " " 3
25	Quinamass Bay	" " " 3
26	Union Bay	" " " 3
27	Hogan Island	" " " 3
28	Parkin Island	" " " 3
29	Bay south of Maskelyne Is.	" " " 3
30	Birnie Island	" " " 3
31	Port Simpson	" " " 3
32	Finlayson Island	" " " 4
33	Green Island	" " " 4
34	South Hudson Bay Passage	" " " 4
35	Triple Island	" " " 4
36	Avery Island	" " " 4
37	Riel Point	" " " 4
38	Rod Island	" " " 4
39	Oval Bay	" " " 4
40	Goble Point	" " " 4
41	Edye Passage	" " " 4
42	Grace Island	" " " 4

Cont./...

Table (continued)

<u>Number</u>	<u>Name</u>	<u>Location</u>
43	Rachael Islands	B.C. Statistical Area 4
44	Kinahan Islands	" " " 4
45	Ridley Island	" " " 4
46	Lelu Island	" " " 4
47	Smith Island	" " " 4
48	Horsey Bank	" " " 4
49	Hazel Point	" " " 4
50	Oceanic	" " " 4
51	Croasdaile Island	" " " 4
52	Georgy Point	" " " 4
53	De Horsey Island	" " " 4
54	Moore Cove	" " " 4
55	Gibson Island	" " " 5
56	Ogden Channel	" " " 5
57	Beaver Passage	" " " 5
58	End Hill	" " " 5
59	Mikado Bay	" " " 5
60	Mink Trap	" " " 5
61	Gil Island	" " " 5

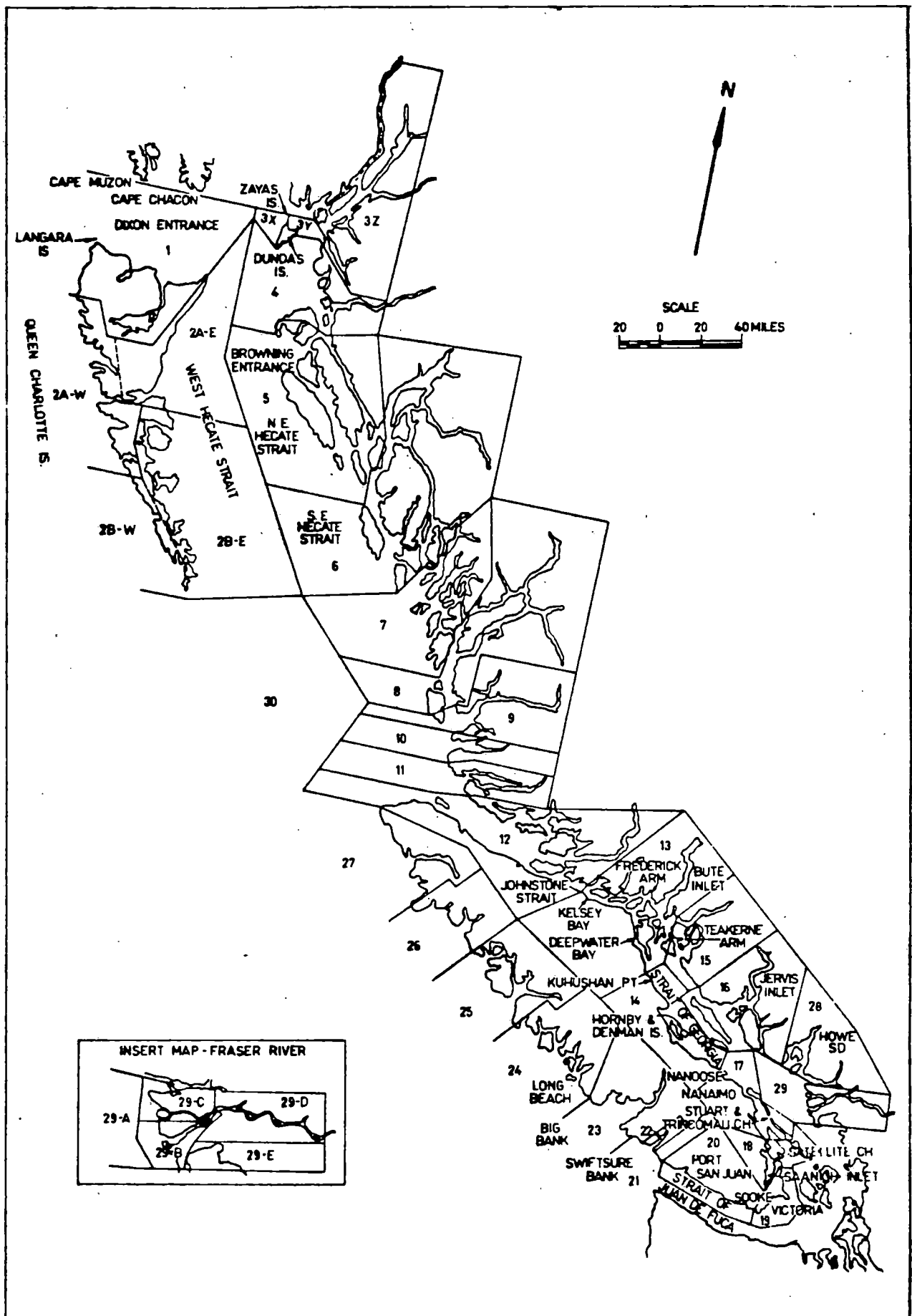


Figure: (Replaces Figs. 2 and 3 from Argue and Heizer, 1971.) British Columbia Statistical Areas.

MAIN REGULATORY DISTRICTS

- A ICY STRAIT
- B WESTERN
- C EASTERN
- D STIKINE
- E SUMNER STRAIT
- F CLARENCE STRAIT
- G WEST COAST
- H SOUTHERN

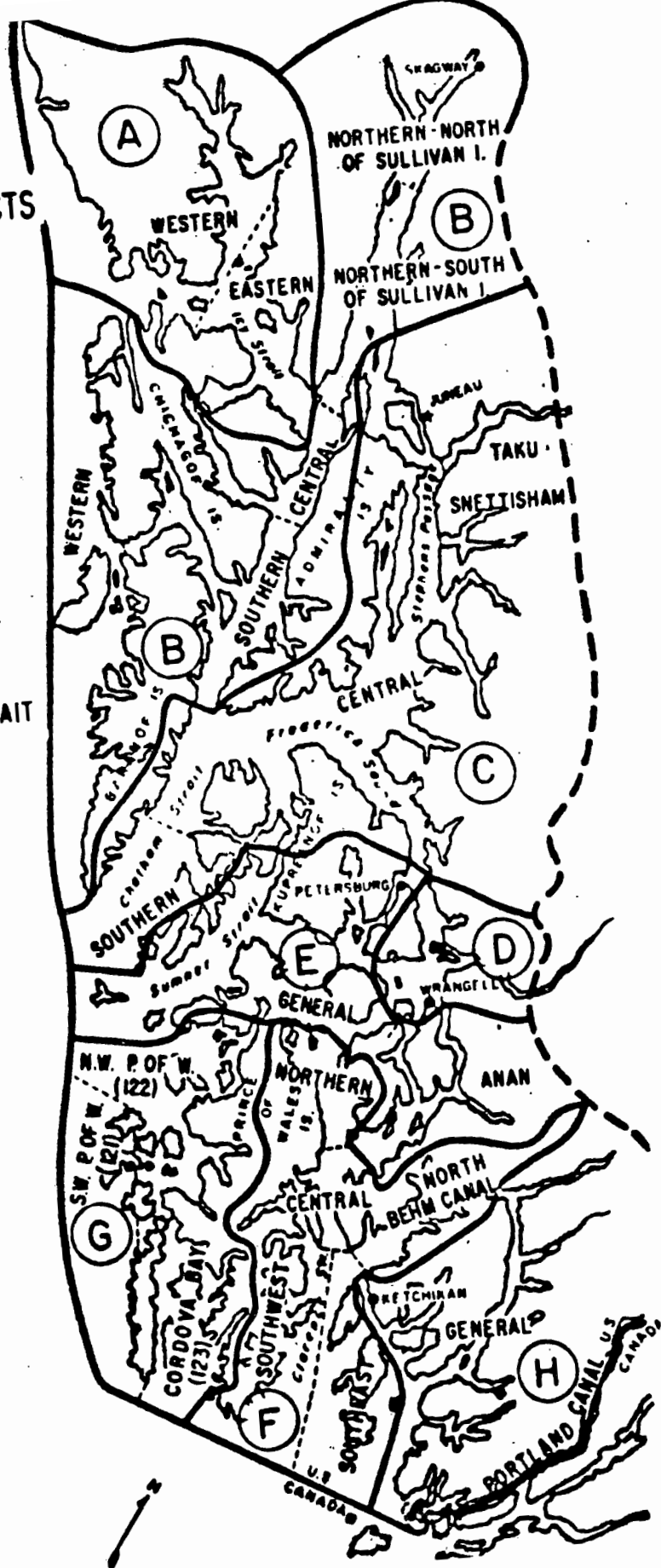


Figure 4. Regulatory districts in Southeast Alaska.

HIPPA ISLAND SPRING TAGGING, 1925

Tagging

In 1925 the Fisheries Branch and the Biological Board of Canada tagged spring salmon near Hippa Island, B. C., as part of Canada's contribution to a coast-wide salmon tagging program to investigate the migration routes of salmon. The tagging was carried out under the supervision of H. C. Williamson. Spring salmon were obtained for tagging from the catches of trollers operating out of Hippa Island (Fig. 1). During the period June 19 to July 25 a total of 274 was tagged.

Recovery

Tags were recovered from various sources in Southeastern Alaska, British Columbia, Washington, and Oregon. The number and percentage of recoveries in Southeastern Alaska, in the present statistical areas in B. C., in Washington, in Oregon, and on the Columbia River are shown in the accompanying table. The recoveries from the Columbia River have been shown separately since it is difficult to determine in which state the recovery occurred. Of the total of 274 spring salmon tagged, 13.5% were recovered. Of the recoveries 2.7% were recovered in Alaska, 32.4% in B. C., 8.1% in Washington, 32.4% in Oregon, and 24.3% on the Columbia River.

References

- Williamson, H. C. Pacific Salmon Migration: Report on the tagging operations in 1925. Cont. Can. Biol. & Fish., III(9): 265-306.
- Williamson, H. C. Pacific Salmon Migration: Report on the tagging operations in 1926, with additional returns from the operations of 1925. Cont. Can. Biol. & Fish., IV(29): 453-470.

Figures of the tagging program are summarized in Godfrey (1968) (reference no. 45, chinook section of report).

The numbers and percentages of spring salmon tag recoveries made from taggings at Hippa Island in 1925.

Recovery area	Number recovered	% of total recovered
Alaska, West Coast District	1	2.7
British Columbia		
Area 2	1	2.7
Area 3	1	2.7
Area 4	2	5.4
Area 20	1	2.7
Area 23	2	5.4
Area 29	5	13.5
Total B. C.	12	32.4
Washington*	3	8.1
Columbia River	9	24.3
Oregon*	12	32.4
Total	37	99.9

* Not including recoveries from the Columbia River.

HAYSTACK ISLAND SOCKEYE TAGGING, 1925

Tagging

In 1925, the Fisheries Branch and the Biological Board of Canada carried out a sockeye tagging at Haystack Island as part of Canada's contribution to a coast-wide salmon tagging program to investigate the migration routes of salmon. The tagging was carried out under the supervision of H. C. Williamson. Sockeye were obtained for tagging from the trap of the Canadian Fishing Company near Haystack Island which is located in Tongass Passage between the southwest shore of Wales Island and the Alaska-British Columbia boundary (Fig. 1). During the period August 3 to August 21 a total of 659 sockeye were tagged.

Recovery

Tags were recovered from the commercial and native food fisheries in B. C. and in Southeastern Alaska. The number of recoveries from the marine fisheries and from streams in the present statistical areas in B. C. and in sections of the present Alaskan regulatory districts are shown in Table I. These recovery areas are shown in Figures 2, 3, and 4. The percentages of the total recoveries made in the various areas are shown in Table II. Of the total of 659 sockeye tagged, 22.9% were recovered. Of the recoveries, 68% were made in Area 3, 12% in Area 4, 1% in Area 5, and 19% in Alaska. Most of the recoveries from Alaska were from the general section of the Southern District.

References

- Williamson, H. C. Pacific Salmon Migration: Report on the tagging operations in 1925. Cont. Can. Biol. & Fish., III(9): 265-306.
- Williamson, H. C. Pacific Salmon Migration: Report on the tagging operations in 1926, with additional returns from the operations of 1925. Cont. Can. Biol. & Fish., IV(29): 453-470.

Figures of the tagging program are summarized in Williamson (1927) (reference no. 86, sockeye section of report).

Table II. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings at Haystack Island in 1925.

Number tagged	659
<u>Recoveries</u>	
<u>British Columbia</u>	
Area 3	67.9
Area 4	12.1
Area 5	0.7
Total B. C.	80.7
<u>Alaska</u>	
Southern, General	9.3
Clarence Strait, Southeastern	2.1
Clarence Strait, Central	5.7
Clarence Strait, Northern	0.7
West Coast	1.5
Total Alaska	19.3

CHATHAM SOUND SOCKEYE TAGGING, 1944

Tagging

In 1944, the Fisheries Research Board of Canada carried out sockeye taggings in and around Chatham Sound to provide information regarding the timing and routes of approach of Skeena sockeye, and to assess the extent to which each of the component runs were exploited. Tagging was carried out in Statistical Areas 3, 4, and 5 during the period June 14 to July 21, inclusive, from a chartered purse-seiner. Conventional Peterson-type disc tags, 1/2" in diameter, with white numbered discs and red baffles were used. The tagging sites are shown on Figure 1. The numbers of sockeye tagged at each site are shown in Table I.

Recovery

Tags were recovered from the commercial, and native food fisheries, and from spawning grounds in B. C. and in Southeastern Alaska. The number of recoveries from the marine fisheries and from streams in statistical areas in B. C. and in sections of the Alaskan regulatory districts are shown in Table I. These recovery areas are shown in Figures 2, 3, and 4. The percentages of the total recoveries made in the various areas are shown in Table II. Of the total of 1373 sockeye tagged in Areas 3, 4, and 5, about 44% were recovered. All of the four sockeye tagged in Area 3 were recovered, three of them in Area 3 and one in Alaska. From the Area 4 tagging 98% of the recoveries were in Area 4 and the other 2% in other parts of B. C. About 97% of the recoveries from the Area 5 tagging were made in the same area, 2% in Area 4, and 1% in Area 6.

Table II. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1944.

Tagging area	3	4	5	Total
Number tagged	4	915	454	

Recoveries

British Columbia

Area 3	75.0	0.9	--	1.2
Area 4	--	97.6	2.0	73.4
Area 5	--	0.9	97.3	24.5
Area 6	--	0.4	0.7	0.5
Area unknown	--	0.2	--	0.2
Total B. C.	75.0	100.0	100.0	99.8

Alaska, Southern, Portland Canal	25.0	--	--	0.2
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CHATHAM SOUND SALMON TAGGING, 1945.

Tagging

In 1945, the Fisheries Research Board of Canada carried out salmon taggings in and around Chatham Sound to provide information regarding the timing and routes of approach of Skeena salmon, and to assess the extent to which the various runs were exploited. Tagging was carried out in Statistical Areas 3, 4, and 5 during the period June 2 to July 30, inclusive, from two chartered commercial purse-seiners. Conventional Peterson-type disc tags, 1/2" in diameter, with white numbered discs and red baffles were used. The tagging sites are shown in Figure 1. The numbers of salmon tagged at each site are shown in Table I.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries, and from spawning grounds in B. C. and in Southeastern Alaska. The recoveries of tags are shown in Tables II, III, IV, V, and VI for pinks, sockeye, chums, coho, and springs, respectively. These tables indicate the number of recoveries from the marine fishery and from streams in statistical areas in B. C. and in sections of the regulatory districts in Alaska. These recovery areas are shown in Figures 2, 3, and 4. Recoveries are shown for taggings in each of the sites listed in Table I.

The percentage of the total recoveries made in the various areas are shown in Table VII for pinks and in Table VIII for sockeye.

Pinks. Of the total of 1594 pinks tagged in Areas 3 and 4, about 8% were recovered. From the tagging in Area 3, about 66% of the recoveries were made in Area 3, 13% in Area 4, and 21% in the Portland Canal section of the Southern District in Alaska. About 96% of the recoveries from the tagging in Area 4 were made in the same area, the remainder in Area 3 and other parts of B. C.

Sockeye. About 29% of the total of 2806 sockeye tagged in Areas 3, 4, and 5 were recovered. All the recoveries were made in B. C. fishing areas and on B. C. spawning grounds. From the Area 3 taggings about 70% of the recoveries were made in Area 3, the remainder in Area 4 and undetermined parts of B. C. About 99% of the recoveries from the Area 4 taggings were made in Area 4, and 1% elsewhere in B. C. Most (92%) of the recoveries of Area 5 tags were recovered in Area 5, the remainder elsewhere in B. C.

Other species. Of the total of 245 chums, coho, and springs tagged in Areas 3, 4, and 5, about 17% were recovered. From the tagging of 52 chums in Area 3, one was recovered in Area 3 and one in Alaska. Of the 9 chums tagged in Area 4, one was recaptured in Area 4. From the taggings in Areas 3, 4, and 5 of 88 coho, 19 were recovered in Area 4 and one in Area 6. Of the 22 springs tagged in Area 3, three were recovered in Area 3 and one in Alaska. From the Area 4 tagging of 68 springs, 14 were recovered in Area 4 and one at an unknown location in B. C. None of the springs tagged in Area 5 was recovered.

(Tables II-VI omitted.)

Table I. The numbers of salmon tagged in statistical areas 3, 4, and 5 in 1945.

Location	Pink	Sockeye	Chum	Coho	Spring	Total
<u>Area 3</u>						
Port Simpson	--	2	--	1	--	3
Hogan Island	--	--	3	1	4	8
Boston Island	--	1	4	2	--	7
Steamer Passage	312	70	45	4	18	449
Total	312	73	52	8	22	467
<u>Area 4</u>						
Edye Passage	--	1	--	--	--	1
Lelu Island	3	176	--	--	6	185
Smith Island	931	1582	5	56	57	2631
Hazel Point	106	429	4	19	5	563
Oceanic	242	6	--	3	--	251
DeHorsey Island	--	16	--	--	--	16
Total	1282	2210	9	78	68	3647
<u>Area 5</u>						
Gil Island	--	--	--	1	--	1
Mink Trap Bay	--	345	--	--	--	345
End Hill	--	168	--	--	--	168
Beaver Pass	--	1	--	1	1	3
Ogden Channel	--	9	--	--	5	14
Total	--	523	--	2	6	531
Grand total	1594	2806	61	88	96	4645

Table VII. Percentage of pink recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3 and 4 in 1945.

Tagging areas	3	4	Total
Number tagged	312	1282	1594
<u>Recoveries</u>			
<u>British Columbia</u>			
Area 3	66.7	3.2	22.0
Area 4	12.8	95.7	71.2
Area unknown	--	1.1	0.8
Total B. C.	79.5	100.0	94.0
Alaska, Southern, Portland Canal	20.5	--	0.6

Table VIII. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1945.

Tagging areas	3	4	5	Total
Number tagged	73	2210	523	2806
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	70.0	1.2	--	2.8
Area 4	20.0	98.6	7.7	95.2
Area 5	--	--	92.3	1.5
Area 29	--	0.1	--	0.1
Area unknown	10.0	0.1	--	0.4
Total B. C.	100.0	100.0	100.0	100.0
Alaska	--	--	--	--

CHATHAM SOUND SALMON TAGGING, 1946

Tagging

In 1946, the Fisheries Research Board of Canada carried out salmon taggings in and around Chatham Sound to provide information regarding the timing and routes of approach of Skeena salmon, and to assess the extent to which the various runs were exploited. Tagging was carried out in Statistical Areas 3, 4, and 5 during the period June 12 to July 28, inclusive, from two chartered commercial purse-seiners. Conventional Peterson-type disc tags, 1/2" in diameter, with white numbered discs and red baffles were used. The tagging sites are shown in Figure 1. The numbers of salmon tagged at each site are shown in Table 1.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries, and from spawning grounds in B. C. and in Southeastern Alaska. The recoveries of tags are shown in Tables II, III, IV, V, and VI for pinks, sockeye, chums, coho, and springs, respectively. These tables indicate the number of recoveries from the marine fisheries and from streams in statistical areas in B. C. and in sections of the regulatory districts in Alaska. These recovery areas are shown in Figures 2, 3, and 4. Recoveries are shown for taggings in each of the sites listed in Table 1.

The percentages of the total recoveries made in the various areas are shown in Table VII for pinks and in Table VIII for sockeye.

Pinks. Of the total of 290 pinks tagged in Areas 3 and 4, about 14% were recovered. All the recoveries were made in B. C. fishing areas and on B. C. spawning grounds. Of the three pinks tagged in Area 3, none was recovered. From the taggings in Area 4, about 91% of the recoveries were made in Area 4 and 9% in Areas 5 and 6.

Sockeye. About 49% of the total of 2418 sockeye tagged in Areas 3, 4, and 5 were recovered, all of them from B. C. fishing areas and spawning grounds. From the Area 3 tagging of 21 sockeye, three were recovered in Area 3 and one at an unknown location in B. C. About 98% of the recaptures from the Area 4 sockeye taggings were made in Area 4 and the remaining 2% in other parts of B. C. While the majority (93%) of the recoveries of sockeye tagged in Area 5 were made in the tagging area some (7%) were also recovered in Area 4.

Other species. Of the total of 380 chum, coho, and spring salmon tagged in Areas 3, 4, and 5, about 25% were recovered. One of the seven chums tagged in Area 3 was recovered in the same area. Of the 38 chums tagged in Area 4, three were recovered in Area 4, one in Area 6, and one in Alaska. From the Area 3 tagging of 17 coho, three were recovered in Area 4 and one in Area 6. From coho tagged in Area 4, about 86% of the recoveries were made in Area 4, 12% in Area 3, and 2% in Area 6. From the Area 3 tagging of 10 springs, one tag was recovered in Area 4. Of the 150 springs tagged in Area 4, one was recovered in Area 3 and 35 in Area 4. The one spring tagged in Area 5 was not recovered.

(Tables II-VI omitted.)

Table 1. The number of salmon tagged in statistical areas 3, 4, and 5 in 1946.

Location	Pink	Sockeye	Chum	Coho	Spring	Total
<u>Area 3</u>						
Union Bay	--	--	--	1	--	1
Truro Island	--	--	--	--	2	2
Steamer Passage	3	21	7	16	8	55
Total	3	21	7	17	10	58
<u>Area 4</u>						
Finlayson Island	--	28	1	1	1	31
Oval Bay	--	--	--	2	--	2
Lelu Island	2	9	--	3	--	14
Smith Island	285	2127	37	151	149	2749
Total	287	2164	38	157	150	2796
<u>Area 5</u>						
Mink Trap Bay	--	79	--	--	--	79
End Hill	--	153	--	--	--	153
Gibson Island	--	1	--	--	1	2
Total	--	233	--	--	1	234
Grand total	290	2418	45	174	161	3088

Table VII. Percentage of pink recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3 and 4 in 1946.

Tagging area	3	4	Total
Number tagged	3	287	290
<u>Recoveries</u>			
<u>British Columbia</u>			
Area 4	--	90.5	90.5
Area 5	--	2.4	2.4
Area 6	--	7.1	7.1
Total B. C.	--	100.0	100.0
Alaska	--	--	--

Table VIII. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5, in 1946.

Tagging area	3	4	5	Total
Number tagged	21	2164	233	2418
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	75.0	0.9	--	1.1
Area 4	--	98.3	6.7	93.3
Area 5	--	0.1	93.3	4.8
Area 6	--	0.5	--	0.5
Area 29	--	0.1	--	0.1
Area unknown	25.0	0.1	--	0.2
Total B. C.	100.0	100.0	100.0	100.0
Alaska	--	--	--	--

CHATHAM SOUND SALMON TAGGING, 1947

Tagging

In 1947, the Fisheries Research Board of Canada carried out salmon taggings in and around Chatham Sound to provide information regarding the timing and routes of approach of Skeena salmon, and to assess the extent to which the various runs were exploited. Taggings were carried out in Statistical Areas 3, 4, and 5 during the period June 12 to July 27, inclusive, from a chartered commercial purse seiner. Conventional Peterson-type disc tags, 1/2" in diameter, with white numbered discs and red baffles were used. The tagging sites are shown in Figure 1. The numbers of salmon tagged at each site are shown in Table I.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries, and from spawning grounds in B. C. only. The recoveries of tags are shown in Tables II, III, IV, V, VI, and VII for pinks, sockeye, chums, coho, springs, and steelheads, respectively. These tables indicate the number of recoveries from the marine fisheries and from streams in statistical areas in B. C. These recovery areas are shown in Figures 2 and 3. Recoveries are shown for taggings in each of the sites listed in Table I.

Pinks. Of the total of 619 pinks tagged in Areas 3 and 4, about 13% were recovered. Of the 11 pinks tagged in Area 3, none was recovered. From the taggings in Area 4 about 99% of the recoveries were made in Area 4 and 1% in Area 6.

Sockeye. About 45% of the total of 2764 sockeye tagged in Areas 3, 4, and 5 were recovered. The percentages of the total recoveries made in the various areas are shown in Table VIII. From the Area 3 tagging of 8 sockeye, two were recovered in Area 3 and one in Area 4. About 98% of the recaptures from the Area 4 sockeye taggings were made in Area 4 and the remaining 2% in other parts of B. C. Of the recoveries from the taggings in Area 5, about 92% were recovered in Area 5, and 8% in Area 4.

Other species. Of the total of 371 chums, coho, springs, and steelheads tagged in Areas 3, 4, and 5, about 21% were recovered. Of the 9 chums tagged in Area 3, one was recovered in Area 3. One of the 78 chums tagged ^{in Area 4} was recovered, also in Area 3. Both of the two coho tagged in Area 3 were recovered in Area 4. From coho tagged in Area 4, about 97% of the recoveries were made in Area 4 and 3% in an unidentified area in B. C. Neither of the two springs tagged in Area 3 was recovered. From the Area 4 taggings of springs, one recovery was made in an unidentified area in B. C. and the other recoveries (39) were made in Area 4. Of the 18 steelheads tagged in Area 4, four were recovered in Area 4.

(Tables II-VII omitted.)

Table I. The numbers of salmon and steelhead tagged in statistical areas 3, 4, and 5 in 1947.

Location	Pink	Sockeye	Chum	Coho	Spring	Steelhead	Total
<u>Area 3</u>							
Wales Island	--	--	1	--	--	--	1
Steamer Passage	11	8	8	2	2	--	31
Total	11	8	9	2	2	--	32
<u>Area 4</u>							
Finlayson Island	4	17	2	2	2	--	27
Lelu Island	20	134	2	2	10	1	169
Smith Island	532	1910	66	98	110	17	2733
Hazel Point	--	43	--	--	2	--	45
Croasdaile Island	4	10	--	1	14	--	29
Georgie Point	5	92	2	3	11	--	113
Moore Cove	43	150	6	1	6	--	206
Total	608	2356	78	107	155	18	3322
<u>Area 5</u>							
Mikado Bay	--	119	--	--	--	--	119
Mink Trap Bay	--	281	--	--	--	--	281
Total	--	400	--	--	--	--	400
Grand total	619	2764	87	109	157	18	3754

Table VIII. Percentage of sockeye recoveries made in B. C. statistical areas from taggings in Areas 3, 4, and 5 in 1947.

Tagging areas	3	4	5	Total
Number tagged	8	2356	400	2764
<u>Recoveries</u>				
Area 3	66.7	1.2	--	1.3
Area 4	33.3	98.3	8.1	95.5
Area 5	--	0.3	91.9	3.1
Area 9	--	0.1	--	<0.1
Area unknown	--	0.1	--	<0.1
Total	100.0	100.0	100.0	100.0

CHATHAM SOUND SALMON TAGGING, 1948

Tagging

In 1948, the Fisheries Research Board of Canada carried out salmon tagging in and around Chatham Sound to provide information regarding the timing and routes of approach of Skeena salmon, and to assess the extent to which the various runs were exploited. Taggings were carried out in Statistical Areas 3 and 4 during the period June 10 to July 18., inclusive, from a chartered commercial purse-seiner. Conventional Peterson-type disc tags, 1/2" in diameter, with white numbered discs and red baffles were used. The tagging sites are shown in Figure 1. The numbers of salmon tagged at each site are shown in Table I.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries and from spawning grounds in B. C. only. The recoveries of tags are shown in Tables II, III, IV, V, VI, and VII for pinks, sockeye, chums, coho, springs, and steelheads, respectively. These tables indicate the number of recoveries from the marine fisheries and from streams in statistical areas in B. C. These recovery areas are shown in Figures 2 and 3. Recoveries are shown for taggings at each of the sites listed in Table I.

Pinks. Of the total of 144 pinks tagged in Areas 3 and 4, about 13% were recovered. From the Area 3 tagging of 124 pinks, 11 were recovered in Area 3 and one in Area 5. Four pinks were recovered in Area 4 from the tagging of 20 pinks in Area 4.

Sockeye. About 35% of the total of 2462 sockeye tagged in Areas 3 and 4 were recovered. The percentages of the total recoveries made in the various areas are shown in Table VIII. From the tagging in Area 3 of 128 sockeye, 12 were recovered in Area 3 and three in Area 4. About 98% of the recoveries from the Area 4 sockeye taggings were made in Area 4 and the remaining 2% in other parts of B. C.

Other species. Of the total of 408 chums, coho, springs, and steelheads tagged in Areas 3 and 4, about 23% were recovered. Of the 139 chums tagged in Area 3, 32 were recovered in Area 3, five in Area 4, and one at an unknown location in B. C. None of the five chums tagged in Area 4 was recovered. Of the three coho tagged in Area 3, one was recovered in Area 6. Two of the 12 coho tagged in Area 4 were recovered in Area 4. From the Area 3 tagging of 73 springs, two were recovered in Area 3 and one in Area 4. All of the recoveries of springs tagged in Area 4 were made in the same area. The one steelhead tagged in Area 3 was not recovered. One of the steelheads tagged in Area 4 was recovered in Area 4.

(Tables II-VII omitted.)

Table I. The numbers of salmon and steelhead tagged in statistical areas 3 and 4 in 1948.

Location	Pink	Sockeye	Chum	Coho	Spring	Steelhead	Total
<u>Area 3</u>							
Steamer Passage	124	114	139	3	73	1	454
<u>Area 4</u>							
Finlayson Island	--	7	--	3	4	--	14
Lelu Island	--	157	--	--	10	--	167
Smith Island	20	2116	5	9	143	8	2301
Oceanic	--	18	--	--	4	--	22
Moore Cove	--	50	--	--	6	--	56
Total	20	2348	5	12	167	8	2560
Grand total	144	2462	144	15	240	9	3014

Table VIII. Percentage of sockeye recoveries made in B. C. statistical areas from taggings in Areas 3 and 4 in 1948.

Tagging areas	3	4	Total
Numbers tagged	114	2348	2462
<u>Recoveries</u>			
Area 3	80.0	0.3	1.7
Area 4	20.0	98.5	97.2
Area 5	--	0.2	0.2
Area unknown	--	1.0	0.9
Total	100.0	100.0	100.0

Tagging

As part of Canada's contribution to the work of the International North Pacific Fisheries Commission, during the summer of 1956 the Fisheries Research Board of Canada carried out exploratory fishing and tagging of juvenile salmon in northern British Columbia and adjacent southeastern Alaskan waters. Fishing was carried out from a chartered commercial drum seiner using a small-meshed purse seine. Adult salmon caught incidentally with the juveniles were tagged from June 15 to August 30 in Statistical Areas 3, 4, and 5, and in Southeastern Alaska. Conventional Peterson-type disc tags 9/16" in diameter, with white numbered discs in the "M" series and green baffles were used. The tagging sites are shown in Figure 1. The numbers of salmon and steelhead tagged at each site are shown in Table I.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries, and from spawning grounds in B. C. and Southeastern Alaska. The recoveries of tags are shown in Tables II, III, IV, V, VI, and VII for pinks, sockeye, chums, coho, springs, and steelhead, respectively. These tables indicate the number of recoveries from the marine fisheries and from streams in statistical areas in B. C. and in sections of the regulatory districts in Alaska. These recovery areas are shown in Figures 2, 3, and 4. Recoveries are shown for taggings in each of the sites listed in Table I.

The percentages of the total recoveries made in the various areas are shown in Tables VIII for pinks and in Table IX for sockeye.

Pinks. Of the total of ⁷⁶⁸~~1254~~ pinks tagged in Areas 3, 4, and 5, and in Alaska, about 26% were recovered. From the tagging in Alaskan waters 35% of the recoveries were made in the general section of the Southern District in Alaska, 8% in other parts of Alaska, 46% in Area 4, and 11% in other parts of B. C. From the Area 3 tagging, 40% of the recoveries were from Area 4, 35% from Area 3, 18% from other parts of B. C., and 7% from Alaska. Of the three pinks tagged in Area 4, one was recovered in Area 4, another in Alaska. From the tagging in Area 5, about 61% of the recoveries were made in Area 4, 29% in Area 5, and the remainder in other parts of B. C.

Sockeye. About 55% of the 128 sockeye tagged in Areas 3, 4, and 5, and in Alaska, were recovered. The single sockeye tagged in Alaska was not recovered. From the taggings in Area 3, about 67% of the recoveries were made in Area 4, 17% in Area 3, 14% in other parts of B. C., and 2% in Alaska. Of the recoveries of sockeye tagged in Area 4, 93% were from Area 4 and 7% from Area 3. Two of the eight sockeye tagged in Area 5 were recovered in Area 4.

Other species. Of the total of 93 chums, coho, springs and steelheads tagged in Areas 3, 5, and in Alaska, about 18% were recovered. All of the recoveries came from B. C. areas. Of the 28 chums tagged in Areas 3 and 5, two were recovered in Area 3 and one in Area 4. The single coho tagged in Alaska was recovered in Area 3. From the tagging of 26 coho in Area 3, three tags were recovered in Area 3 and two in Area 4. From the Area 5 tagging of 33 coho, one recovery was made in Area 4, three in Area 5, and one in Area 6. One spring salmon was recovered from the three springs tagged in Area 3. The single spring tagged in Area 5 was not recovered. The one steelhead tagged in Area 3 was recovered in Area 4.

Table I. The numbers of salmon and steelhead tagged in Alaska and in B. C. statistical areas 3, 4, and 5, in 1956.

Location	Pink	Sockeye	Chum	Coho	Spring	Steelhead	Total
<u>Alaska</u>							
Garnet Point	63	1	--	--	--	--	64
Barren Island	7	--	--	1	--	--	8
Cape Chacon	8	--	--	--	--	--	8
Total	78	1	--	1	--	--	80
<u>Area 3</u>							
Arniston Point	287	78	8	19	3	1	396
East Devil Rocks	--	--	--	4	--	--	4
Prince Leboo Island	10	--	4	--	--	--	14
Holliday Island	--	1	--	--	--	--	1
Pointer Rocks	2	1	--	2	--	--	5
Parkin Island	32	9	--	--	--	--	41
Tracy Island	--	1	--	--	--	--	1
Somerville Island	74	2	1	1	--	--	78
Total	405	92	13	26	3	1	540
<u>Area 4</u>							
Rachael Islands	--	25	--	--	--	--	25
Avery Island	1	2	--	--	--	--	3
Triple Island	2	--	--	--	--	--	2
Total	3	27	--	--	--	--	30
<u>Area 5</u>							
Ogden Channel	~~282~~ 768	8	15	33	1	--	~~339~~ 825
Grand total	~~1254~~ 768	128	28	60	4	1	~~1475~~ 769

Table VIII. Percentage of pink recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Alaska and in Areas 3, 4, and 5, in 1956.

Tagging area	Alaska	3	4	5	Total
Number tagged	78	405	3	~~768~~ 768	~~1254~~ 768
<u>Recoveries</u>					
<u>British Columbia</u>					
Area 3	46.0	34.5	--	4.9	30.1
Area 4	5.4	39.7	50.0	61.0	37.7
Area 5	--	4.3	--	29.3	8.7
Area 6	--	3.4	--	2.4	2.6
Area unknown	5.4	11.2	--	2.4	8.1
Total B. C.	56.8	93.1	50.0	100.0	87.2
<u>Alaska</u>					
Southern, Portland Canal	5.4	0.9	--	--	1.5
Southern, General	35.1	1.7	--	--	7.7
Clarence Strait, Southeastern	--	0.9	--	--	0.5
Unknown	2.7	3.4	50.0	--	3.1
Total Alaska	43.2	6.9	50.0	--	12.8

Table IX. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Alaska and in Areas 3, 4, and 5, in 1956.

Tagging areas	Alaska	3	4	5	Total
Number tagged	1	92	27	8	128
<u>Recoveries</u>					
<u>British Columbia</u>					
Area 3	--	16.7	6.7	--	14.1
Area 4	--	66.7	92.3	100.0	73.2
Area 5	--	3.7	--	--	2.8
Area unknown	--	11.0	--	--	8.5
Total B. C.	--	98.1	100.0	100.0	98.6
<u>Alaska, Southern, General</u>					
	--	1.9	--	--	1.4

CHATHAM SOUND SALMON TAGGING, 1957

Tagging

In 1957, the Skeena salmon investigation of the Fisheries Research Board of Canada carried out salmon taggings in and around Chatham Sound to provide information regarding the timing and routes of approach of Skeena salmon through the British Columbia net fishing areas, and to determine the degree to which Skeena salmon were mixed with non-Skeena salmon stocks in these waters. Tagging was carried out in Statistical Areas 3, 4, and 5 during the period June 5 to August 22, inclusive, from a chartered commercial drum-seiner. Conventional Petersen-type disc tags, 9/16" in diameter, with white numbered discs in the "R" and "X" series and yellow baffles were used. The tagging locations are shown in Figure 1. The numbers of salmon and steelhead tagged at each location are shown in Table 1.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries, and from spawning grounds in B. C. and Southeastern Alaska. Recoveries from Alaska were provided by fishermen, fishing companies, the U. S. Fish and Wildlife Service, and the Fisheries Research Institute of the University of Washington. The recoveries of tags are shown in Tables II, III, IV, V, VI, and VII for pinks, sockeye, chums, coho, springs, and steelheads, respectively. These tables indicate the number of recoveries from the marine fishery and from streams in statistical areas in B. C. and in sections of the regulatory districts in Alaska. These recovery areas are shown in Figures 2, 3, and 4. Recoveries are shown for taggings in each of the locations listed in Table 1.

Movement of Tagged Salmon

The percentage of the total recoveries made in different B. C. statistical areas and in different sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5, are shown in Tables VIII to XIII.

Pinks. Of the total of 6914 pinks tagged in Areas 3, 4, and 5, about 46% were recovered. Most recoveries were made in B. C. fishing areas and on B. C. spawning grounds. From the Area 3 tagging, 65% of the recoveries were made in Area 4, 23% in Area 3, 7% in other parts of B. C., and 5% in Alaska. About 90% of the recoveries from the tagging in Area 4 were made in the same area, 7% in Area 3, 2% in other parts of B. C., and 1% in Alaska. From the taggings in Area 5, about 51% of the recoveries were made in Area 5, 43% in Area 4, and 6% in other B. C. areas. The majority of the Alaskan recoveries of pink tags were from the Portland Canal and General sections of the Southern District.

Sockeye. Of the total of 1534 sockeye tagged in Areas 3, 4, and 5, about 52% were recovered. From the taggings in Area 3, about 68% of the recoveries were made in Area 4, 25% from Area 3, 6% from other B. C. areas, and 1% from Alaska. Around 81% of the recaptures from the Area 4 sockeye taggings were made in the same area, 16% in Area 3, 2% elsewhere in B. C., and 1% from Alaska. Most (71%) of the recoveries of Ogden Channel tags were made in Area 4. Alaskan recoveries of sockeye tags were mainly from the General section of the Southern District.

Chums. Of the total of 1144 chums tagged in Areas 3, 4, and 5, about 30% were recovered. Most recoveries from taggings of chums in Area 3 were made in the same area (59%), 13% were recovered from other B. C. waters, and 28% from Alaska. Most (67%) of the recoveries of chums tagged in Area 4 were from Area 3. The majority (60%) of the recoveries of chums tagged in Ogden Channel were made in Area 4 but 35% were recovered in other parts of B. C., and 5% in Alaska. Most of the recoveries of chum tags in Alaska were from the Portland Canal section of the Southern District.

Other species. Of the total of 459 coho, springs, and steelheads tagged in Areas 3, 4, and 5, about 34% were recovered. The majority of recoveries came from B. C. fishing areas, mainly from Area 4 and Area 3. From taggings in Area 3, 6.3% of the coho recoveries, 2.8% of the spring recoveries, and 14.3% of the steelhead recoveries were made in Alaska. All recoveries from taggings in Area 4 and Ogden Channel were made in B. C. waters.

(Tables II-VII omitted.).

Table I. The number of salmon and steelhead tagged in Statistical Areas 3, 4 and 5 in 1957.

Location	Pink	Sockeye	Chum	Coho	Spring	Steelhead	Total
<u>Area 3</u>							
South end, Caamano Passage	--	6	--	--	--	--	6
North end, Caamano Passage	--	1	--	2	--	--	3
Arniston Point	2061	857	101	199	36	18	3272
First point east of Arniston Point	190	23	17	3	--	1	234
Gnarled Islands	575	32	3	15	--	--	625
Whitly Point	250	12	6	3	--	--	271
West of Bristol Rock	--	--	--	2	--	1	3
West of Birnie Island	56	22	2	6	2	--	88
Bay south of Maskelyne Island	416	21	3	1	3	--	444
Boston Island	378	74	262	17	8	--	739
Tracy Island	84	20	451	4	7	--	566
Elliott Point	38	276	119	13	64	--	510
Quinamass Bay	--	1	--	--	3	--	4
Total	4048	1345	964	265	123	20	6765
<u>Area 4</u>							
Southwest of Green Island	30	24	5	2	3	--	64
South end of Hudson's Bay Passage	2	7	--	--	--	--	9
West of Finlayson Island	574	105	3	9	3	1	695
South of Riel Point	--	1	--	--	--	--	1
Goble Point	17	--	--	1	--	--	18
Northwest of Grace Island	465	16	8	3	--	--	492
Kinahan Island	380	--	--	1	--	--	381
Total	1468	153	16	16	6	1	1660
<u>Area 5</u>							
Ogden Channel	1398	36	164	25	1	2	1626
Grand total	6914	1534	1144	306	130	23	10051

Table VIII. Percentage of pink recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1957.

Tagging areas	3	4	5	Total
Number tagged	4048	1468	1398	6914
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	22.6	7.3	3.8	16.0
Area 4	65.2	89.6	42.5	67.2
Area 5	1.5	1.3	51.2	9.6
Area 6	0.9	--	1.5	0.8
Area 7	0.9	--	--	0.5
Area 8	0.5	--	--	0.3
Area 9	0.2	--	--	0.1
Area 10	0.1	--	--	<0.1
Area 12	0.5	0.3	--	0.3
Area 13	0.1	--	--	<0.1
Area 29	<0.1	--	0.2	<0.1
Area unknown	2.1	0.8	0.8	--
Total B. C.	94.6	99.3	100.0	96.6
<u>Alaska</u>				
Southern, Portland Canal	2.9	--	--	1.7
Southern, General	2.0	0.6	--	1.4
Clarence Strait, Southeastern	0.3	0.1	--	0.2
Clarence Strait, Southwestern	<0.1	--	--	<0.1
Sumner Strait, Anan	0.1	--	--	<0.1
Area unknown	<0.1	--	--	<0.1
Total Alaska	5.4	0.7	--	3.4

Table IX. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1957.

Tagging areas	3	4	5	Total
Number tagged	1345	153	36	1534
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	25.1	16.4	5.9	23.5
Area 4	67.9	80.9	70.6	69.7
Area 5	3.0	--	11.7	2.7
Area 6	0.3	--	11.7	0.5
Area 7	0.3	--	--	0.3
Area 12	0.5	0.9	--	0.5
Area 20	0.1	--	--	0.1
Area 29	0.3	0.9	--	0.4
Area unknown	1.2	--	--	1.0
Total B. C.	98.7	99.1	100	98.8
<u>Alaska</u>				
Southern, Portland Canal	0.1	--	--	0.1
Southern, General	0.9	0.9	--	0.9
Clarence Strait, North Behm Canal	0.1	--	--	0.1
Stikine	0.1	--	--	0.1
Total Alaska	1.3	0.9	--	1.2

Table X. Percentage of chum recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1957

Tagging areas	3	4	5	Total
Number tagged	964	16	164	1144
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	58.8	66.6	3.4	49.6
Area 4	8.3	16.7	60.3	17.3
Area 5	0.4	--	10.3	2.1
Area 6	0.7	--	20.7	4.1
Area 7	0.4	--	--	0.3
Area unknown	3.6	16.7	--	3.2
Total B. C.	72.2	100	94.8	76.5
<u>Alaska</u>				
Southern, Portland Canal	22.7	--	3.4	19.1
Southern, General	3.6	--	1.7	3.2
Southern, Unknown	0.4	--	--	0.3
Clarence Strait, Southeastern	0.4	--	--	0.3
West Coast	0.4	--	--	0.3
Unknown	0.4	--	--	0.3
Total Alaska	27.8	--	5.2	23.5

Table XI. Percentage of coho recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1957.

Tagging areas	3	4	5	Total
Number tagged	265	16	25	306
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	28.4	33.3	--	27.6
Area 4	51.6	50.0	100	53.3
Area 5	6.3	--	--	5.7
Area 6	2.1	--	--	1.9
Area 7	2.1	--	--	1.9
Area 8	1.1	--	--	1.0
Area 9	1.1	16.7	--	1.9
Area 29	1.1	--	--	1.0
Total B. C.	93.7	100	100	94.3
<u>Alaska</u>				
Southern, General	4.2	--	--	3.8
Clarence Strait, Central	1.1	--	--	1.0
Western, Western	1.1	--	--	1.0
Total Alaska	6.3	--	--	5.7

Table XII. Percentage of spring recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1957.

Tagging areas	3	4	5	Total
Number tagged	123	6	1	130
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	58.3	100	--	60.5
Area 4	33.3	--	--	31.6
Area 5	2.8	--	--	2.6
Total B. C.	94.4	100	--	94.7
Alaska, unknown location	2.8	--	--	2.6
Columbia River	2.8	--	--	2.6

Table XIII. Percentage of steelhead recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory district from taggings in Areas 3, 4, and 5 in 1957.

Tagging areas	3	4	5	Total
Number tagged	20	1	2	23
<u>Recoveries</u>				
British Columbia, Area 4	85.7	--	100	88.9
Alaskan, Southern, General	14.3	--	--	11.1

CHATHAM SOUND SALMON TAGGING, 1958

Tagging

The Skeena salmon investigation of the Fisheries Research Board of Canada carried out salmon tagging in and around Chatham Sound in 1958 to provide information about the timing and routes of approach of Skeena salmon through the B. C. net fishing areas, and to determine the degree to which Skeena salmon were mixed with non-Skeena salmon stocks in these waters. Tagging was carried out in Statistical Areas 3, 4, and 5 during the period July 12 to August 12 from a chartered commercial drum seiner. Conventional Peterson-type disc tags, 11/16" in diameter, with white numbered discs in the "V" series and white baffles, were used. A few sockeye were tagged experimentally with plastic dart-type tags. The tagging sites are shown in Figure 1. The numbers of salmon and steelhead tagged at each site are shown in Table I.

Recovery

Tags were recovered from the commercial, native food, and sport fisheries, and from spawning grounds in B. C. and Southeastern Alaska. Recoveries from Alaska were provided by fishermen, fishing companies, the U. S. Fish and Wildlife Service, and the Fisheries Research Institute of the University of Washington. The recoveries of tags are shown in Tables II, III, IV, V, VI, and VII for pinks, sockeye, chums, coho, springs, and steelhead, respectively. These tables indicate the number of recoveries from the marine fisheries and from streams in statistical areas in B. C. and in sections of the regulatory districts in Alaska. These recovery areas are shown in Figures 2, 3, and 4. Recoveries are shown for taggings in each of the sites listed in Table I.

The percentages of the total recoveries made in the various areas are shown in Tables VIII, IX, X, and XI for pinks, sockeye, chums, and coho, respectively.

Pinks. Of the total of 6628 pinks tagged in Areas 3, 4, and 5, about 41% were recovered. From the Area 3 tagging, almost equal numbers of tags were recovered from B. C. and from Alaska. Of the recoveries, 25% were made in Area 4, 18% in Area 3, 9% elsewhere in B. C., 31% in the general section of the Southern District in Alaska, 9% in the southeastern section of the Clarence Strait District of Alaska, and 8% in other parts of Alaska. About 73% of the recoveries from the tagging in Area 4 were made in Area 4, 7% in Area 3, 8% in Area 5, 3% in other parts of B. C., and 9% in Alaska, mainly in the general section of the Southern District. From the tagging in Area 5, about 59% of the recoveries were made in Area 4, 34% in Area 5, 5% in other parts of B. C., and about 2% from Alaska.

Sockeye. Of the total of 761 sockeye tagged in Areas 3, 4, and 5, about 62% were recovered. From taggings in Area 3, about 77% of the recoveries were made in Area 4, 11% from Area 3, 5% from other parts of B. C., and 7% from Alaska. Around 95% of the recaptures from the Area 4 sockeye tagging were made in Area 4 and 5% elsewhere in B. C. Most (85%) of the recoveries of Ogden Channel sockeye tags were made in Area 4. The remainder of the recoveries were from other parts of B. C., mainly from Area 5.

Chums. Of the total of 185 chums tagged in Areas 3, 4, and 5, about 28% were recovered. Of the recoveries from the chum tagging in Area 3, about 20% were made in Area 4, 20% in Area 5, 12% in Area 3, 8% in other parts of B. C., and 40% in Alaska. Of the recoveries in Alaska, one-half were recovered in the general section of the Southern District, the other half elsewhere in Alaska. Of the 11 chums tagged in Area 4, one was recovered in Area 4. The majority (68%) of the recoveries of chums tagged in Ogden Channel were recovered in Area 4. The remainder were recovered in Area 5 and other parts of B. C.

Other species. Of the total of 255 coho, springs, and steelheads tagged in Areas 3, 4, and 5, about 20% were recovered. From the coho tagging in Area 3, about 90% were recovered in B. C. and 10% in Alaska. All the recoveries of coho tagged in Areas 4 and 5 were made in B. C., mainly in Area 4. Of the 16 springs tagged in Areas 3, 4, and 5, four were recovered in Area 4. Two of the three steelhead tagged in Areas 3 and 5 were recovered, one each in Areas 3 and 4.

Table I. The numbers of salmon and steelhead tagged in statistical areas 3, 4, and 5 in 1958.

Location	Pink	Sockeye	Chum	Coho	Spring	Steelhead	Total
<u>Area 3</u>							
Arniston Point	2472	376	91	150	2	--	3091
Whitly Pt.-Prospector Pt.	154	11	4	6	--	1	176
Table Hill	168	1	1	1	1	--	172
Total	2794	388	96	157	3	1	3439
<u>Area 4</u>							
Green Island	63	7	1	6	--	--	77
Rod Island	2	3	--	--	--	--	5
Oval Bay	1	1	--	--	1	--	3
Grace Island	1247	225	10	17	5	1	1505
Horse Bank	5	17	--	--	2	1	25
Total	1318	253	11	23	8	2	1615
<u>Area 5</u>							
Ogden Channel	2516	120	78	56	5	--	2775
Grand total	6628	761	185	236	16	3	7829

Table VIII. Percentage of pink recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1958.

Tagging areas	3	4	5	Total
Number tagged	2794	1318	2516	6628
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 2	1.0	0.2	0.4	0.6
Area 3	18.2	6.6	1.7	8.9
Area 4	25.0	73.4	58.5	48.7
Area 5	4.1	7.5	34.3	17.6
Area 6	2.0	1.1	0.7	1.3
Area 7	0.4	0.2	0.1	0.2
Area 8	0.5	0.2	0.1	0.3
Area 9	--	0.2	--	<0.1
Area 12	0.1	0.4	--	0.1
Area unknown	1.0	1.3	1.8	1.4
Total B. C.	52.3	91.1	97.6	79.1
<u>Alaska</u>				
Southern, Portland Canal	1.1	0.2	0.3	0.6
Southern, General	30.6	6.4	1.4	13.5
Southern, unknown	0.4	0.2	0.3	0.3
Clarence Strait, Southeastern	8.5	0.6	--	3.4
Clarence Strait, Southwestern	1.3	--	0.1	0.5
Clarence Strait, Central	0.8	0.4	0.2	0.4
Clarence Strait, North Behm Canal	0.5	0.2	--	0.2
Clarence Strait, Northern	0.4	--	--	0.1
West Coast	0.6	0.2	--	0.3
Sumner Strait, Anan	0.1	--	--	<0.1
Eastern, Southern	0.1	--	--	<0.1
Unknown	3.3	0.7	0.1	1.5
Total Alaska	47.7	8.9	2.4	20.9

Table IX. Percentage of sockeye recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1958.

Tagging areas	3	4	5	Total
Number tagged	388	253	120	761
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 2	0.4	--	--	0.2
Area 3	11.4	2.6	2.5	7.0
Area 4	76.6	95.5	84.8	84.2
Area 5	2.9	1.3	11.4	3.8
Area 6	0.8	--	--	0.4
Area 8	0.4	--	--	0.2
Area unknown	0.8	0.6	1.3	0.8
Total B. C.	93.3	100.0	100.0	96.6
<u>Alaska</u>				
Southern, General	3.8	--	--	1.9
Clarence Strait, Southeastern	0.8	--	--	0.4
Clarence Strait, Southwestern	0.8	--	--	0.4
Unknown	1.3	--	--	0.7
Total Alaska	6.7	--	--	3.4

Table X. Percentage of chum recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1958.

Tagging areas	3	4	5	Total
Number tagged	96	11	78	185
<u>Recoveries</u>				
<u>British Columbia</u>				
Area 3	12.0	--	12.0	11.8
Area 4	20.0	100.0	68.0	45.1
Area 5	20.0	--	16.0	17.6
Area 6	4.0	--	--	2.0
Area unknown	4.0	--	4.0	3.9
Total B. C.	60.0	100.0	100.0	80.4
<u>Alaska</u>				
Southern, General	20.0	--	--	9.7
Clarence Strait, Southeastern	4.0	--	--	2.0
Clarence Strait, North Behm Canal	4.0	--	--	2.0
Unknown	12.0	--	--	5.9
Total Alaska	40.0	--	--	19.6

Table XI. Percentage of coho recoveries made in B. C. statistical areas and in sections of the Alaskan regulatory districts from taggings in Areas 3, 4, and 5 in 1958.

Tagging areas	3	4	5	Total
Number tagged	157	23	56	236

Recoveries

British Columbia

Area 3	20.0	--	--	13.0
Area 4	46.7	75.0	66.7	54.4
Area 5	--	--	33.3	8.7
Area 6	6.7	--	--	4.3
Area 8	6.7	--	--	4.3
Area 9	3.3	--	--	2.2
Area 10	3.3	--	--	2.2
Area 12	--	25.0	--	2.2
Area unknown	3.3	--	--	2.2
Total B. C.	90.0	100.0	100.0	93.5

Alaska

Southern, General	6.7	--	--	4.3
Clarence Strait, Southwestern	3.3	--	--	2.2
Total Alaska	10.0	--	--	6.5

The following information was extracted from reference no. 43 (Gillhousen, 1960):

Variable migratory behavior of adults of Fraser River sockeye races was analyzed to assist the design of regulations for the fishery. Unusually large diversions of sockeye through Johnstone Strait were associated with unusual oceanographic conditions and with sunspot maxima. Variable migration timing of the Adams River race and of other sockeye races is illustrated and possible relationships with abundance of sockeye and with moon phase are noted. Variations in the upriver migrations of Adams River sockeye is related to variable Fraser discharge in the summer. It is suggested that migration and spawning timing is a consequence of maturation, which is photoperiodically controlled, and that photoperiodism may be involved in variable timing.

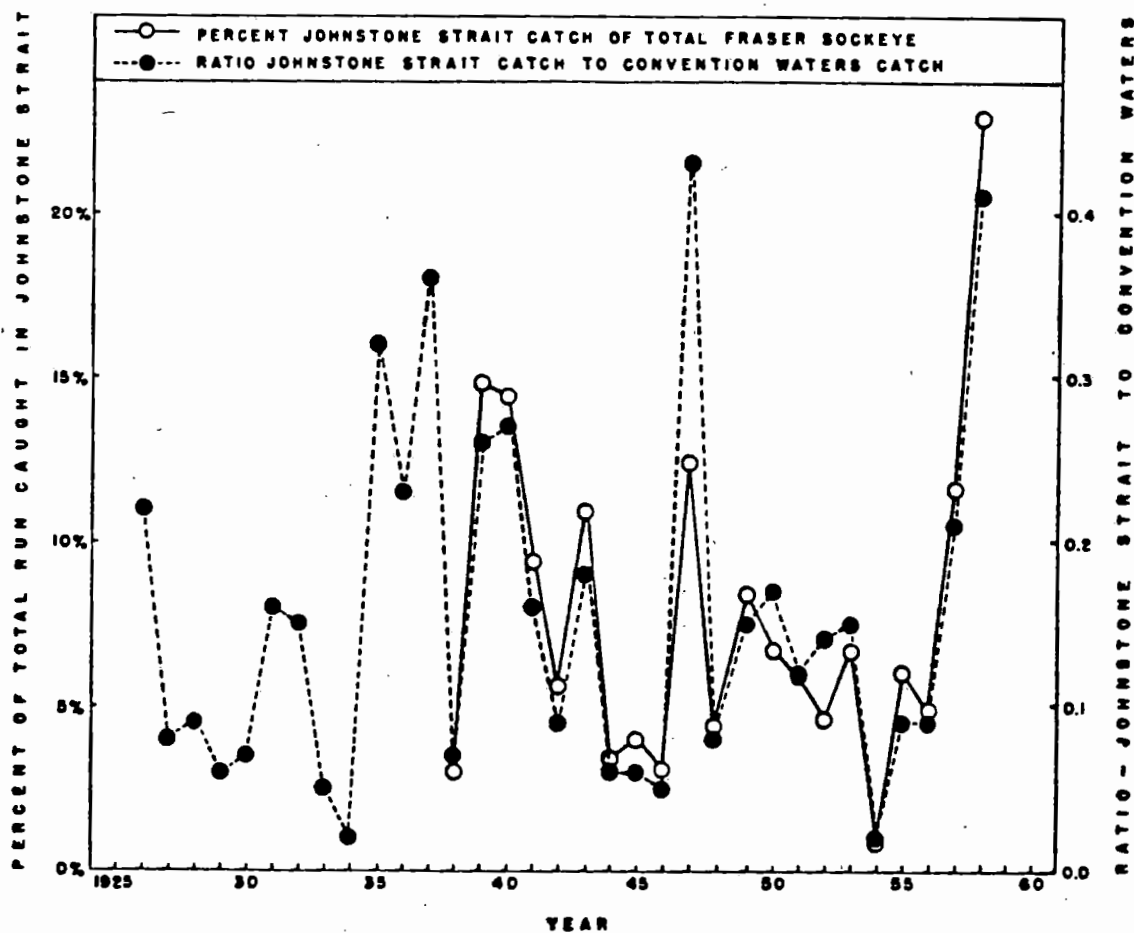


FIGURE 4 - Two indices of proportion of Fraser River sockeye migrating through Johnstone Strait.

The following information was extracted from reference no. 52 (Committee on Problems of Mutual Concern, MS 1961). This report summarizes additional information on stream recoveries for tagging programs conducted in 1956, 1957 and 1958. The following table lists the recovery of species for each of the years of study. (NB: Tabular information listing the areas of individual recapture are available in the publication, but were not extracted for this report. Migration route maps can be drawn from the individual recapture data.)

Year of Study	Sockeye	Pink	Chum	Coho	Chinook
1956	X	X		X	
1957	X	X	X	X	X
1958	X	X	X	X	X

"Committee on Problems of Mutual Concern Related to the Conservation and Management of Salmon Stocks in Southeast Alaska and Northern British Columbia.

"Further Information on the Salmon Tagging Experiments in Northern British Columbia - Effectiveness of Tag Recovery in British Columbia Waters, 1956, 1957, and 1958.

Submitted by the Canadian Section, December 1961.

At the second meeting of the "Committee on problems of mutual concern related to conservation and management of salmon stocks in southeast Alaska and northern British Columbia" (held in Prince Rupert, January 26, 1961), it was agreed that:

- (a) "an exchange of tagging data in the detail necessary for analysis be carried out to the best of each section's ability." (item 5b of the Minutes).
- (b) "an exchange of information describing the methods and effort directed toward recovery of tagged fish in the commercial fishery and on the spawning grounds be carried out. This was to be considered part of the exchange on tagging....." (item 5d of the Minutes).

Following the meeting and after communication between the correspondents the basic data from the 1957 and 1958 taggings in the West Coast District carried out by the Fisheries Research Institute of the University of Washington and for the 1956, 1957, and 1958 tagging in and around Chatham Sound carried out by the Fisheries Research Board of Canada were exchanged. This exchange was in the form of duplicate IBM cards for data on each salmon tag which was recovered, listings of the numbers of salmon of each species tagged daily at each tagging location, and lists of IBM codings. This exchange of data fulfills the requirements of (a) above.

The purpose of the present report is to describe the methods and effort directed toward recovery of both Canadian and United States salmon tags in the commercial fishery and on the spawning grounds in British Columbia in 1956, 1957, and 1958. This report also provides the numbers of Canadian salmon tags recovered in Alaskan spawning streams in these years.

Recovery in British Columbia commercial fisheries.

The efficiency of recovery of tags recaptured in commercial fisheries is difficult to assess in a precise way. Tagging has been conducted at various locations along the British Columbia coast at various times for the past 30 years and as a result the Canadian fishing industry is familiar with the general procedures for turning in of tags recaptured in commercial fisheries. The salmon tagging carried out in 1956 by the Fisheries Research Board of Canada in and around Chatham Sound was of a preliminary nature. It was carried out mainly to determine the feasibility of catching salmon for tagging from a drum seiner in the outer portions of the Skeena and Nass gill-net areas. Because of the preliminary nature of the tagging, relatively little effort was put into recovering the tags from either the commercial fishery or the spawning grounds. The 1957 and 1958 salmon taggings were larger and were publicized in the press and in radio broadcasts.

Arrangements were made in all years for fishermen to turn in their salmon tags at cannery offices, at the Department of Fisheries office in Prince Rupert, and to Department of Fisheries personnel in the field. Prepaid tag-recovery envelopes were made available throughout the area so that recovered tags could be mailed by individuals. In 1957 and 1958, personnel of the Fisheries Research Board canvassed as many fishermen as possible each week-end throughout the period of the tagging for tags at the Skeena River canneries and along the Prince Rupert waterfront.

A general indication of the efficiency of turning in of tags from the commercial fisheries is provided by the fact that of 10,052 and 7,828 salmon tagged in 1957 and 1958, 39% and 37% were recaptured and turned in by commercial fishermen. Considering that in any tagging experiment, substantial numbers of tagged fish die or lose their tags before becoming available to the fishery^{1/}, and that rates of exploitation on the stocks in the various fisheries during the years in question were probably in the order of 50-75%, there is no doubt that the majority of the tags recaptured by fishermen were turned in. Repeated canvass of the fishery in later years failed to reveal significant numbers of tags, again indicating that the vast majority of tags recaptured by fishermen had been recovered.

Recovery in spawning areas

Salmon tags were recovered from spawning areas in British Columbia from the following sources:

1. Governmental agencies. Tags were recovered in the Skeena River drainage by Fisheries Research Board personnel in 1956, 1957, and 1958 from salmon at counting weirs and during special stream surveys. Two counting weirs were operated, one on the Babine River in all years of tagging, the other at Kleanza Creek during the 1957 and 1958 taggings. The salmon are counted at the Babine River counting weir as they swim through openings in the weir. By a special arrangement of doors at the openings it is possible to stop tagged fish for examination. Following examination, tagged fish are usually released for possible recovery in the final spawning stream. In years whenever observations have been made for tagged fish at the weir, it has been found that it is not possible to stop all tagged fish seen and that some tagged salmon pass through the weir with the tag unnoticed.

Large numbers of salmon were also examined in 1957 and 1958 on spawning streams upstream from the Babine River counting weir.

In 1957 and 1958 the Fish Culture Development Branch of the Department of Fisheries carefully examined portions of the Nass River run as part of a tagging experiment to determine timing of Nass sockeye runs and the effect of the obstruction at Meziadin Falls, and to make population estimates. Salmon were tagged at a fish wheel located in the Nass River a few miles upstream from the village of Aiyansh, and at Meziadin Falls. Since all of the sockeye which enter Meziadin Lake and other spawning areas above Aiyansh must pass the fish-wheel site, some fish examined at Meziadin Lake, Kwinageese River, and Damdochax River undoubtedly also had already been examined at Aiyansh. Similarly, some of those examined at the Meziadin Falls weir were later re-examined further upstream on Hanna and McLeod Creeks.

Surveys are carried out on most British Columbia salmon spawning streams each year by officers and guardians of the Protection Branch of the Department of Fisheries to make approximate estimates of the number of spawners and observations on the condition of spawning grounds. These surveys usually do not entail pitching or otherwise handling substantial portions of the runs. Hence, although the officers and guardians frequently recovered tags from the spawning grounds, the effective tag-recovery effort was much lower than in areas like the Skeena and Nass where fence counts or intensive carcass pitching surveys were conducted.

2. Private individuals. Salmon tags were recovered in spawning areas in all years by the native subsistence fishery. The recovery of tags is incomplete from some areas because of a lack of interest and/or reluctance on the part of many natives to turn in or report tags. In other instances, selective fishing was carried out for tagged salmon by natives in order to collect the rewards. Hence, although estimates are available of the catch of salmon in the native food fishery, the data are not suitable for studies of tag-recovery effort.

Some salmon tags were returned by sports fishermen but no information is available on the numbers of salmon caught or examined for tags.

Salmon tags have been returned by other private individuals who had recovered the tags from live or dead salmon in spawning streams or who had found the tags lying loose in the gravel. Again no information is available on the numbers of salmon involved.

The numbers of salmon tags recovered in spawning areas and the effort directed toward recovery of tags are described in the following text for the years 1956, 1957, and 1958.

1/ Tag loss due to mortality or dropping off of tags in the intensive 1959 tagging experiments in Juan de Fuca and Johnstone Straits (carried out under terms of the pink salmon protocol to the Fraser River Treaty) averaged slightly over 20%. If the average rate of exploitation of stocks in the Chatham Sound area in 1957 and 1958 was 65% and if the same tag loss occurred in this area as was observed in southern areas, then receipt of 37% and 39% of the total number of tags applied would indicate an effective recovery rate well over 70%.

Variation in Timing of Saltwater Migration

The clearest picture of the variation in migration timing of a racial run is provided by the dominant Adams River sockeye run. Peak dates of occurrence were determined for this run in the San Juan Islands for the last nine cycle years, and are as follows:

1926 - August 7-10	1938 - August 24	1950 - August 21
1930 - August 28-31	1942 - August 24	1954 - August 29
1934 - August 18	1946 - August 28	1958 - September 2

The dates were not all derived by the same method. In 1942 through 1954, the date of peak catch in the San Juan Islands was used. In 1938 and 1958, the catches were not strictly symmetrical and therefore the peak date was taken as the center of a sixteen day catch period which gave the minimum standard deviation in days. Catch on days closed to fishing was provided by interpolation. In 1942 through 1954, this method gives the same date as the peak catch. In 1926, 1930 and 1934, traps took an important part of the United States catch, and of necessity the timing was estimated mainly on the basis of trap catches. Purse seine catches could not be used because, prior to 1935, catches in the San Juan Islands were not recorded separately from those made at Point Roberts where Adams River sockeye are sometimes taken in large numbers after saltwater migration has ended. Catches by the Canadian traps in the vicinity of Sooke on Southern Vancouver Island were also used as verification of the time of occurrence in United States traps. This is possible because the Sooke traps reflected the timing of the run within two or three days prior to 1947 when an effective purse seine fishery developed in the same general area.

SALMON TAG RECOVERIES IN NORTHERN BRITISH COLUMBIA, 1956.

As indicated earlier, very little emphasis was placed on recovery of salmon tags from spawning areas in 1956 because of the preliminary nature of the tagging.

Pink. The number of pink salmon examined and the number of tags recovered are shown in Table I. Only small numbers of pink salmon were examined in 1956 because the large-scale study of the Skeena River pink populations did not commence until the following season. Of the 2,691 pinks counted through the Babine River counting weir, the carcasses of 2,009 were re-examined for tags when they drifted back on the weir after spawning.

Sockeye. The recoveries of sockeye tags and the number of sockeye examined for tags in 1956 are indicated in Table II. A total of 45 sockeye tags were recovered from spawning areas. One of these tags was recovered in the native subsistence fishery on the Nass River, 7 from the native subsistence fishery along the Skeena River, and 37 from Babine Lake. Only 36 tags were recovered from the sockeye as they were counted through the Babine River counting weir. However, among 9 sockeye tags recovered later from the native subsistence fishery upstream from the weir, one tag was found which had not been observed earlier at the weir.

Coho. Three coho salmon tags were recovered from spawning areas in 1956. Table III indicates the number of coho salmon examined and the number of coho tags recovered.

Chum, spring, and steelhead. No chum, spring, or steelhead tags were recovered from spawning areas in 1956. Three chum, 4,345 spring, and 92 steelhead were examined for tags at the Babine River counting weir.

SALMON TAG RECOVERIES IN NORTHERN BRITISH COLUMBIA, 1957.

Effort was increased in 1957 toward recovering salmon tags from the large taggings carried out simultaneously by the Fisheries Research Board of Canada and by the Fisheries Research Institute of the University of Washington.

Pink. The number of pink salmon examined and the number of pink salmon tags recovered from spawning areas in 1957 are indicated in Table IV. A total of 171 Fisheries Research Board pink tags were recovered from spawning areas; two from Alaska, 169 from British Columbia. In addition, 101 Fisheries Research Institute pink tags were recovered from spawning areas in British Columbia. Of the 25,856 pinks examined at the Babine River counting weir the carcasses of 20,705 were re-examined after spawning. Among these pinks which were re-examined were found two tags which had not been recorded passing the weir.

Sockeye. The recoveries of sockeye tags and the number of sockeye examined for tags are indicated in Table V. A total of 347 Fisheries Research Board and 11 Fisheries Research Institute sockeye tags were recovered from spawning areas in British Columbia. Examination of the sockeye as they were counted through the Babine River counting weir resulted in recovery of a total of 197 Fisheries Research Board and 6 Fisheries Research Institute sockeye tags. Of these, 193 Fisheries Research Board and all 6 Fisheries Research Institute tagged sockeye were allowed to continue upstream tagged. Subsequently, 55 Fisheries Research Board tags and one Fisheries Research Institute tag were recovered from the native subsistence fishery or from the final spawning grounds. Among these 55 tags were 5 Fisheries Research Board tags and one Fisheries Research Institute tag which had not been recorded passing the weir. These 6 tags were among 15 tags recovered in the examination of 44,354 which had spawned out immediately above the weir.

Chum, coho, spring, and steelhead. The numbers of chum, coho, spring, and steelhead examined and the numbers of chum, coho, spring, and steelhead recovered from spawning areas in 1957 are shown in Tables VI, VII, VIII, and IX, respectively. Records of the numbers of each of these species examined are available from the Babine River counting weir only.

SALMON TAG RECOVERIES IN NORTHERN BRITISH COLUMBIA, 1958.

In 1958, as in 1957, considerable effort was placed into recovering tags from spawning areas in northern British Columbia. Tagging was carried out again in 1958 by the Fisheries Research Board of Canada and the Fisheries Research Institute of the University of Washington.

Pink. The number of pink salmon examined and the number of pink salmon tags recovered from spawning areas in 1958 are indicated in Table X. A total of 183 Fisheries Research Board tags were recovered from spawning areas, 15 in Alaska and 168 in British Columbia. Five Fisheries Research Institute pink tags were recovered from spawning areas in British Columbia.

Sockeye. The recoveries of sockeye tags and the number of sockeye examined for tags are indicated in Table XI. A total of 199 Fisheries Research Board sockeye tags were recovered from spawning areas, one of them from Hugh Smith Lake in Alaska, the remainder from British Columbia. In addition, 102 Fisheries Research Institute tags were recovered from spawning areas in British Columbia. Recoveries of sockeye tags at the Babine River counting weir amounted to 171 Fisheries Research Board and 94 Fisheries Research Institute tags. From these fish 14 Fisheries Research Board and 6 Fisheries Research Institute tags were removed. The remaining fish were allowed to continue upstream tagged. Subsequently 18 Fisheries Research Board and 12 Fisheries Research Institute tags were recovered from the native subsistence fishery and from spawning streams. Amongst these were 2 Fisheries Research Board tags and one Fisheries Research Institute tag which had not been recorded at the Babine River counting weir.

Chum, coho, spring, and steelhead. The numbers of chum, coho, spring, and steelhead examined and the numbers of chum, coho, spring, and steelhead tags recovered from spawning areas in 1958 are shown in Tables XII, XIII, XIV, and XV, respectively. Records of the numbers of each of these species examined are available from the Babine River counting weir only.

The following information was extracted from reference no. 80 (Verhoeven and Davidoff, 1962). This report is considered to be the definitive publication concerning sockeye salmon movements into the natal streams (in this case, the Fraser River). The report gives comprehensive information on tagging and recovery methods, routes of migration, rates of migration, and times of passage of the different Fraser River sockeye races through the fishery. Many of the discussion sections regarding tag-recovery problems are applicable to similar programs in other areas, and this report is considered important as background reading for any proposed tagging programs on the B. C. coast.

"A series of tagging experiments was begun in 1938 at Sooke near the southern end of Vancouver Island (Figure 1) and was carried on annually until 1948 in which year the tagging was terminated before the start of the sockeye fishing season. Additional marine tagging was conducted intermittently from 1938 to 1941 at Salmon Banks, San Juan Channel, South Lopez, West Beach, Lummi Island, Point Roberts, Johnstone Strait, and Sand Heads off the mouth of the Fraser River. A total of 33,334 sockeye were tagged and 17,219 tags or 51.7 per cent were recovered (Table 1). Table 2 lists for each tagging area during the combined years the percentage distribution of the tag recoveries according to the recovery areas shown in Figure 2. Preliminary analyses of the data from some of the experiments have been presented by MacKay, Howard and Killick (1944, 1945) and Idyll (1951).

"The purpose of this report is to make a complete and critical analysis of all the saltwater tagging data obtained from the Salmon Commission's experiments and to summarize information from previous tagging and finmarking experiments to assess (1) routes of migration, (2) speed of migration, (3) time of passage of individual races, and (4) commercial fishing mortality.

"It will be shown that saltwater tagging was successful in fulfilling some of the objectives, but that it was of little or no value in solving others. Each of the objectives will be treated separately, although they may be inter-related"

TABLE 1—Period and number of occasions of tagging and per cent recovered by year and tagging area. (Occasions when oval tags were used instead of, or in addition to disk tags are indicated.)

Year	Tagging Area	First Date	Last Date	Number of Occasions	Number Tagged	Number Recovered	Per cent Recovered
1938	Sooke	June 11	Sept. 3	13	980	438	44.7
	Sand Heads	Aug. 27	Sept. 15	13	2,587	1,269	49.1
1939	Sooke	May 25	Sept. 7	14	960	546	56.9
	Salmon Banks	July 28	Sept. 4	20	1,355	947	69.9
	San Juan Channel	Aug. 25	Aug. 29	4	220	158	71.8
	South Lopez	July 20	Sept. 5	16	1,011	634	62.7
	West Beach	July 19	Aug. 15	7	63	41	65.1
	Lummi Island	July 24	Aug. 23	12	1,144	603	52.7
	Point Roberts	Aug. 8	Sept. 1	3	31	21	67.7
	Sand Heads	Aug. 13	Sept. 29	24	2,325	1,751	75.3
1940	Sooke	June 13	Sept. 5	13	930	444	47.7
	Salmon Banks	July 29	Aug. 18	7	869	482	55.5
	South Lopez	Aug. 15	Aug. 16	2	60	31	51.7
	Lummi Island	July 29	Aug. 16	14	706	328	46.5
	(Oval tags)	Aug. 1	.....	1	10	4	40.0
	Sand Heads	July 27	Sept. 13	6	16	7	43.8
	(Oval tags)	Aug. 20	Sept. 11	5	63	38	60.3
	Johnstone Strait	July 16	Aug. 12	15	1,555	770	49.5
1941	Sooke	June 12	Sept. 4	13	849	501	59.0
	Salmon Banks	July 16	Aug. 27	13	332	195	58.7
	San Juan Channel	July 8	Aug. 24	4	72	46	63.9
	South Lopez	July 25	Aug. 12	8	270	188	69.6
	West Beach	July 17	July 18	2	94	63	67.0
	Lummi Island	July 8	Aug. 23	10	690	402	58.3
	Point Roberts	July 11	July 24	4	179	120	67.0
	Sand Heads	July 24	Sept. 18	37	1,614	1,005	62.3
	(Oval tags)	Aug. 6	Sept. 20	10	296	132	44.6
	Johnstone Strait	July 21	Aug. 7	14	1,191	784	65.8
1942	Sooke	July 2	Sept. 8	17	1,744	824	47.2
1943	Sooke	July 8	Sept. 2	16	1,001	506	50.5
1944	Sooke	July 3	Sept. 7	20	537	246	45.8
	(Oval tags)	July 3	Sept. 5	19	526	235	44.7
1945	Sooke	May 10	Sept. 13	33	882	326	37.0
	(Oval tags)	May 10	Aug. 2	21	543	238	43.8
1946	Sooke	June 6	Sept. 23	35	3,902	1,484	38.0
1947	Sooke	July 10	Sept. 15	25	3,294	1,256	38.1
1948	Sooke	June 30	July 6	3	433	156	36.0
Total					33,334	17,219	51.7

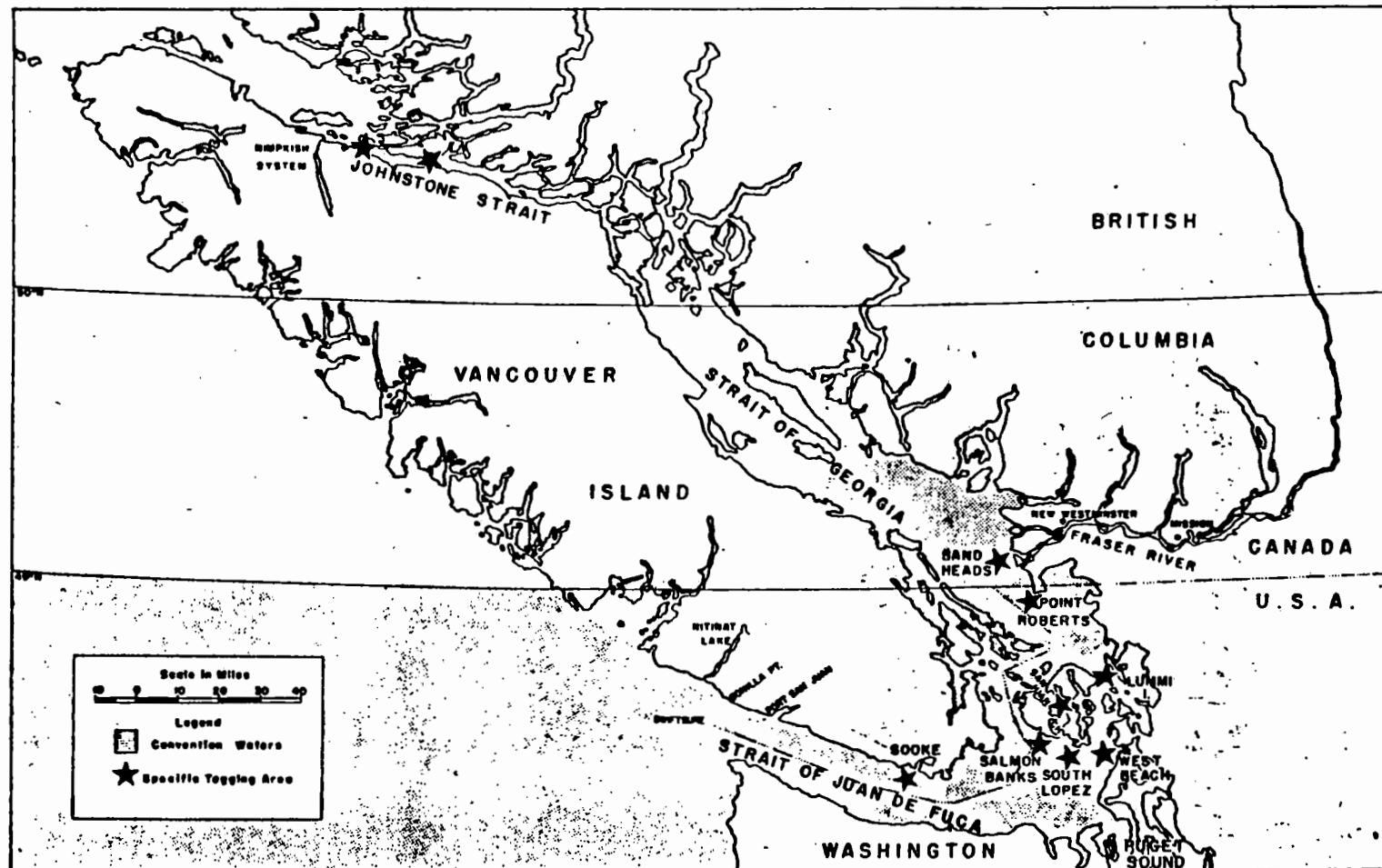


FIGURE 1—Convention waters and tagging areas.

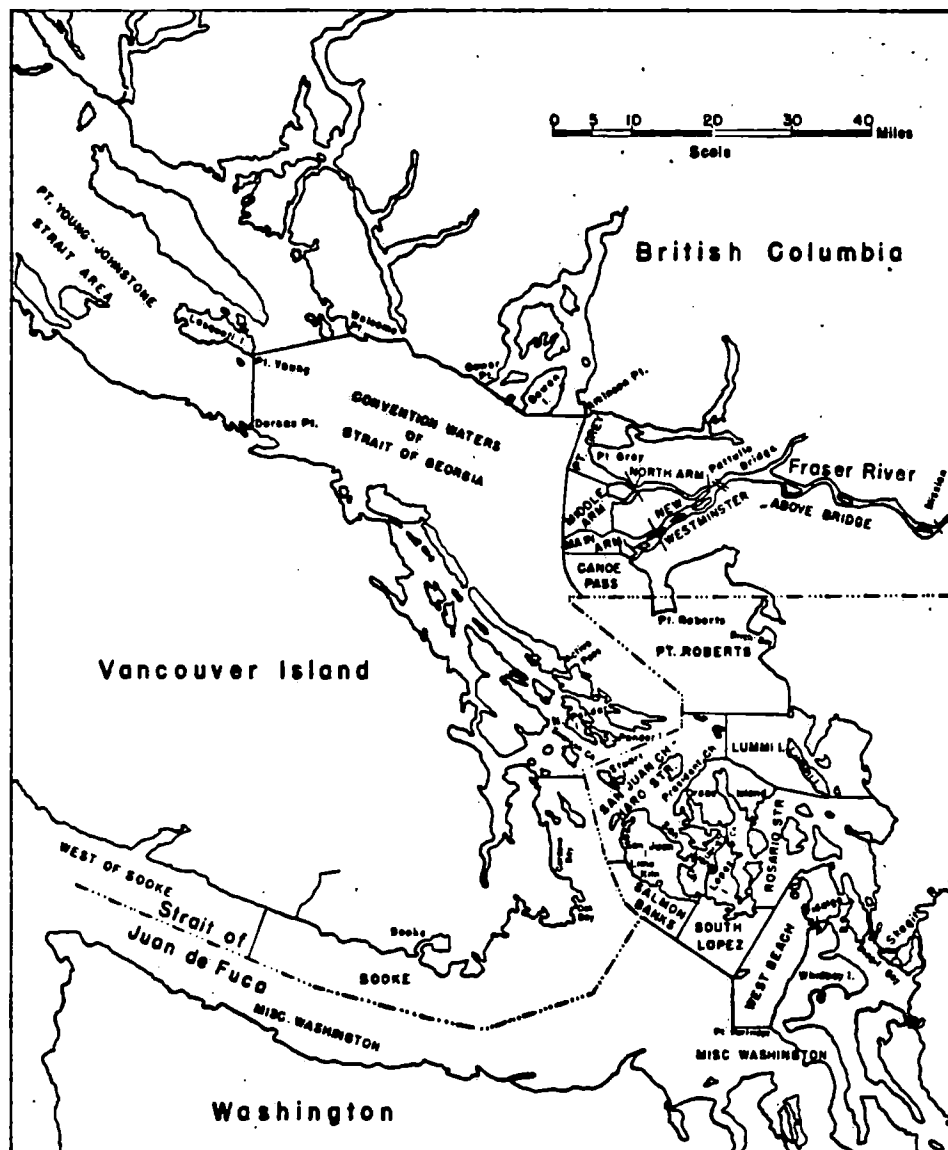


FIGURE 2—Recovery areas. Miscellaneous Washington area includes: off west coast of Washington, Swiftsure Bank, Strait of Juan de Fuca, Hoods Canal, inner Puget Sound, and Washington streams. See FIGURE 5 for detailed map of Point Young-Johnstone Strait area.

TABLE 2—Percentage distribution of recovered tags by recovery area for each tagging area, all years combined.

RECOVERY AREA	TAGGING AREA								
	Sooke	Salmon Banks	San Juan Channel	South Lopez	West Beach	Lummi Island	Point Roberts	Sand Heads	Johnstone Strait
United States									
Salmon Banks	5.7	9.5	7.4	5.0	1.9	1.7	....	*	*
South Lopez	1.5	1.8	2.9	2.1	5.8	1.0	....	....	....
West Beach	2.2	3.0	2.9	2.7	....	1.0	....	....	....
Rosario Strait	1.5	0.7	....	1.9	....	0.4	....	....	....
Lummi Island	2.4	3.6	2.5	2.7	1.9	3.0	....	*	*
San Juan Channel-Haro Strait	0.8	3.3	5.9	1.6	1.0	0.6	....	....	....
Point Roberts	10.6	12.3	23.0	14.5	10.6	16.1	7.1	2.2	0.5
Miscellaneous Washington	5.0	0.3	....	....	1.0	0.1	....	....	....
Unknown United States	2.3	3.0	2.9	1.8	1.9	1.9	....	0.1	*
All United States Areas	32.1	37.6	47.5	32.4	24.0	25.9	7.1	2.4	0.6
Canada									
West of Sooke	2.1	....	....	....	....	....	....	....	....
Sooke	2.3	0.2	....	0.2	....	0.1	....	....	....
Convention Waters of Georgia Strait	6.6	10.2	11.8	12.7	3.8	10.8	9.2	13.7	5.4
Fraser Estuary and River									
Canoe Pass	4.8	6.3	2.9	6.6	11.5	7.9	5.0	5.7	2.4
Main Arm	13.1	12.6	11.3	14.2	20.2	19.7	27.0	19.7	16.0
Middle Arm	1.4	3.3	2.5	3.5	2.9	4.1	7.8	2.6	6.9
Point Grey	1.8	5.7	5.9	6.8	1.9	5.8	9.9	3.1	9.7
North Arm	1.2	1.8	0.5	1.4	1.9	2.7	4.3	1.4	4.0
New Westminster	8.7	5.2	5.4	5.6	11.5	7.0	7.8	8.9	5.3
Above Bridge	7.5	8.6	8.3	7.7	13.5	7.2	15.6	12.7	5.8
Above Commercial Fishery	10.8	3.8	2.0	5.9	6.7	6.0	4.3	14.6	3.9
Spawning Grounds	5.1	3.5	0.5	2.6	1.0	2.2	0.7	14.0	1.5
Pt. Young-Johnstone Strait	0.7	0.2	....	....	....	....	....	....	**37.9
Unknown Canada	1.9	1.1	1.5	0.5	1.0	0.1	1.4	1.1	0.5
All Canadian Areas	67.9	62.4	52.5	67.6	76.0	74.1	92.9	97.6	99.4

*Indicates area in which 1 or 2 tags were recovered and were too small a percentage of the total recoveries to list in the table.

**The 37.9 per cent were distributed as follows in the subdivisions of the Point Young-Johnstone Strait area: Upper Johnstone Strait 25.4%, Lower Johnstone Strait 11.5%, Non-Convention Waters of Georgia Strait 1.0%.

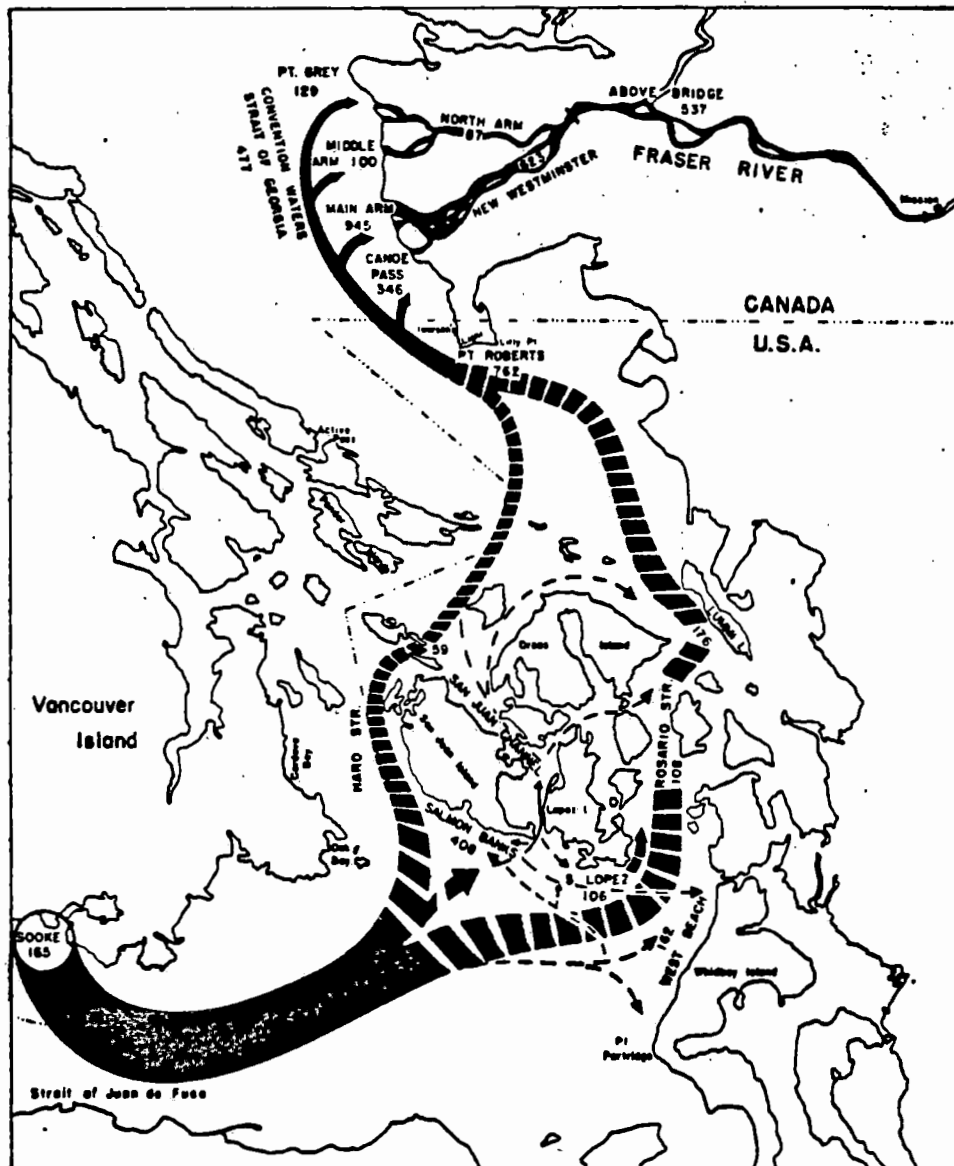


FIGURE 4—Routes of migration of Fraser River sockeye as indicated by tagging at Sooke, 1938-1948, and by information from tagging in other areas. The number of Sooke tags recovered in each area are shown. Broken portions indicate that the relative importance of the routes could not be determined precisely.

LATE-RACE YEARS
COMBINED 1938, 1939, 1942 AND 1943

EARLY-RACE YEARS
COMBINED 1940, 1941, 1944 AND 1945

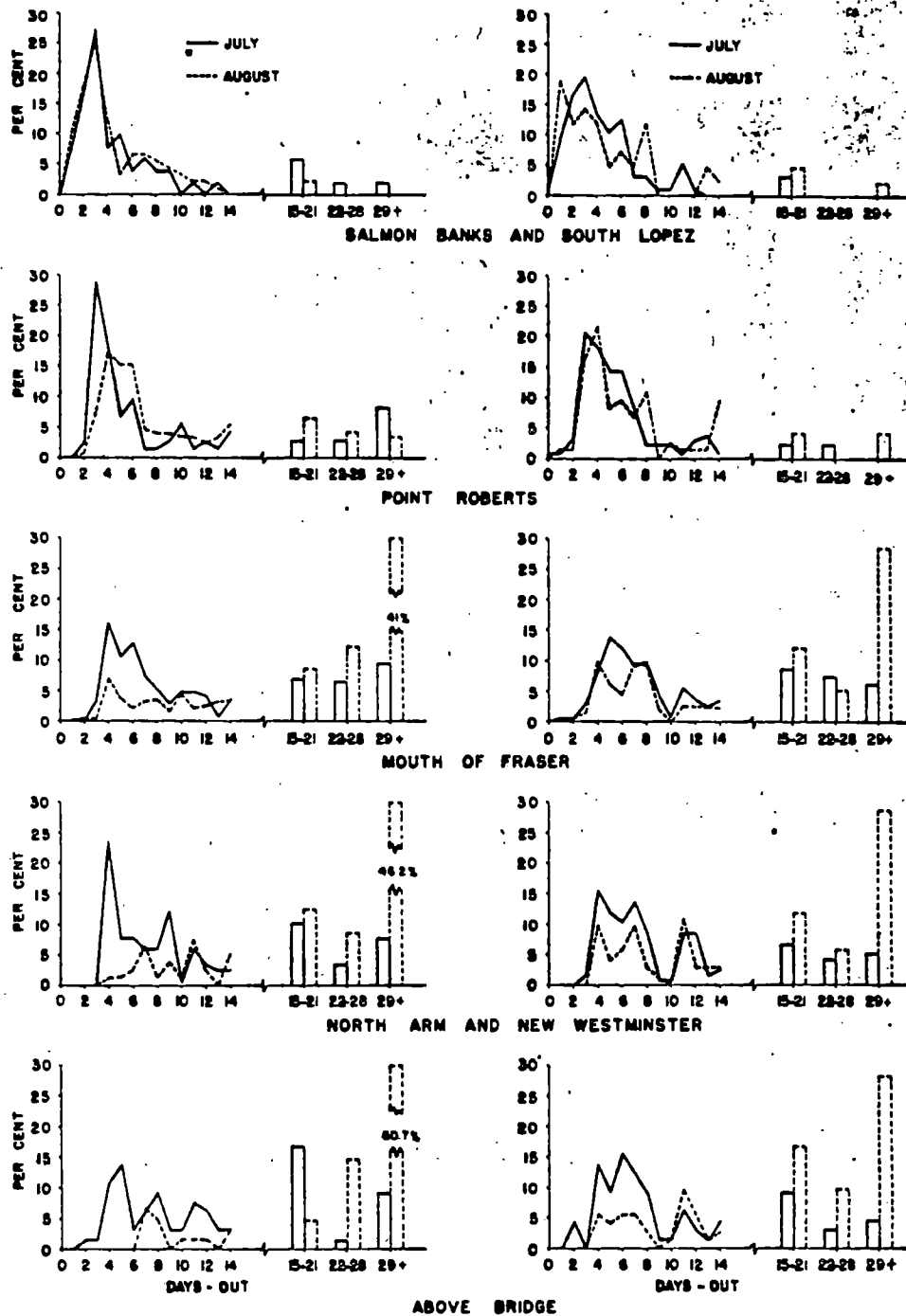


FIGURE 6—Sooke tagged sockeye. Percentage frequency distribution by days-out of July and of August tagged sockeye recovered in specific areas during 1938, 1939, 1942 and 1943 combined and 1940, 1941, 1944 and 1945 combined.

TABLE 26—Summary of the most likely migration times of marine-tagged sockeye in terms of days-out to certain recovery areas in the commercial fisheries.

RECOVERY AREA	DISTANCE IN STATUTE LAND MILES FROM		TAGGING AREA AND YEAR				
	Sooke ¹ to	Johnstone ² Strait to	Sooke	Salmon Banks	Lummi Island	Sand Heads	Johnstone Strait
			1938-1947	1939-1941	1939-1941	1938, 1939, 1941	1940-1941
Salmon Banks and South Lopez	38.0	.....	2	----	---	---	—
Point Roberts	87.5	.....	3-4	2-3	2	---	—
Mouth of Fraser	104.1	186.1	4-5	3-7	3-6	2-3	8
North Arm and New Westminster	119.7	201.7	4-7	6-10	3-6	2-7	9
Above Bridge	138.2	220.2	4-11	7+	6-13	3-7	12

¹Measured from Sooke Inlet to: Salmon Banks (Cattle Point), Point Roberts (Point Roberts Light), Mouth of Fraser (2½ miles upstream from Steveston Jetty Light), North Arm-New Westminster (St. Mungo Cannery), and Above Bridge (Port Haney).

²Measured from Robson Bight.

SUMMARY

1. The International Pacific Salmon Fisheries Commission inaugurated a program of tagging sockeye salmon in salt water for purposes of gaining information, which would be useful in the management of the fishery for Fraser River sockeye, such as: routes of migration, rates of migration, times of passage of different races, fishing intensity, and the effects of closed periods and other regulations on fishing intensity.

2. During the years 1938 to 1948, a total of 33,334 sockeye were tagged primarily with disk tags, but 1,438 oval tags were included. Of the number tagged, 17,219 or 51.7 per cent were recovered. Most of the recoveries occurred in the commercial fisheries but substantial numbers of tagged sockeye were also recovered from the Indian fisheries above the limits of commercial fishing and by the Salmon Commission's staff on the spawning grounds. The tagging and recovery methods and also the recovery problems were described.

3. The major tagging effort was in the Sooke area, where sockeye were tagged from traps, primarily on Mondays and Thursdays, during the years 1938 to 1948. Other tagging areas in decreasing order of numbers tagged during various years from 1938 through 1941 were: Sand Heads, Johnstone Strait, Salmon Banks, Lummi Island, South Lopez, San Juan Channel, Point Roberts and West Beach. Tagging in these other areas was done from purse seines except at Lummi Island where most of the fish were tagged from reef nets.

4. The recoveries of sockeye tagged at Sooke indicated that the principal route of migration from Sooke to the Fraser River was through United States Convention waters via Salmon Banks, South Lopez, Rosario Strait, Lummi Island, and Point Roberts. Near Point Roberts in the Strait of Georgia the sockeye re-entered Canadian Convention waters and proceeded to enter the Fraser River, principally via its Main Arm. The routes of lesser importance differed from the principal route in that the sockeye using them approached the Strait of Georgia via Haro Strait or San Juan Channel instead of Rosario Strait. The experiments were not adequate for purposes of establishing the precise relative importance of the various routes or their annual or seasonal variations in importance.

5. The recoveries of sockeye tagged at Salmon Banks, South Lopez, San Juan Channel and Lummi Island indicated a route of migration which was consistent with the principal route used by those tagged at Sooke. However the Salmon Banks tagging indicated that Haro Strait was a slightly more important approach to the Strait of Georgia than was indicated by the Sooke tagging. Catch information indicated that the importance of Haro Strait varied from year to year and also during the season.

6. The recoveries of sockeye tagged in Johnstone Strait indicated a direct movement toward the Fraser River and a greater use of the northern entrances to the river than had been exhibited by the Sooke-tagged sockeye.

7. The Sand Heads tagging confirmed the concept that late-season races of sockeye delay entry into the river and that occasionally large numbers of these sockeye drop back into the Point Roberts area, particularly after September 1. Examination of wind, tide and catch data indicated that abundance and position of delaying sockeye are important factors contributing to dropping back to the Point Roberts area and that northwest winds and strong ebb tides may expedite this regression.

8. In general, regardless of area of tagging, very little retrograde movement or migration in a direction away from the Fraser River was indicated.

9. The rates of migration of Fraser River sockeye obtained from tagging by other investigators and also the effects of tagging and of other problems on the estimation of rates were discussed. The extent of the injurious effects of tagging could not be determined, however, this did not appear to be sufficiently serious during the Salmon Commission's experiments to prevent estimation of rates of migration provided the rates were derived from modal rather than arithmetic mean or median values. The modal values were selected as the best measures of common tendency, since the modes tended to ignore data that might have been derived from injured or unusual fish or that might have been affected by other sources of error. Migration time or days-out between tagging and recovery was selected as a practical means of expressing rate of migration, and modal-migration times from various tagging areas to certain recovery areas were listed.

10. The migration times derived from tagging at Sooke indicated a lack of seasonal or annual variations in migration times from Sooke to Salmon Banks, but the existence of possibly significant seasonal and of significant annual variations in migration times from Sooke to Point Roberts. The variations appeared to be the result of differences in delay behavior between early and late-season races of sockeye. This delay behavior occurred near the mouth of the Fraser River beginning in August and resulted in significant variations in migration times as measured by days-out from Sooke to the Mouth of Fraser area both seasonally and annually.

11. The tagging at Sand Heads indicated: (a) that some sockeye, principally those present in September, delayed a minimum of 19 to 34 days; (b) that the regression of sockeye from the mouth of the river to the Point Roberts area occurred primarily in September; (c) that once the sockeye entered the river they were either rapidly caught or they quickly escaped upstream past the limits of commercial fishing.

12. Sockeye tagged in Johnstone Strait on Thursday appeared to receive more protection from the week-end closure in that area than did those tagged there on other days of the week and they arrived off the Mouth of Fraser area in the shortest modal-migration time, 7 or 8 days-out.

13. Sockeye tagged in Johnstone Strait appeared to require 1 to 2 days more migration time to reach the Mouth of Fraser than did sockeye tagged at Sooke.

14. Times of passage of various races of Fraser River sockeye through the commercial fishery and at certain points within the Fraser River drainage were derived primarily from recoveries of marine-tagged and of freshwater-tagged sockeye, on or near specific spawning grounds. This information plus supplemental information from fin-marked fish and published data were discussed for individual races and groups of races.

15. Estimated times of passage at Sooke were derived for non-Fraser races of sockeye, such as: Somass, Nitinat, Skagit (Baker River) and Lake Washington (Issaquah Creek). These races passed through the fishing areas early in the season, primarily in advance of the Fraser River races.

16. Tagging was of value in supplying expected times of passage of individual races, although the times lacked precision. Factors which affected the precision were discussed.

17. Estimates of the numerical size of annual Fraser River sockeye runs, which are stratified populations, were not obtained by tagging; since neither the tagging nor fishing for purposes of sampling the tagged populations was done in proportion to the abundance of sockeye. In addition there were no measures of tagging mortality, selectivity for tagged fish, or of recruitment by untagged fish via Johnstone Strait. A practical marine tagging program to estimate the annual sockeye populations would be extremely difficult to design and execute. Consequently, in recent years the annual populations and the abundance of individual races have been determined by compilation of catch statistics, enumeration of the spawning escapements, and analyses of scale samples.

18. Accurate and consistent estimates of fishing intensity were not obtained from the marine-tagging experiments because: The amounts of natural and tagging mortality were unknown. The selectivity of nets for tagged fish could not be measured although experiments in which disk-tagged fish were compared with oval-tagged fish showed that selectivity existed. The effects of tagging on different days of the week could not be quantified although their existence was demonstrated.

The following information was extracted from reference no. 16 (Anon., 1963):

"Sockeye

"The timing of the sockeye salmon migration through the Johnstone Strait area will be of particular importance during 1963. This will be the year of the dominant Chilko River cycle and as indicated in Figure 6, the timing exhibited by the 1959 brood in Johnstone Strait coincided closely with that of the 1959 non-Fraser pink salmon. As shown by the figure, however, this stock was actually present in Johnstone Strait in real abundance in only one of the last three cycle years."

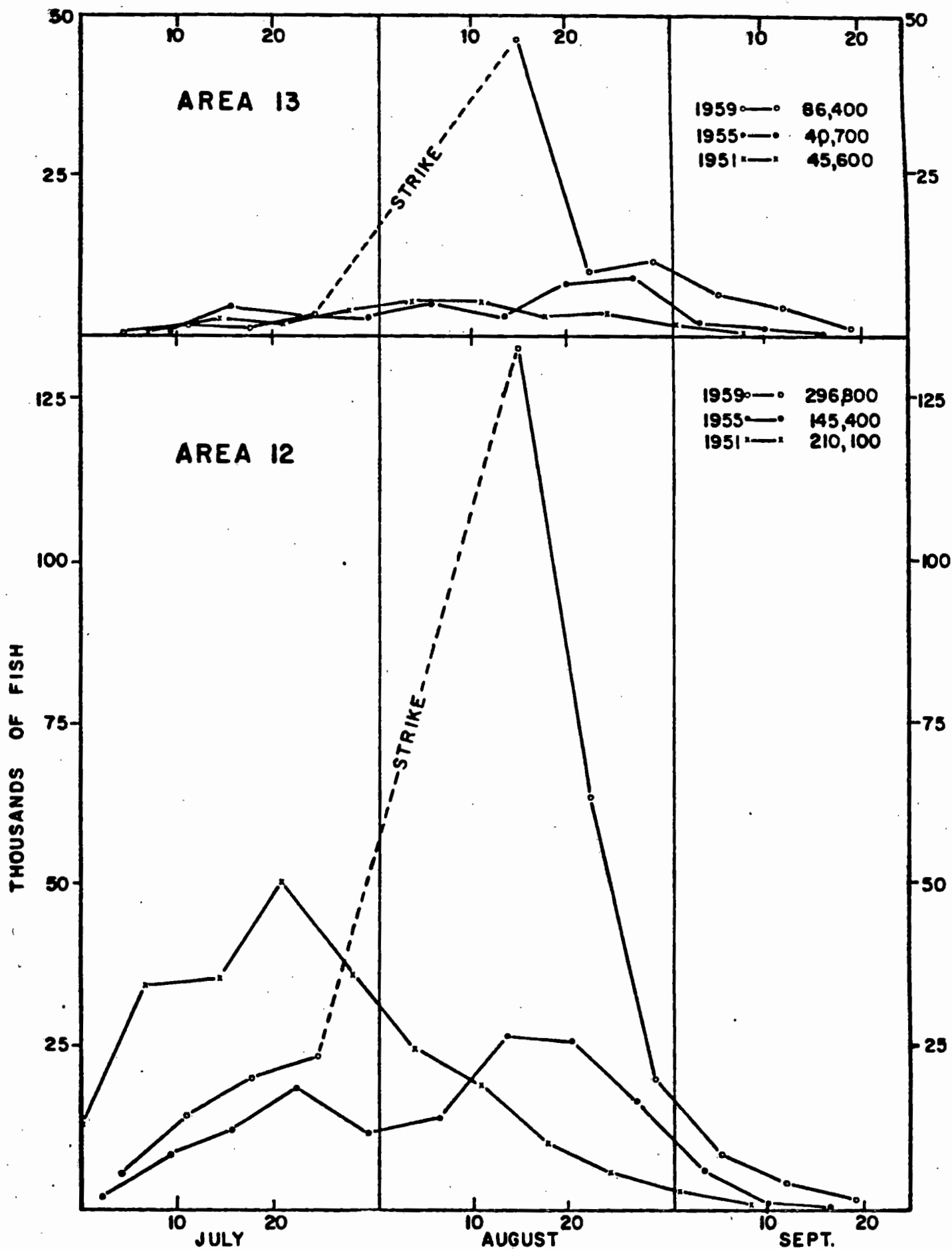


Figure 6. Weekly catches of sockeye salmon in Areas 12 & 13 in the years 1951, 1955, and 1959.

The following information was extracted from reference no. 56 (Killick and Clemens, 1963):

"The Adams River sockeye usually reach their peak numbers at Sooke about August 20. They delay in the Strait of Georgia for 15 to 20 days and then enter the Fraser River about September 15. The fish travel for 300 miles at a rate of approximately 17 miles per day and the peak of spawning occurs from October 15 to 20 (Killick, 1955)."

TABLE 1- The average expected duration and peak dates of passage of various Fraser River sockeye runs at the Sooke traps, based on scale analysis by Henry, (1961).

RACE	DURATION	PEAK OF ABUNDANCE
Early Stuart	June 18 to July 22	July 4
Bowron	July 2 to August 3	July 18
Pitt	July 5 to August 5	July 20
Quesnel (Horsefly)	July 15 to August 4	July 26
Chilko	July 8 to August 29	July 31
Late Stuart	July 16 to August 19	August 1
Stellako	July 16 to August 29	August 2
Birkenhead	July 18 to September 2	August 8
Harrison Rapids*	July 20 to August 31	August 11
Weaver	July 23 to September 3	August 14
Cultus	July 29 to September 10	August 19
Adams River	August 3 to September 10	August 20

* Limited information.

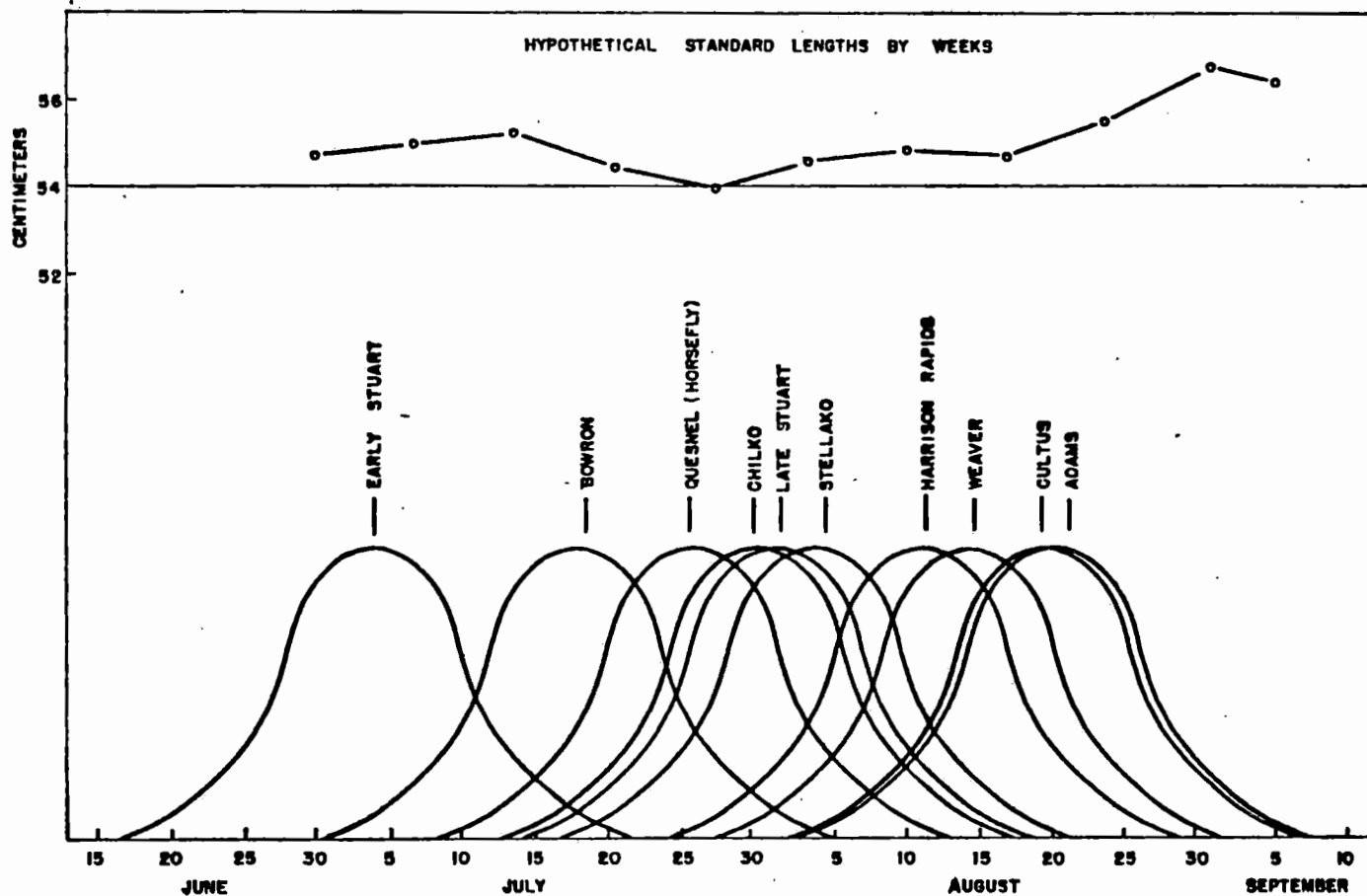


FIGURE 19—Best estimates of the average dates of passage at Sooke and the abundance curves of major Fraser River sockeye races showing the hypothetical weekly length measurement that would occur if each race were of equal numbers.

The following information was extracted from reference no. 71. The publication also contains information concerning pink salmon. This report is considered to be a key document in tag-recovery studies conducted in coastal waters of B. C. The publication presents two opposing points of view, one for each of the U. S. and Canadian researchers. The publication is based on the following documents:

REPORT OF THE COMMITTEE ON PROBLEMS OF MUTUAL CONCERN RELATED
TO THE CONSERVATION AND MANAGEMENT OF SALMON STOCKS IN
SOUTHEAST ALASKA AND NORTHERN BRITISH COLUMBIA

Formation of the Committee and terms of reference

At the "Second Conference on Co-ordination of Fisheries Regulations between Canada and the United States of America", held in Vancouver, B.C., from April 21 to 24, 1959, complete agreement could not be reached on the location of offshore salmon net fishing limits for Pacific salmon off the Pacific coast of Canada and the United States.

Canada expressed particular concern regarding the position of the offshore net fishing line off the State of Alaska. After an exchange of observations regarding the appropriateness of the offshore net fishing line and the management problems associated with the salmon fisheries of Southeast Alaska and northern British Columbia, the Conference adopted the following joint resolution:

"This Conference, recognizing the desirability of reaching an early solution of problems of mutual concern related to the conservation and management of salmon stocks in Southeast Alaska and Northern British Columbia which became apparent during the Second Conference on Co-ordination of Fisheries Regulations, recommends to the Governments of the United States and Canada, that a committee be established as soon as possible to consider these problems and subsequently recommend appropriate action to insure continued effective conservation of these stocks."

It was agreed that such a committee would be established at an early date with instructions to submit a report as quickly as possible.

Meetings of the Committee

Four meetings of this Committee have been held on the dates and at the places listed below:

First meeting: January 27, 1960, Ketchikan, Alaska

Second meeting: January 26, 1961, Prince Rupert, B. C.

Third meeting: April 25-26, 1962, Juneau, Alaska

Fourth meeting: June 4, 1963, Vancouver, B. C.

Summary of work done by the Committee

At the outset, the Committee decided that "problems of mutual concern" be considered to occur when fish destined for rivers of one country are caught by the fisheries of the other country. Each country then listed the statistical fishing areas of the other country where interception was indicated or considered possible. Both the United States and Canada reserved the right to add to their areas of concern in the future. It was agreed "that the first step of the Committee should be a full interchange of data and statistics for full study and to familiarize the respective sections with the fisheries in question.....

Three items were selected for interchange:

- (1) Information on the salmon fisheries of mutual concern, including descriptions of the gear used and amount, catch statistics, and statistical area charts.
- (2) Full information on salmon tagging.
- (3) Salmon fishing regulations."

Subsequently, the Committee agreed that exchange of interpretations of data would be carried out. Each country would include in its reports anything thought to be pertinent to the areas of concern. It was further agreed that a joint report would result, made up of separate interpretive reports which might or might not be endorsed in toto by both countries.

(a) Areas of concern

To this date the areas listed below have been designated as "areas of concern" by Canada and the United States. For easy reference a statistical map of Southeast Alaska and Northern British Columbia is provided (fig. 1). *

By Canada: Southeast Alaska statistical areas

No. 101-43, 101-45, 101-51, 101-52, 112-30, 113-30,
123-12, 123-23, 121, 144-40, 144-50, 154-81,
154-82, 164 and 173.

By United States: British Columbia statistical areas

No. 1, 2, 3, 4 and 5.

(b) Exchange of information

In all, 23 documents have been exchanged, together with copies of fishing regulations for areas of concern. These documents and their dates of submission to the Committee are listed in Appendix No. 1.

(c) Analysis and interpretation of information

Analysis of tag and recovery data obtained from tagging programs carried out in Southeast Alaska and Northern British Columbia in past years, and interpretation of the results have been submitted to the Committee by the Canadian and United States sections. These reports are appended (Appendices No. 2 and 3). They have provided the basis for the conclusions contained in this report.

* All references to Alaska statistical areas are based on 1957 boundaries.

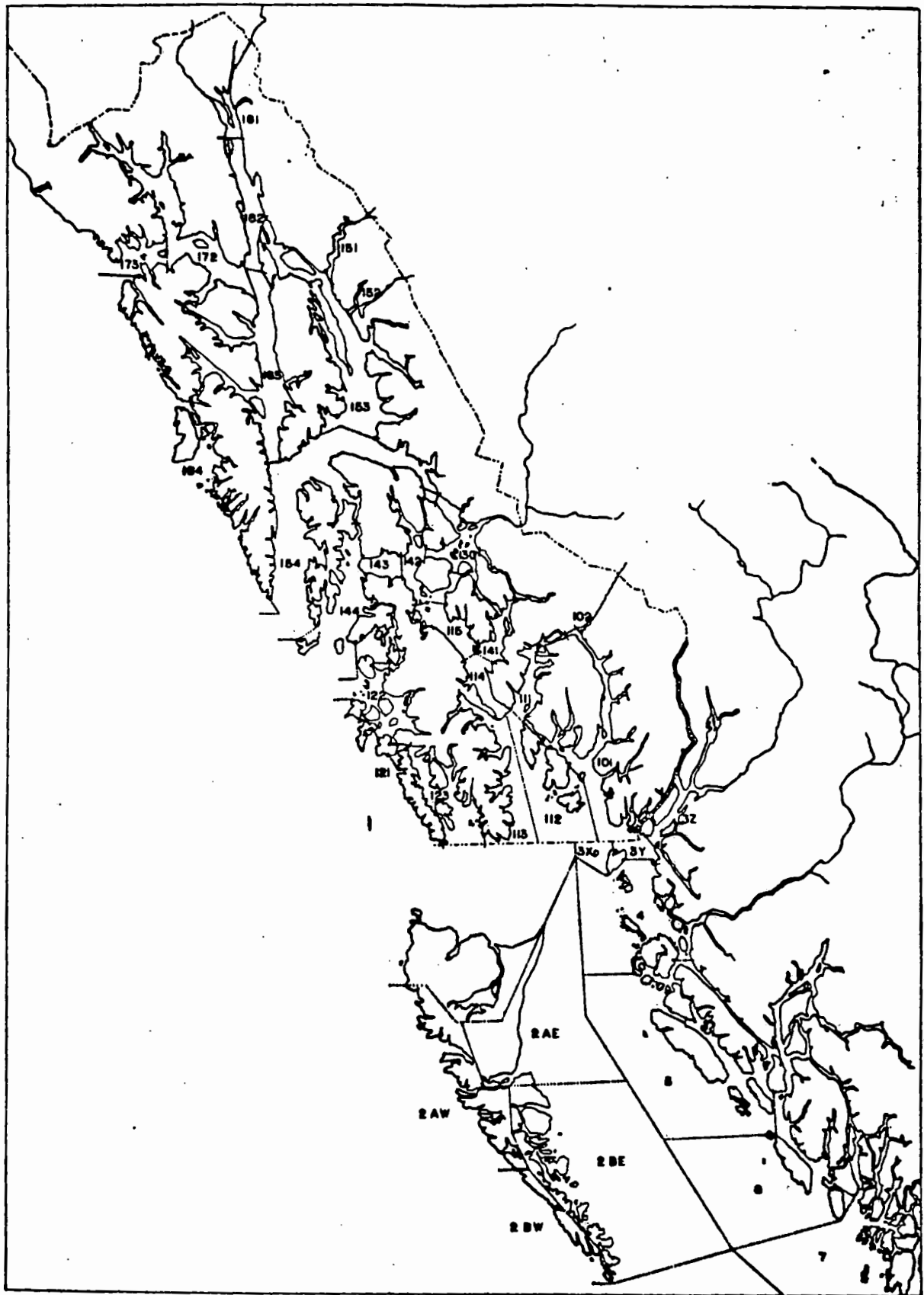


Fig. 1 Statistical areas in Southeastern Alaska and northern British Columbia.

Summary of results from the information and interpretations exchanged

(a) Areas of mixing of Alaska and British Columbia stocks and interception of salmon bound for one country by the fisheries of the other

Many thousands of salmon have been tagged in Northern British Columbia-Southeast Alaska areas since the first tagging experiments were conducted in 1924. The experiments have been concerned primarily with pink salmon, the most abundant species in the area, although major taggings of sockeye have also been carried out. A small number of the other three species also has been tagged.

Figures 2 and 3 show the sites of taggings of pinks and sockeye respectively and the approximate proportion of recoveries from British Columbia taggings made in Alaska, and of recoveries from Alaska taggings made in British Columbia.

These tagging programs provide the only factual data available but their application to assessing degree of mixing of Alaskan and British Columbian stocks is subject to many difficulties. One of the most serious is the variable tag and recovery effort in the fisheries and spawning areas of the two countries. Moreover, neither individual nor collective tagging experiments were designed to answer satisfactorily all of the questions on problems of mutual concern. Also, with the exception of the rather extensive programs in 1957 and 1958 (and in 1947 in Southeast Alaska only) experiments have been infrequent, of short duration, and incomplete with respect to area coverage.

Substantial recoveries of both pinks and sockeye were made in British Columbia from taggings in Southeast Alaska in the Cape Fox area in 1947 and near Noyes Island off the west coast of Prince of Wales Island in 1957 and 1958. Very few recoveries were made in Canada from taggings in other areas of Southeast Alaska. Taggings in and around Chatham Sound in British Columbia in 1957 and 1958 provided substantial numbers of pink salmon recoveries in Southeast Alaska but taggings in other Canadian areas resulted in only a few Alaskan recoveries.

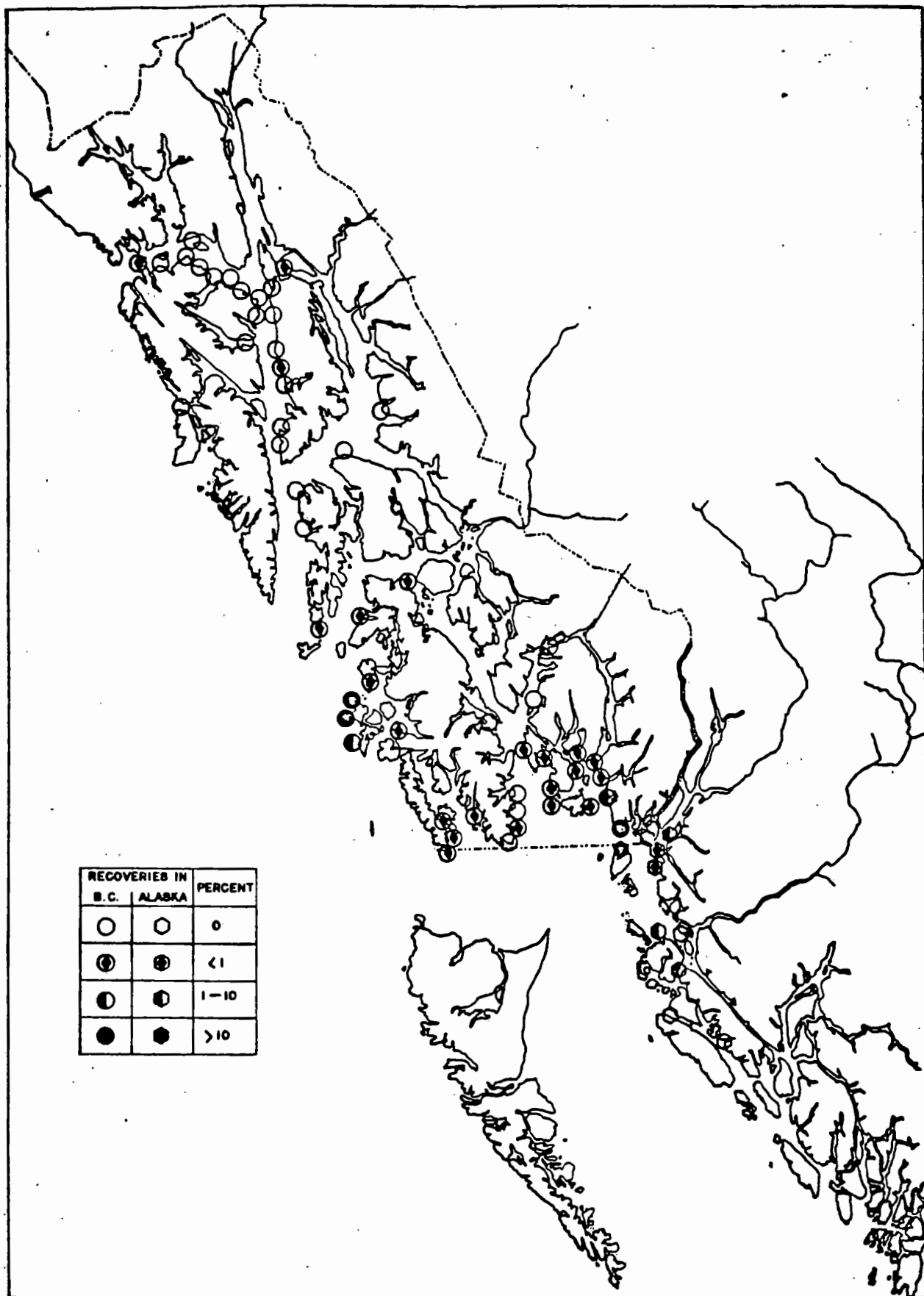


Figure 2 Pink salmon tagging sites in Southeastern Alaska and northern British Columbia, 1924-1958, indicating approximate proportions of recoveries from British Columbia taggings made in Alaska and of recoveries from Alaskan taggings made in British Columbia.

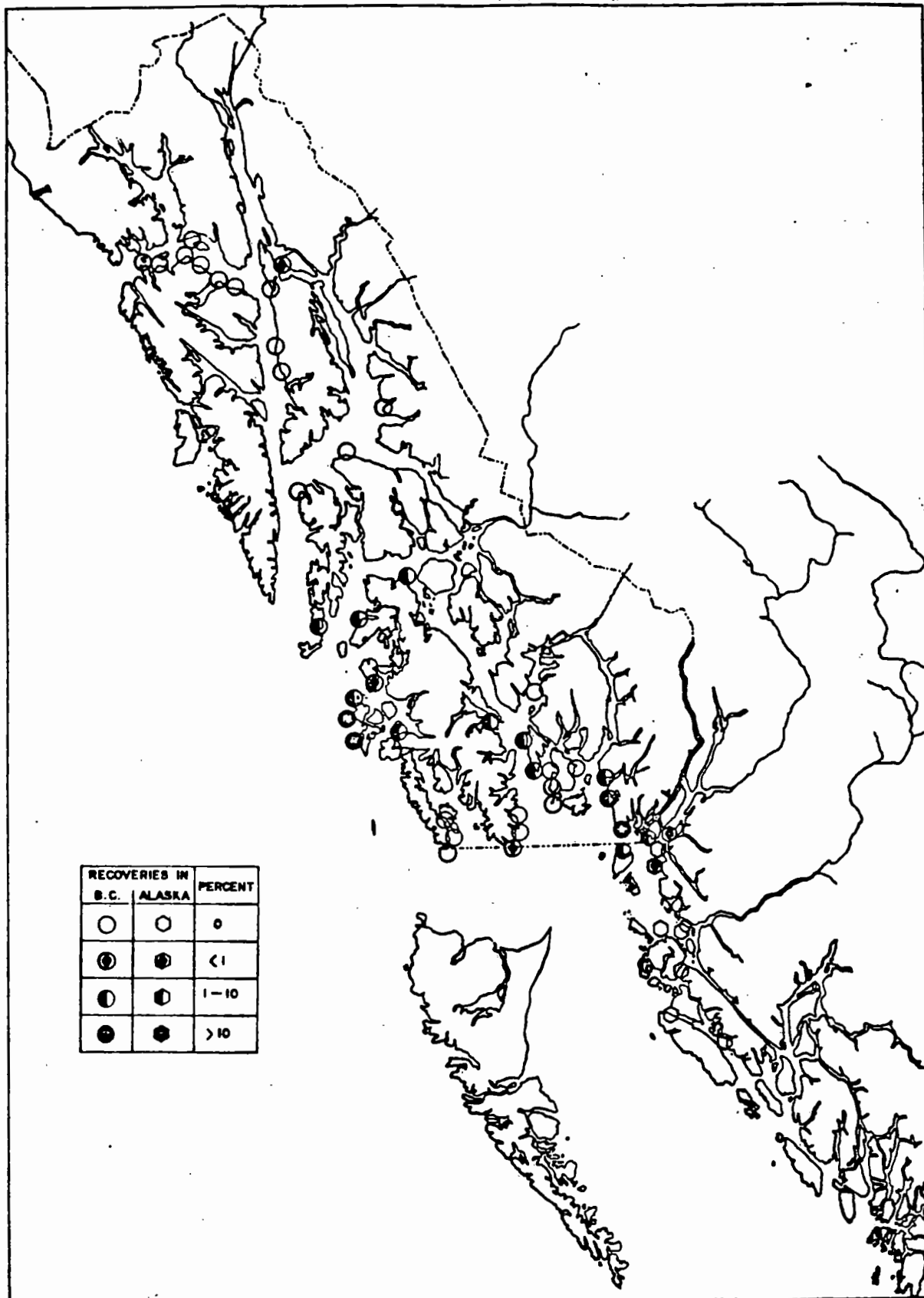


Figure 3. Sockeye salmon tagging sites in Southeastern Alaska and northern British Columbia, 1924-1958, indicating approximate proportions of recoveries from British Columbia taggings made in Alaska and of recoveries from Alaskan taggings made in British Columbia.

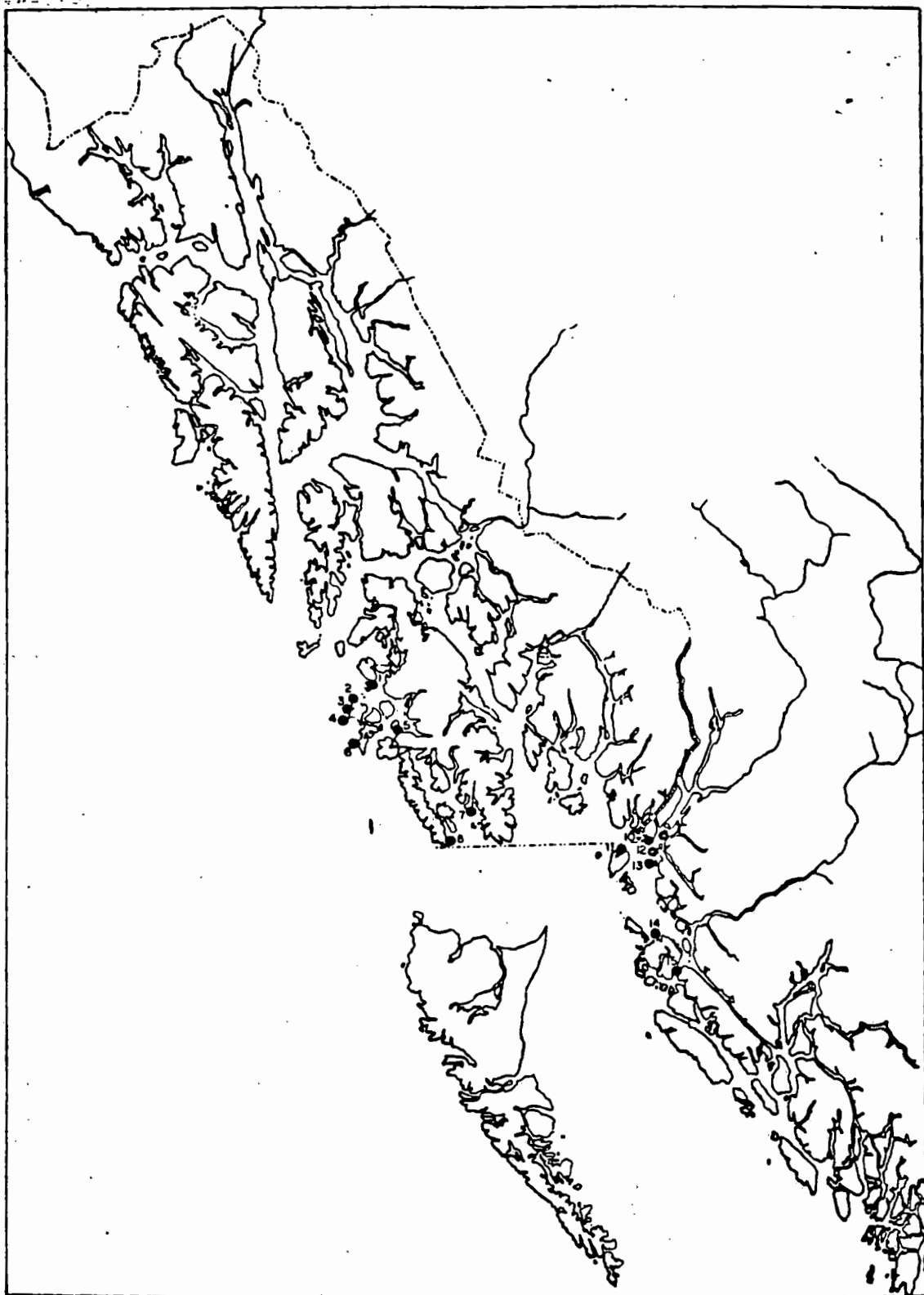


Fig. 4 Tagging areas for pink and sockeye salmon in Southeastern Alaska and northern British Columbia in 1957 and 1958.

- | | |
|----------------------|-----------------------------|
| 1. Point Desconocida | 9. Somerville Island |
| 2. Cape Ulitka | 10. Boston-Tracy Islands |
| 3. Roller Bay | 11. Dundas Island |
| 4. Cape Addington | 12. Birnie-Maskelyne Island |
| 5. Tranquil Point | 13. Finlayson Island |
| 6. Granite Point | 14. Southern Chatham Sound |
| 7. Ruth Bay | 15. Ogden Channel |
| 8. McLeod Bay | |

Table 1. Estimates of the interception of Alaska and British Columbia-bound pink salmon in 1957 and 1958.

Statistical Area	United States Report					Canadian Report				
	Catch	Estimated Number and Percent bound for				Catch	Estimated Number & Percent bound for			
		Alaska		British Columbia			Alaska		British Columbia	
		Number	Percent	Number	Percent		Number	Percent	Number	Percent
1957										
Alaska										
Area 121	2,818,143	1,114,471	39.5	1,703,672	60.5	2,818,143	826,043	29.3	1,992,100	70.7
122	318,117	318,117	100.0	0	0	318,121		m i x e d		
123	126,610	126,610	100.0	0	0	138,580	138,500	100.0	0	0
Totals	3,262,870	1,559,198	47.8	1,703,672	52.2	3,274,844	964,543+	29.5+	1,992,100+	60.8+
B. C.										
Area 3X	150,276	no estimate				150,276	1,787	1.2	148,489	98.8
3Y	424,531	4,538	1.1	419,993	98.9	424,585	3,271	0.8	421,314	99.2
3Z	126,227	no estimate				126,227		m i x e d		
4	2,341,525	0	0	2,341,525	100.0	2,341,525	0	0	2,341,525	100.0
5	126,265	0	0	126,265	100.0	126,265	0	0	126,265	100.0
Totals	3,168,824	4,538+	0.1+	2,887,783+	88.3+	3,168,878	5,058+	0.2+	3,037,593+	95.9+
1958										
Alaska										
Area 121	496,326	453,933	91.5	42,393	8.5	496,326	453,134	91.3	43,192	8.7
122	467,691	462,738	98.9	4,953	1.1	467,691	460,691	98.5	7,000	1.5
123	428,069	428,069	100.0	0	0	428,069	428,069	100.0	0	0
Totals	1,392,086	1,344,740	96.6	47,346	3.4	1,392,086	1,341,894	96.4	50,192	3.6
B. C.										
Area 3X	89,078	no estimate				89,078	46,249	51.9	42,829	48.1
3Y	205,939	112,364	54.6	93,575	45.4	205,939*	53,101*	51.6*	49,869*	48.4*
3Z	356,543	no estimate				386,543		m i x e d		
4	901,092	92,812	10.3	808,280	89.7	901,352	50,769	5.6	850,583	94.4
5	479,883	6,594	1.4	473,289	98.6	479,883	1,410	0.3	478,473	99.7
Totals	2,032,535	211,770+	10.4+	1,375,144+	67.7+	2,062,795	151,529+	7.3	1,421,754+	68.9+

*It was assumed that the catch was equally divided between the eastern and western halves of 3Y. The estimated number and percent bound for Alaska and B. C. are for the western half. The catch in the eastern half was considered to be 'mixed'.

Table II: Estimates of the interception of Alaska and British Columbia-bound sockeye salmon in 1957 and 1958.

Statistical Area	United States Report					Canadian Report				
	Catch	Estimated Number and Percent bound for				Catch	Estimated Number & Percent bound for			
		Alaska		British Columbia			Alaska		British Columbia	
		Number	Percent	Number	Percent		Number	Percent	Number	Percent
<u>1957</u>										
<u>Alaska</u>										
Area 121	233,650	95,326	40.8	138,324	59.2	233,650	74,150	31.7	159,500	68.3
122	21,370	21,370	100.0	0	0	21,374	21,374	100.0	0	0
123	10,296	10,296	100.0	0	0	10,296	10,296	100.0	0	0
Totals	265,316	126,992	47.9	138,324	52.1	265,320	84,446+	31.8+	159,500+	60.1+
<u>B. C.</u>										
Area 3X	15,031	no estimate				15,031	227	1.5	14,804	98.5
3Y	63,353	632	1.0	62,721	99.0	63,333	342	0.5	62,991	99.5
3Z		no estimate				64,881	0	0	64,881	100.0
4	282,181	0	0	282,181	100.0	282,209	0	0	282,209	100.0
5	26,562	0	0	26,562	100.0	26,562	0	0	26,562	100.0
Totals	452,008	632	0.1	371,464	82.2+	452,016	569	0.1	451,447	99.9
<u>1958</u>										
<u>Alaska</u>										
Area 121	55,553	39,119	70.4	16,434	29.6	55,553	35,562	64.0	19,991	36.0
122	15,149	15,149	100.0	0	0	15,121	14,779	97.7	342	2.3
123	28,869	28,869	100.0	0	0	28,867	28,867	100.0	0	0
Totals	99,571	83,137	83.5	16,434	16.5	99,541	79,208	79.6	20,333	20.4
<u>B. C.</u>										
Area 3X	33,022	no estimate				33,029	5,833	17.7	27,196	82.3
3Y	139,088	8,541	6.1	130,547	93.9	139,088*	12,594*	18.1*	56,950*	81.8*
3Z	226,607	no estimate				226,607	0	0	226,607	100.0
4	602,070	0	0	602,070	100.0	602,070	0	0	602,070	100.0
5	74,760	0	0	74,760	100.0	74,760	0	0	74,760	100.0
Totals	1,075,547	8,541	0.8	807,377	75.1+	1,075,554	18,427+	1.7+	987,583+	91.8+

*It was assumed that the catch was equally divided between the eastern and western halves of 3Y. The estimated number and percent bound for Alaska and B. C. are for the western half. The catch in the eastern half was considered to be 'mixed'.

Canadian section estimated that 53,000 Alaska-bound pinks were intercepted in the western half of sub-area 3Y and described the stock in the eastern half as mixed. The Canadian section estimated that 46,249 or 52 percent of the 89,078 fish taken in sub-area 3X were bound for Alaska waters while the catch of 386,543 pinks in sub-area 3Z was described as "mixed". Estimates of the degree of interception of Alaska-bound pinks in sub-areas 3X and 3Z were not made by the United States.

The total catches of pinks in British Columbia areas 4 and 5 were 901,352 and 479,883 respectively. Canadian and United States sections estimate that 50,769 and 92,812 fish or 6 percent and 10 percent of the area 4 catch was destined for Alaska and that 1,410 and 6,594 or 0.3 percent and 1.4 percent of the area 5 catch was destined for Alaska.

Sockeye salmon, 1957. Substantial interception of British Columbia-bound sockeye in Alaska areas off the west coast of Prince of Wales Island occurred in 1957. Of the total catch of 255,024 sockeye in Alaska areas 121 and 122, a minimum of 159,500 or 63 percent was estimated by the Canadian section to be fish bound for British Columbia. The United States section estimated that 138,324 or 54 percent of the catch of 255,024 was destined for British Columbia.

Both Canadian and United States estimates of the number of Alaska-bound sockeye taken in British Columbia in 1957 suggest an insignificant degree of interception occurred (less than 1 percent).

Sockeye salmon, 1958. Mixing of sockeye salmon of Alaska and British Columbia origin in 1958, as in 1957, was mostly confined to the waters closely adjacent to the International Boundary and to area 121 off the west coast of Prince of Wales Island. Although British Columbia-bound sockeye again formed a substantial proportion of the catch of 55,553 fish in area 121 (Canadian and United States estimates are 36 percent and 30 percent respectively), the number

involved was small. Interception of British Columbia-bound sockeye in area 122 was insignificant and no interception in area 123 was indicated.

Interception of Alaska-bound sockeye occurred in British Columbia area 3. United States and Canadian estimates indicate that 8,541 and 12,954 sockeye or 6 percent and 9 percent of the catch of 139,088 fish in sub-area 3Y were Alaska-bound. The Canadian section estimated that 5,833 fish or 18 percent of the sub-area 3X catch of 33,029 was destined for Alaska and that no interception of Alaska-bound fish occurred in sub-area 3Z. No estimate of the degree of interception in these sub-areas was made by the United States section.

No interception of Alaska-bound sockeye in British Columbia areas 4 and 5 was indicated.

Conclusions

(1) The mixing of salmon stocks of British Columbia and Alaska origin within the study area has been demonstrated.

(2) Interception of fish destined for the rivers of one country by the fisheries of the other has occurred.

(3) Mixing of British Columbia and Alaska sockeye and pink stocks has occurred within the fishing areas of British Columbia and Southeast Alaska from as far south of the International Boundary as British Columbia Statistical Area 5, to as far north of the International Boundary as Southeast Alaska Statistical Area 173.

(4) Areas in which substantial interception has been demonstrated are those on both sides of, and closely adjacent to, the International Boundary, and in the vicinity of Noyes Island off the west coast of Prince of Wales Island. Substantial agreement on the degree of interception of sockeye and pinks in 1957 and 1958 in these areas was shown in the United States and Canadian interpreta-

tions of the exchanged data.

(5) The 1957 pink runs in the areas under study were characterized by a strong southward movement past Noyes Island into British Columbia waters and a minor northward movement from northern British Columbia into Alaska waters. The Canadian and United States sections estimated that 1,992,000 and 1,704,000 respectively, or 71 percent and 61 percent, of the Alaska area 121 catch of 2,818,000 pinks were bound for British Columbia rivers. The degree of interception of Alaska-bound pinks in British Columbia was minor and relatively insignificant.

(6) The 1958 pink runs approached the study area from a more southerly direction than in 1957. Interception of British Columbia-bound pinks in Alaska was relatively much less - the Canadian and United States sections estimated that 50,000 and 47,000 respectively or 5 percent of the catch of 964,017 pinks in Alaska areas 121 and 122 was bound for British Columbia. Substantial numbers of Alaska-bound pinks were taken in British Columbia waters in 1958, particularly in British Columbia areas 3 and 4. The Canadian and United States sections estimated that a minimum of 152,000 and 212,000 respectively or 7 percent and 10 percent of the catch of 2,063,000 pinks in areas 3, 4 and 5 were bound for Alaska rivers.

(7) In both 1957 and 1958, sockeye runs approached the areas under study from a northerly direction. Substantial proportions of the 1957 and 1958 catch in Alaska area 121 were bound for British Columbia rivers. For 1957 the Canadian and United States sections estimated that 160,000 and 138,000 respectively or 68 percent and 59 percent of the area 121 catch of 234,000 sockeye were British Columbia-bound. For 1958 the Canadian and United States sections estimated that 20,000 and 16,000 respectively, or 36 percent and 30 percent of the area 121 catch of 56,000 were bound for British Columbia rivers.

In both 1957 and 1958 only minor proportions of the British Columbia sockeye catch within the study area were estimated to be Alaska-bound. For 1957 and 1958, the United States section estimated that a minimum of 600 and 8,500 sockeye respectively, or 0.1 percent and 0.8 percent of the combined catches made in British Columbia areas 3, 4 and 5, were Alaska-bound. For 1957 and 1958, the Canadian section estimated that 600 and a minimum of 18,400 sockeye respectively, or 0.1 percent and 1.7 percent of the combined catches made in British Columbia areas 3, 4 and 5, were Alaska-bound.

(8) None of the tagging programs carried out by either country has been designed specifically to answer questions on problems of mutual concern, and existing tagging data from programs designed for other purposes do not provide necessary data to indicate with precision either all of the locations or degrees of mixing of Alaska and British Columbia stocks. It should be emphasized that the calculations of Alaska-bound fish taken by Canadian fishermen and of Canada-bound fish taken by United States fishermen applied to 1957 and 1958 only. The results cannot necessarily be applied to other years because of possible year-to-year variations in migration routes, weather conditions affecting efficiency of fishing gear, and in the character of the fisheries. Further study of such factors is recommended.

APPENDIX NO. 1

List of documents submitted to the Committee by the United States and Canadian Sections.

United States documents and submission dates

1. Review of information of salmon migrations in southeastern Alaska February 1960.
2. Summary of the fishing regulations as were effective in 1957, 1958 and 1959 for the West Coast, Portland Canal, and Southern Clarence Strait sections. April 1960.
3. Southeastern Alaska salmon tagging experiments, 1924-1958. May 1960.
4. 1957, 1958 and 1959 salmon catches for Alaskan areas. July 1960.
5. Pink salmon tagging experiments in Icy Strait and upper Chatham Strait 1950. Fishery Bulletin 100. United States Fish and Wildlife Service. March 1961.
6. Duplicate IBM cards of tag recoveries from the taggings in the West Coast District in 1957 and 1958. Coding data and tabulations of numbers of fish tagged daily at each location. May 1961.
7. 1960 salmon catches for Alaskan areas. July 1961.
8. 10-year historical review of southeastern Alaska statistical areas 101, 112, 113, 121, 122 and 123 with respect to changes and conditions affecting the salmon fisheries, 1951-1960. December 1961.
9. Spawning ground information and fishing seasons for areas of mutual concern. Early 1962.
10. United States and Canadian exploitation of pink and sockeye salmon runs to northern British Columbia and southern Southeastern Alaska. January 1963.

11. 1961 salmon catches for areas of mutual concern. May 1963.
12. Tables on seasons, fishing time and gear, 1961, for Alaska's statistical areas 101, 112, 113, 114, 115, 121, 122, 123, 141, 143, 144-61 and 144-70. June 1963.
13. Table on annual catches of reds, pinks, and chum, 1957-62, inclusive, for areas 101, 112, 113, 121, 122 and 123. June 1963.

Canadian documents and submission dates

1. Documents on salmon taggings in northern British Columbia. March 1960
 - (a) Williamson, H. C. Pacific salmon migration: report on the tagging operations in 1925. Contrib. Canadian Biol. Fish., Vol. III, No. 9 (pp. 267, 278-297 only).
 - (b) Williamson, H. C. Pacific salmon migration: report on the tagging operations in 1926, with additional returns from the operation in 1925. Contrib. Canadian Biol. Fish., Vol. IV, No. 29 (pp. 455, 466, 467 only).
 - (c) Pritchard, A. L. Sockeye salmon tagging off the Skeena River in 1944. Fish. Res. Bd. Canada, Pacific Prog. Rept., No. 61, pp. 8-12.
 - (d) Pritchard, A. L. Sockeye salmon tagging off the Skeena River in 1945. Fish. Res. Bd. Canada, Pacific Prog. Rept., No. 65, pp. 77-79.
 - (e) Pritchard, A. L. Sockeye salmon tagging off the Skeena River in 1946. Fish. Res. Bd. Canada, Pacific Prog. Rept., No. 70, pp. 13-16.
 - (f) Pritchard, A. L. Sockeye salmon tagging off the Skeena River in 1947. Fish. Res. Bd. Canada, Pacific Prog. Rept., No. 75, pp. 40-42.
 - (g) Milne, D. J. Salmon tagging off the Skeena River in 1948. Fish. Res. Bd. Canada, Pacific Prog. Rept., No. 80, pp. 50-51.
 - (h) Aro, K. V. Chatham Sound salmon tagging, 1956. Manuscript.

- (1) Aro, K. V. Chatham Sound salmon tagging, 1957 and 1958. Manuscript.
2. First statistical compilation for joint committee on salmon management problems - northern British Columbia and southeastern Alaska.

Copy of British Columbia fishery regulations, amended extracts from regulations with particular reference to Areas 1, 3, 4, 5. Catch statistics, salmon narrative, regulatory measures for Areas 1, 3 (3X, 3Y, 3Z), 4, 5 - 1957 to 1959. April 1960.

3. Results of salmon tagging experiments in northern British Columbia - preliminary summaries. May 1960.
4. Recoveries of salmon tags in Area 3 from salmon tagging experiments in northern British Columbia. July 1960.
5. Duplicate IBM cards of tag recoveries from the taggings in and around Chatham Sound in 1956, 1957 and 1958. Coding data and tabulations of numbers of fish tagged daily at each location. April 1961.
6. Second statistical compilation for joint committee on salmon management problems - northern British Columbia and southeastern Alaska.

British Columbia.

- A. Ten-year historical review - Areas 1, 2, 3, 4, 5 - 1951 to 1960.
- B. Ten-year annual catch statistics - Areas 1, 2, 3, 4, 5 - 1951 to 1960.
- C. 1957, 1958, 1959 - catch statistics, salmon narrative, and regulatory measures - Areas 2A and 2B.
- 1960 - catch statistics, salmon narrative, and regulatory measures - Areas 1, 2, 3, 4, 5. August 1961.
7. Further information on the salmon tagging experiments in northern British Columbia - effectiveness of tag recoveries in British Columbia waters, 1956, 1957 and 1958. December 1961.

8. Spawning escapement data for British Columbia statistical areas 1 to 6 for the period 1951 - 1960. April 1962.
9. Exploitation by United States and Canadian fisheries on pink and sockeye salmon enroute to northern British Columbia and southern Southeast Alaska. August 1962.
10. Third statistical compilation for joint committee on salmon management problems - northern British Columbia and southeastern Alaska.
British Columbia.
 - A. Catch statistics - Areas 1, 2, 3, 4, 5 - 1961.
 - B. Summary of daily sockeye, pink, coho and chum catches in Nass (Area 3X, 3Y, 3Z), Skeena (Area 4), and Grenville-Prince (Area 5) - 1961. October 1962.

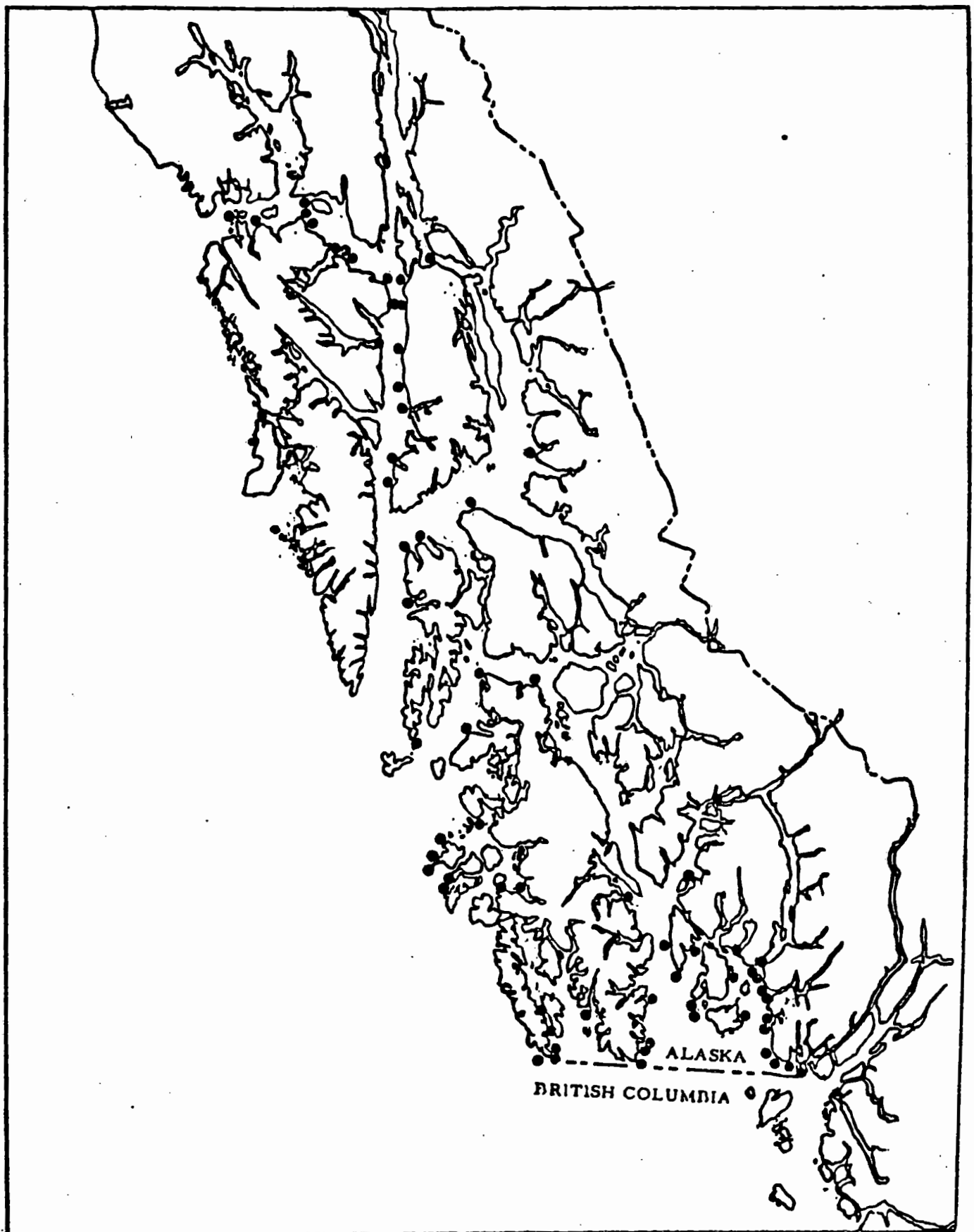


Figure 3. --Tagging sites in Southeastern Alaska, 1924-58.

Table 4. --Summary of sockeye salmon tagging experiments in southern Southeastern Alaska showing Alaska and British Columbia recoveries

Statistical area and inclusive dates of tagging	Number tagged	Number recovered		Percent recovered	
		Alaska	B. C.	Alaska	B. C.
101, Southern District					
Aug. 7-8, 1924 ^{1/}	38				
July 30-31, 1925 ^{1/}	45				
June 24-July 1, 1926	761	254	54	82.5	17.5
July 3-Aug. 8, 1930	109	22	6	78.6	21.4
1947	145	35	12	74.5	25.5
112, Southeast Clarence Strait					
Aug. 8, 1924 ^{1/}	8				
July 6-7, 1926	68	10	1	90.9	9.1
Aug. 5-6, 1927	11	6	0	100.	0
July 23-Sept. 7, 1947	182	84	1	98.8	1.2
113, Southwest Clarence Strait					
Aug. 8-13, 1925	121	36	1	97.3	2.7
Aug. 9, 1926	4	1	0	100.	0
July 29-Aug. 14, 1930	51	14	1	93.3	6.7
1947	39	15	0	100.	0
123, Cordova Bay					
Aug. 15, 1925	7	1	0	100.	0
Aug. 10, 1926	55	6	0	100.	0
July 31, 1958	91	32	0	100.	0
121, West Coast of Noyes, Baker, Suemez, and Dall Islands					
July 25-Aug. 11, 1957	501	105	96	52.2	47.8
July 9-Aug. 24, 1958	1,504	399	243	62.1	37.9
122, Northwest Prince of Wales Island					
July 22-Aug. 25, 1958	636	192	2	99.0	1.0

1/ Rich, Willis H. 1926. Salmon-tagging experiments in Alaska, 1924 and 1925. Bulletin of the U. S. Bureau of Fisheries, vol. 42, p. 109-146. (Rich did not indicate distribution of returns between these experiments which were 15 in Alaska and 5 in British Columbia.)

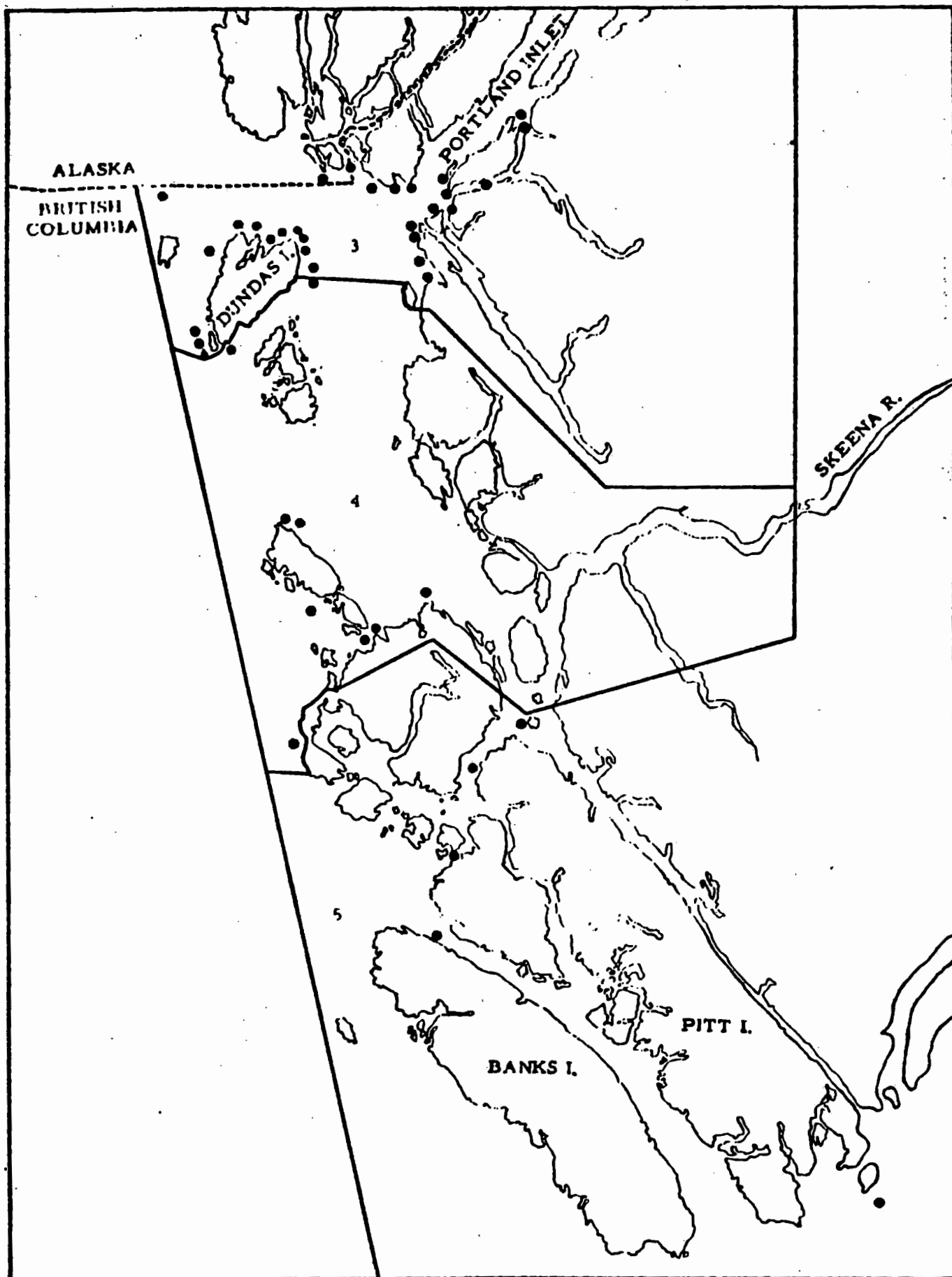


Figure 4.--Tagging sites in northern British Columbia, 1925-58.

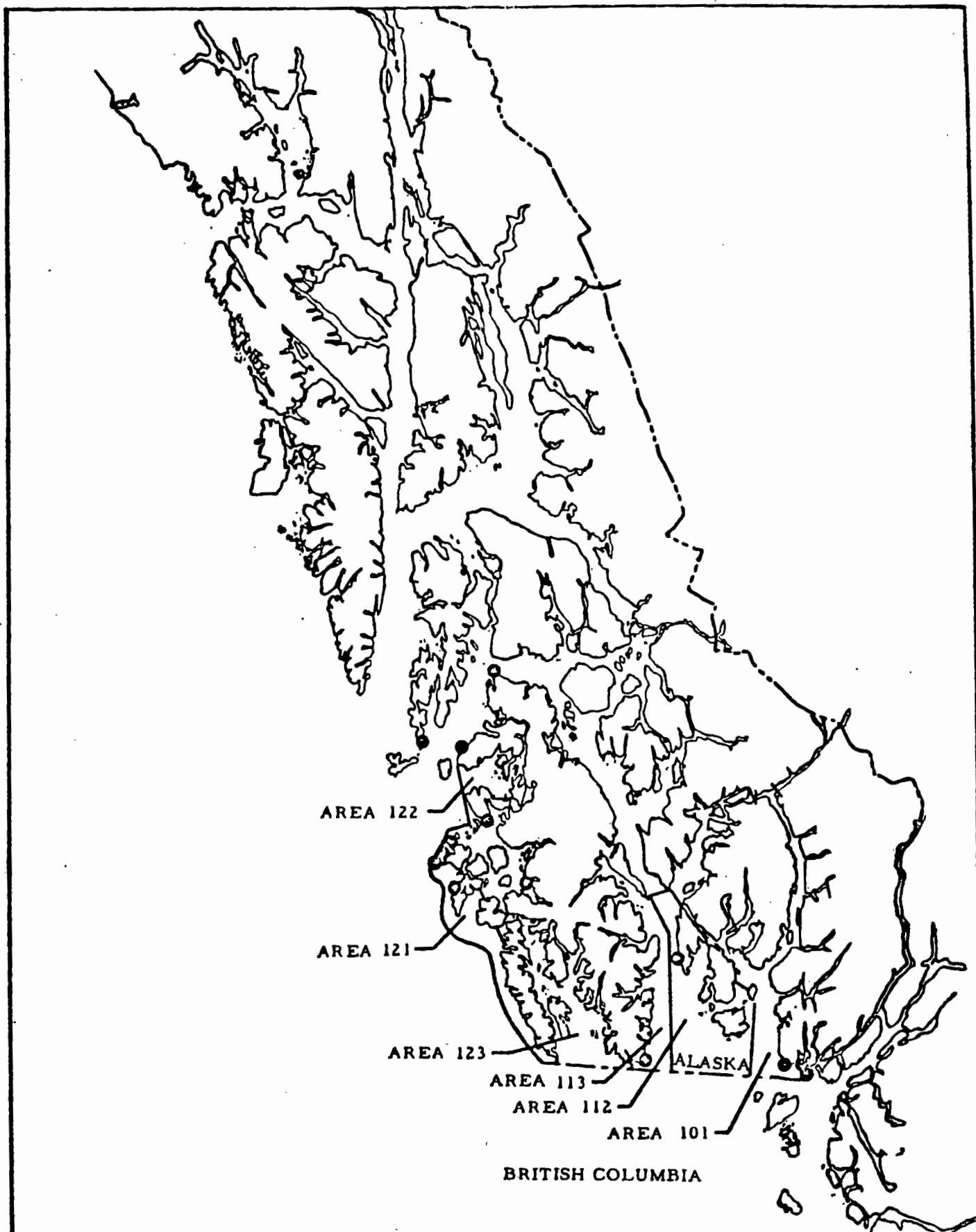


Figure 7.--Tagging sites in Southeastern Alaska yielding recoveries of sockeye salmon in British Columbia.

Table 5. --Summary of sockeye salmon tagging experiments in northern British Columbia showing Alaska and British Columbia recoveries

Statistical area and inclusive dates of tagging	Number tagged	Number recovered		Percent recovered	
		Alaska	B. C.	Alaska	B. C.
3					
Aug. 3-21, 1925	659	27	113	19.3	80.7
June 28-July 11, 1944	4	1	3	25.0	75.0
June 9-July 19, 1945	73	0	20		100.0
July 4-12, 1946	21	0	4		100.0
July 1-13, 1947	8	0	3		100.0
June 10-July 15, 1948	114	0	15		100.0
July 13-Aug. 1, 1956	92	1	53	1.8	98.2
June 5-Aug. 10, 1957	1,345	9	667	1.3	98.7
July 20-Aug. 10, 1958	388	16	223	6.7	93.3
4					
June 14-July 21, 1944	915	0	453		100
June 26-July 30, 1945	2,210	0	788		100
June 27-Aug. 28, 1946	2,164	0	1,123		100
June 15-July 27, 1947	2,356	0	1,196		100
June 11-July 18, 1948	2,348	0	859		100
July 18-July 20, 1956	27	0	15		100
June 15-Aug. 11, 1957	153	1	109	0.9	99.1
July 12-Aug. 11, 1958	253	0	156		100
5					
June 21-July 2, 1944	454	0	149		100
June 13-25, 1945	523	0	13		100
June 12-July 1, 1946	233	0	60		100
June 12-13, 1947	400	0	37		100
July 23-31, 1956	8	0	2		100
June 19-Aug. 21, 1957	36	0	17		100
July 12-Aug. 7, 1958	120	0	79		100

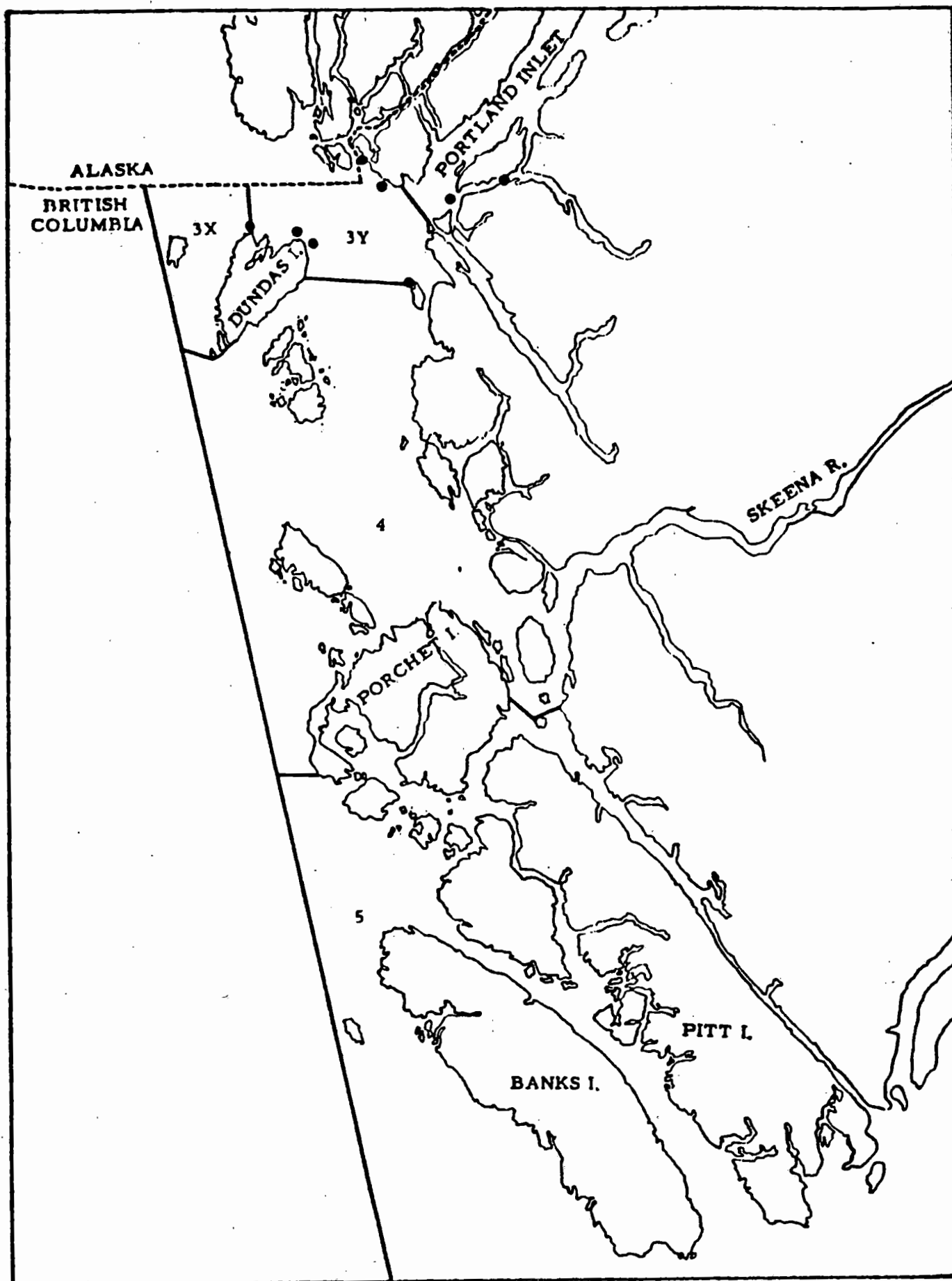


Figure 8.--Tagging sites in northern British Columbia yielding recoveries of sockeye salmon in Southeastern Alaska.

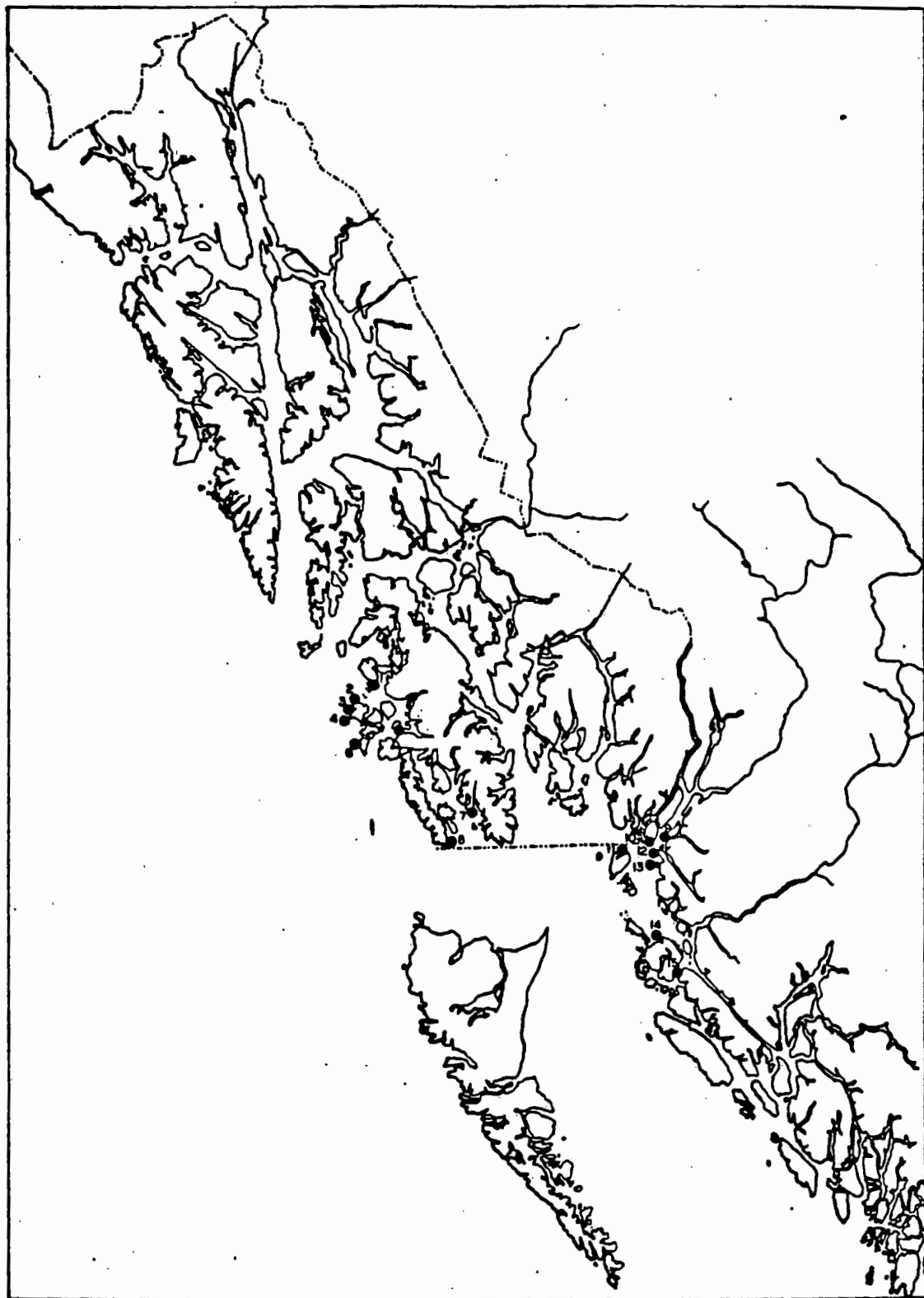


Fig. 6 Tagging areas for pink and sockeye salmon in Southeastern Alaska and northern British Columbia in 1957 and 1958.

- | | |
|----------------------|-----------------------------|
| 1. Point Desconocida | 9. Somerville Island |
| 2. Cape Ulitka | 10. Boston-Tracy Islands |
| 3. Roller Bay | 11. Dundas Island |
| 4. Cape Addington | 12. Birnie-Meskelyne Island |
| 5. Tranquil Point | 13. Finlayson Island |
| 6. Granite Point | 14. Southern Chatham Sound |
| 7. Ruth Bay | 15. Ogden Channel |
| 8. McLeod Bay | |

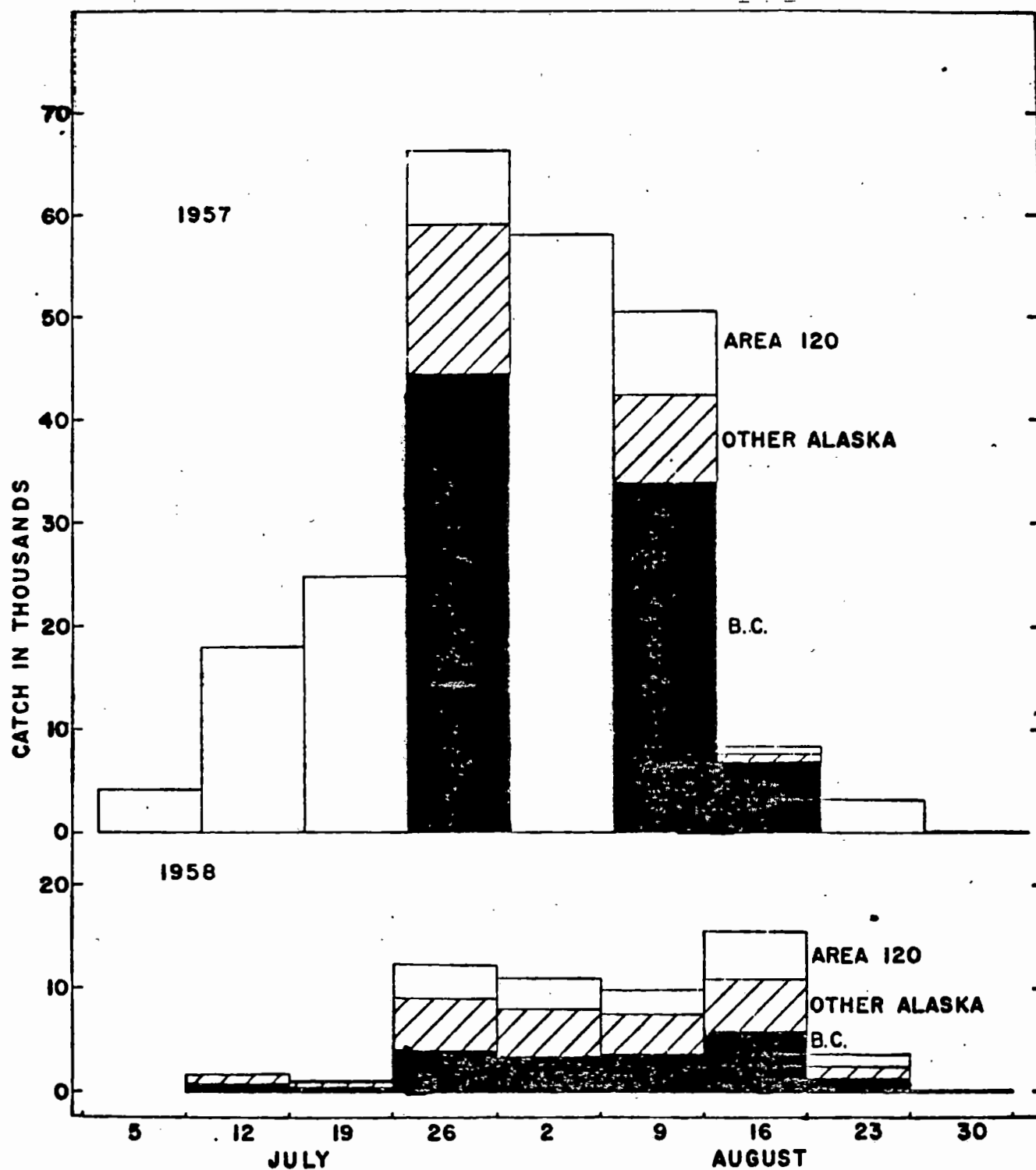


Fig. 18. Estimated numbers of sockeye salmon caught at Noyes Island bound for British Columbia, Alaska area 120 and other Alaskan areas in 1957 and 1958.

Table XI. Catches of sockeye salmon in various statistical areas in 1957
classified according to the likely destination of the fish.

Area	Destination			Total
	Mainly Alaska	Mainly British Columbia	Mixed	
<u>Alaska</u>		(thousands)		
122	-	-	21	21
121	74	159	-	233
123	11	-	-	11
113	22	-	-	22
112	-	-	48	48
101	-	-	66	66
90	-	-	-	0
91	-	-	-	0
Total	107	159	135	401
<u>British Columbia</u>				
1	-	-	1	1
2	-	6	-	6
3X	< 0.5	15	-	15
3Y	1	63	-	64
3Z	-	65	-	65
4	-	282	-	282
5	-	27	-	27
Total	1	458	1	460
Grand Total	108	617	136	861

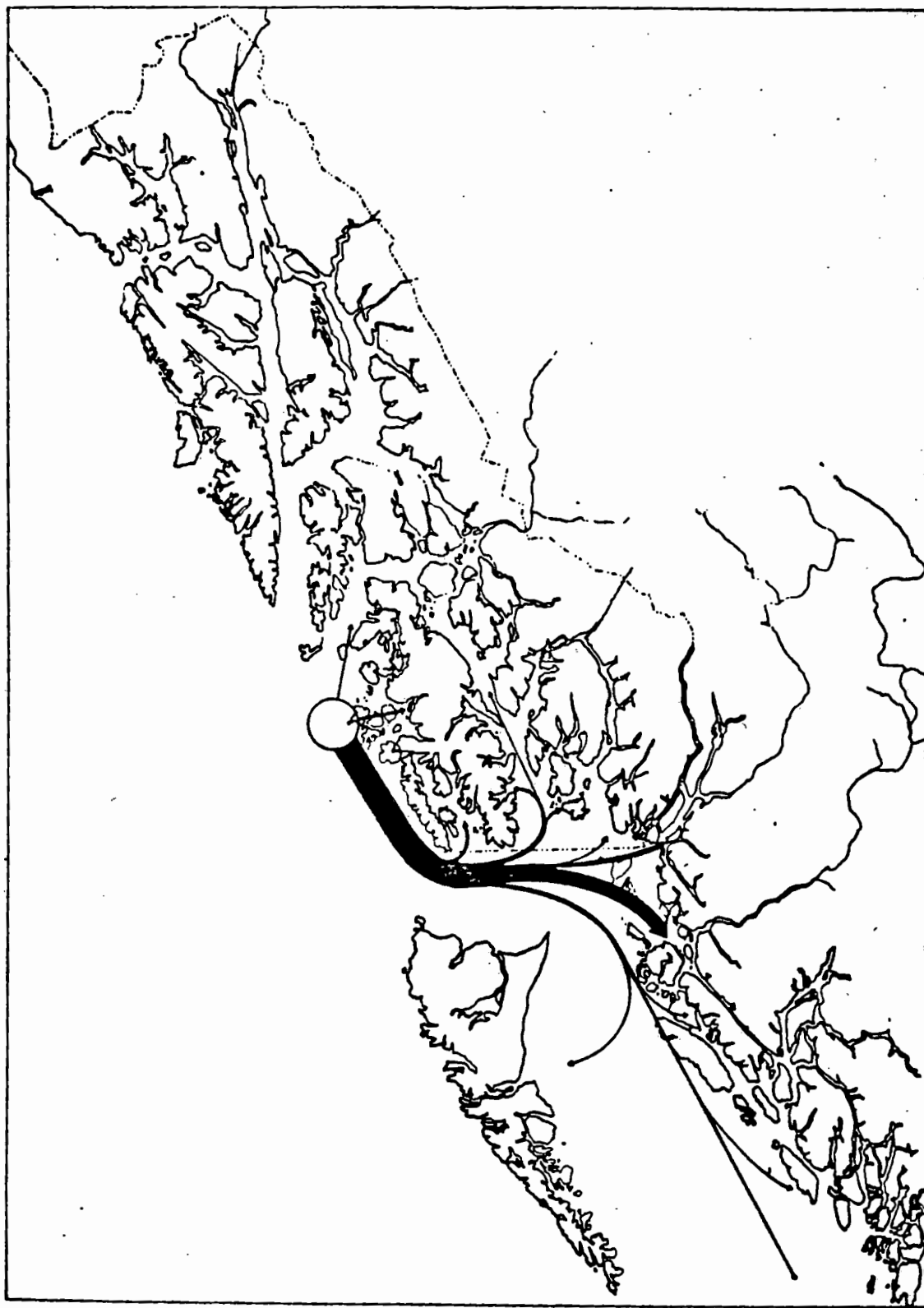


Fig. 15. Distribution of recoveries (outside the tagging area) of sockeye salmon tagged at Cape Addington in 1957. Widths of individual arrows indicate relative proportions of recoveries made in each area. Paths of various arrows do not necessarily indicate migration routes of sockeye recovered in each area.

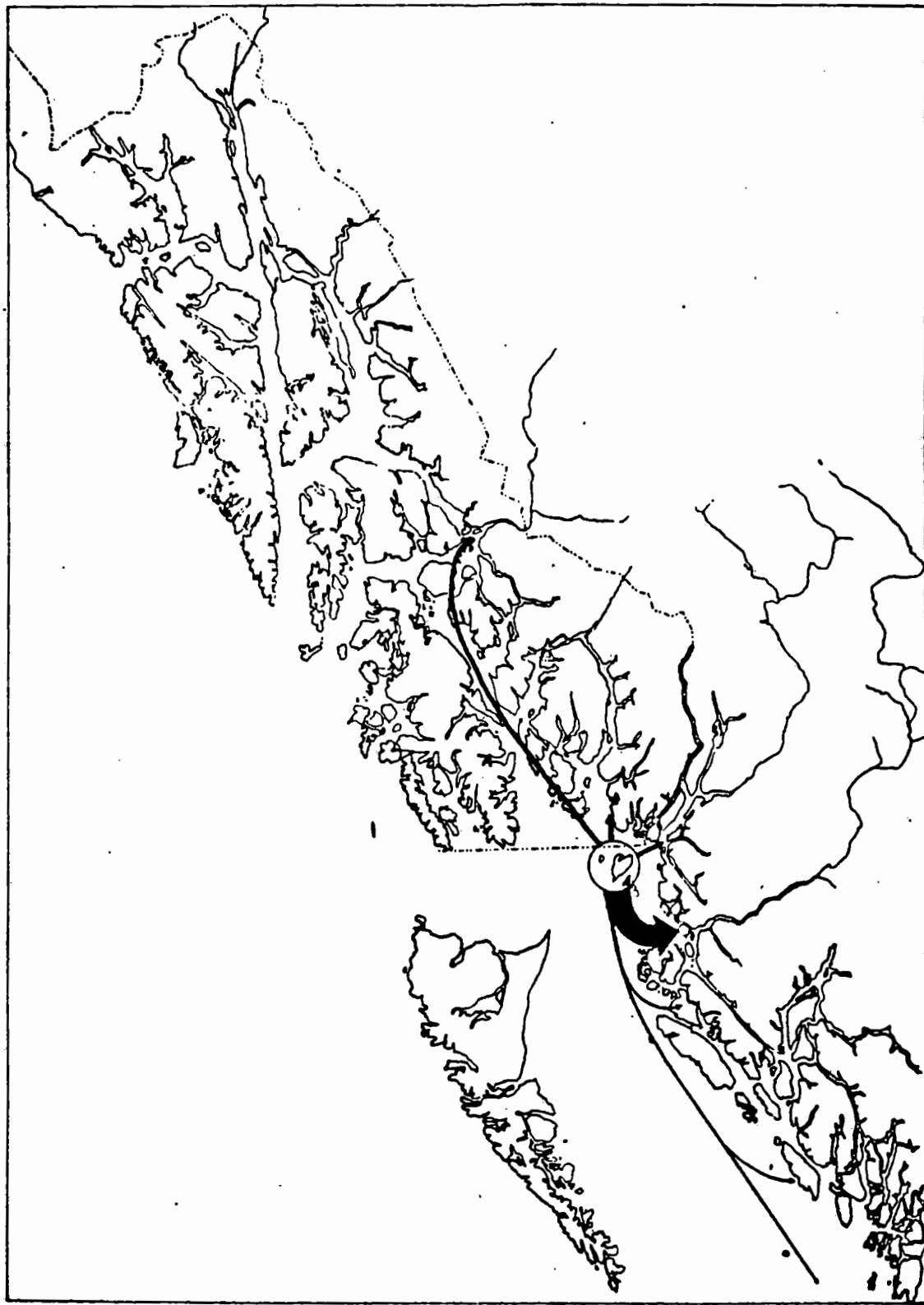


Fig. 16. Distribution of recoveries (outside the tagging area) of sockeye salmon tagged at Dundas Island in 1957. Widths of individual arrows indicate relative proportions of recoveries made in each area. Paths of various arrows do not necessarily indicate migration routes of sockeye recovered in various areas.

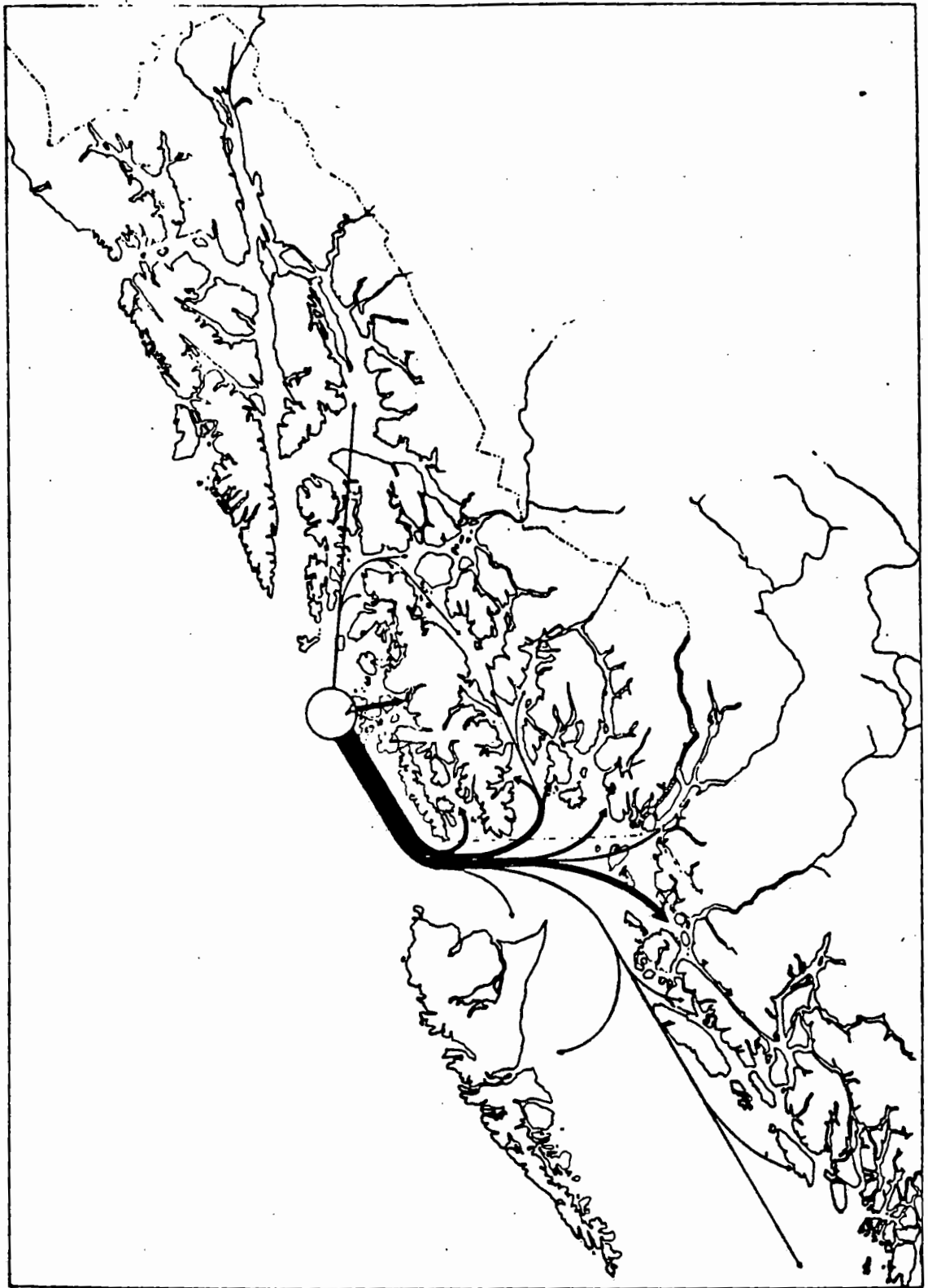


Fig. 27. Distribution of recoveries (outside the tagging area) of sockeye salmon tagged at Cape Addington and Cape Ulitka in 1958 (data for Granite Point and Roller Bay combined with Cape Addington). Widths of individual arrows indicate relative proportions of recoveries made in each area. Paths of various arrows do not necessarily indicate migration routes of sockeye recovered in each area.

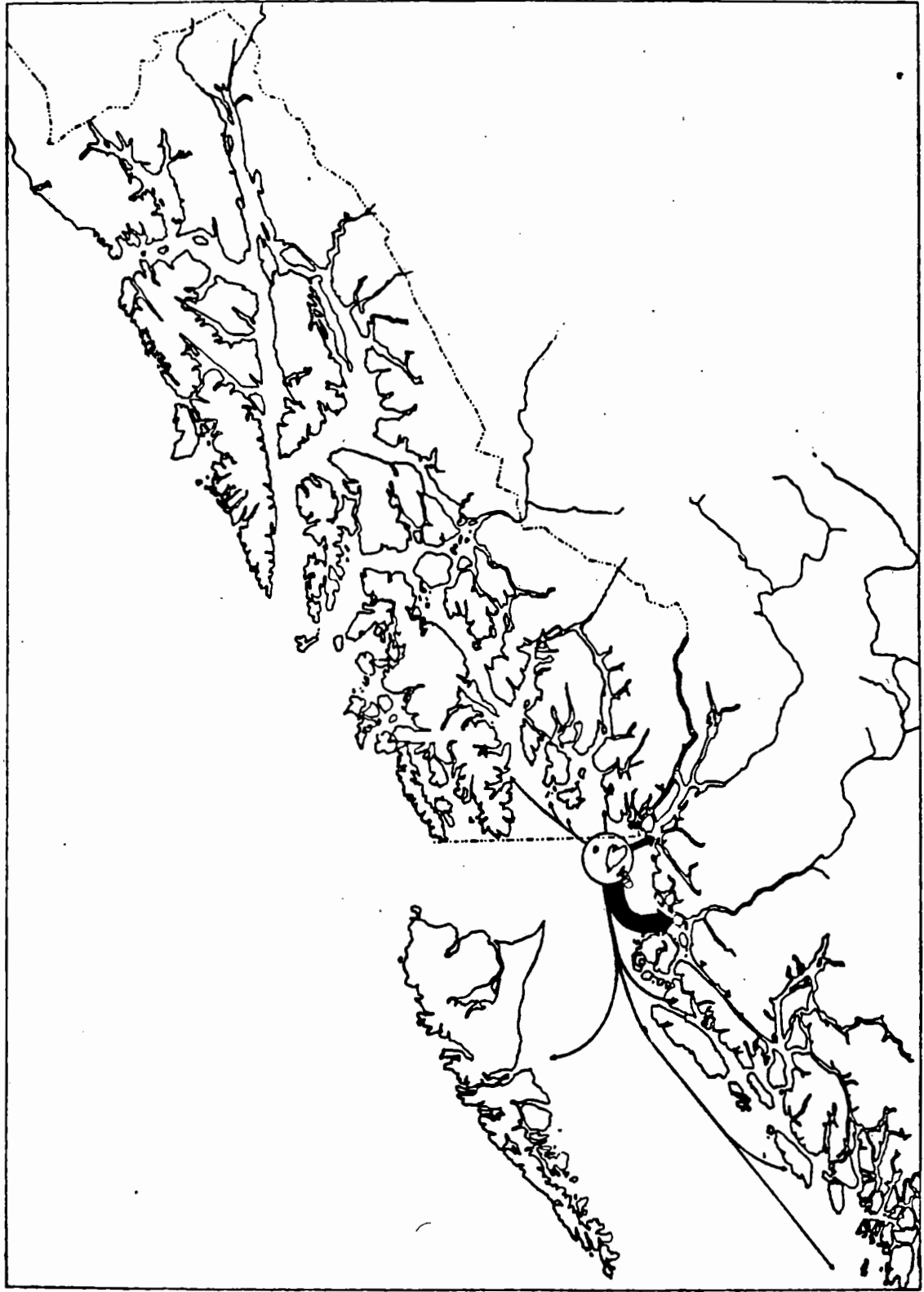


Fig. 28. Distribution of recoveries (outside the tagging area) of sockeye salmon tagged at Dundas Island in 1958. Widths of individual arrows indicate relative proportions of recoveries made in each area. Paths of various arrows do not necessarily indicate migration routes of sockeye recovered in each area.

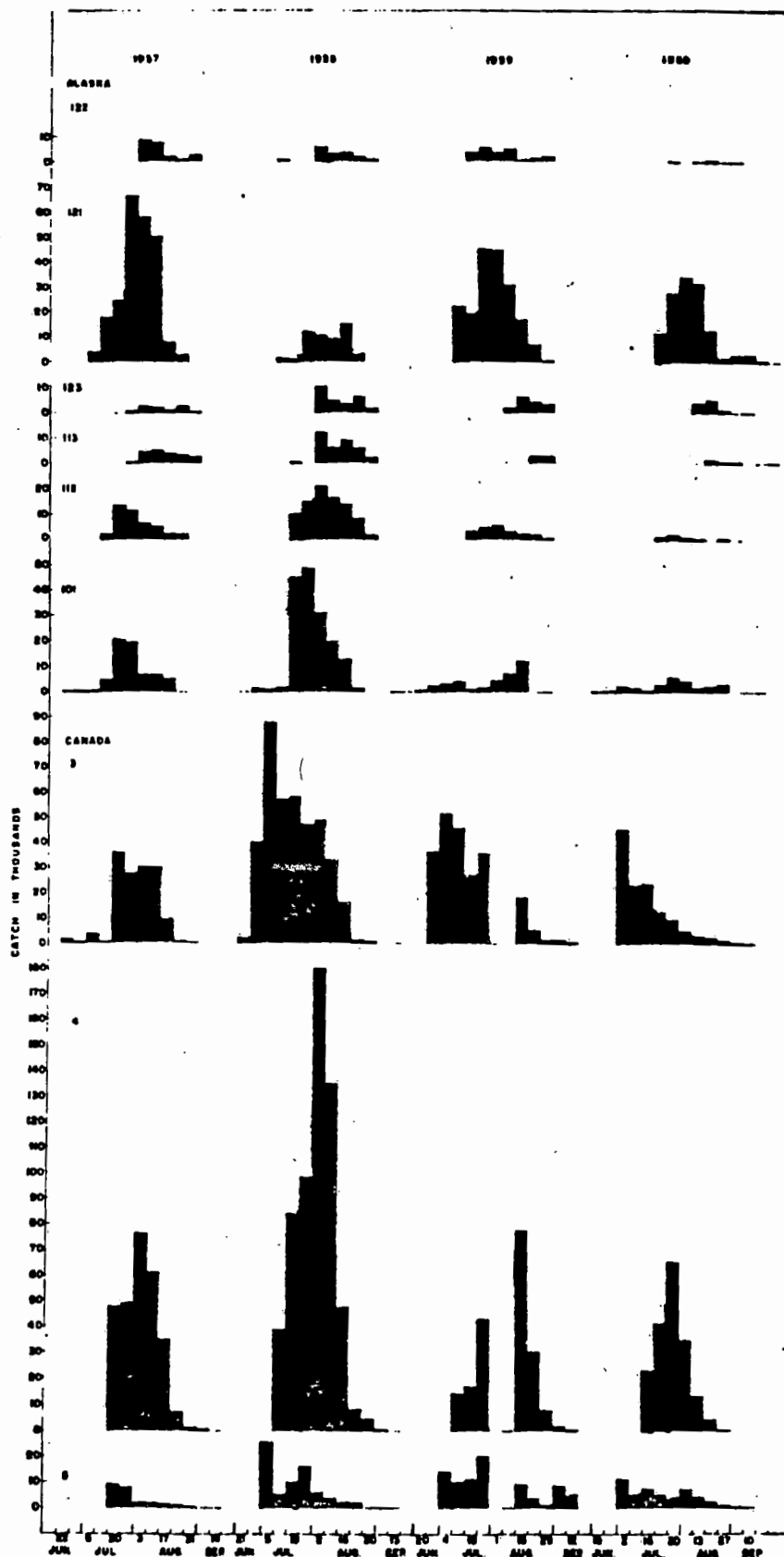


Fig. 14. Weekly catches of sockeye salmon in various statistical areas in South-eastern Alaska and northern British Columbia from 1957 to 1960.

The following information was extracted from reference no. 19 (Anon., 1966). Refer to pink salmon section for introductory remarks.

Sockeye in 1966

The timing of sockeye salmon migrations entering Johnstone Strait in 1966 is similar to that of pink salmon. This is illustrated in Figure 3 which describes the weekly sockeye salmon catches recorded in Area 12 for the cycle years 1954, 1958 and 1962. Both local and Fraser River sockeye stocks contribute to the Johnstone Strait fishery and these are discussed separately below.

(a) Local Stocks

Many local sockeye runs enter Johnstone Strait en route to spawning streams in Areas 12 to 16. Predominant among these is the Nimpkish River stock, other stocks such as the Knight Inlet, Phillips River and Heydon Bay runs are relatively minor and will not be considered here.

In the period 1951 to 1964 the catch of Nimpkish River sockeye, as estimated by field officers on the basis of the time and location of the catch, has ranged from 31,000 to 137,000 and has averaged 72,500. Nimpkish River escapements for the same period have ranged from 70,000 to 150,000 and have averaged 93,000. A native food fishery, located at the mouth of the Nimpkish River, removes an average of 5000 sockeye annually. The total Nimpkish River stock then, in recent years, has averaged approximately 170,000 sockeye. Examination of Nimpkish River sockeye scales has shown that the stock is comprised mainly of age 4_2 and 5_2 fish, and that either age

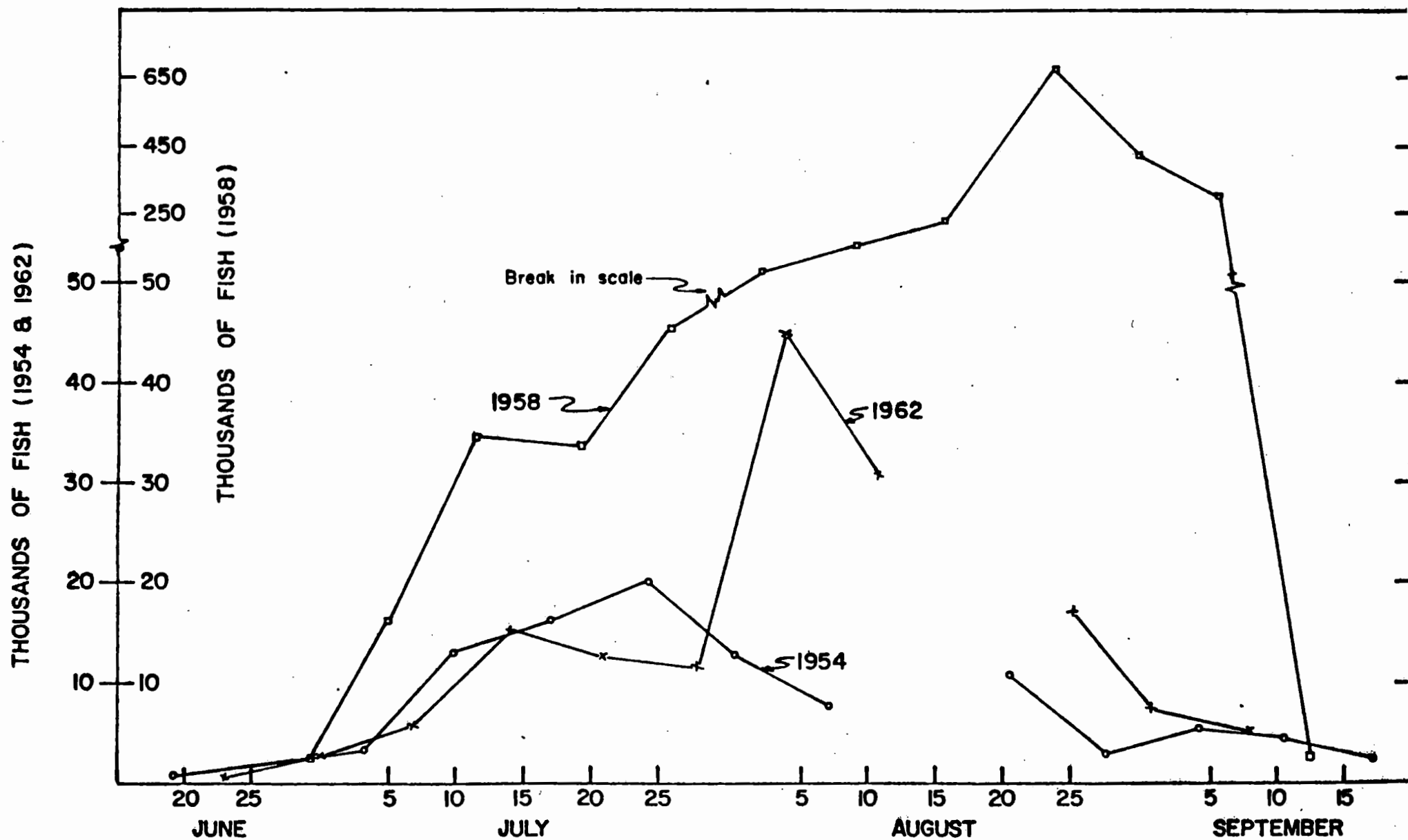


FIGURE 3. Weekly catches of sockeye salmon in Area 12 in the years 1954, 1958 and 1962.

class may predominate in any particular year. The 1966 return then, will be produced by the 1961 and 1962 escapements which were estimated at 75,000 and 110,000 respectively.

Although the timing of the Nimpkish River sockeye migration has not been defined precisely, analysis of Area 12 catches combined with the separation of Nimpkish River and Fraser River sockeye by scale characteristics indicate that the Nimpkish River run contributes significantly to the Area 12 catch from mid-June until the end of July, with a peak contribution around mid-July. Consequently, the migration of Nimpkish River sockeye is virtually completed prior to the main migration period of study area pink salmon.

(b) Fraser River Stocks

With the exception of 1958 when the Johnstone Strait sockeye catch totalled four million fish as a result of a major diversion of Fraser River sockeye through Johnstone Strait, recent catches of Fraser River sockeye in Johnstone Strait have been relatively small on the 1966 cycle. In 1962 the Area 12 sockeye catch totalled 157,349 of which about one-half were estimated to be of Nimpkish River origin. In 1962 pink salmon conservation measures severely restricted the Area 13 fishery and the sockeye catch totalled only 5275 fish. In 1954 the Area 12 and 13 sockeye catches totalled 104,425 and 46,210 fish respectively. Of these fish, an estimated 31,000 were from the Nimpkish River run and a further 15,000 were taken in Phillips Arm. The 1962 catch of Fraser River sockeye in Johnstone Strait, therefore, totalled less than 100,000 even though the total return of Fraser River sockeye exceeded 12 million.

According to predictions of the International Pacific Salmon Fisheries Commission, the 1966 Fraser River sockeye return will approximate three million fish; a return of similar size to that of 1962. If the proportion of Fraser River sockeye returning via the Johnstone Strait route in 1966 is similar to that of 1954 or 1962, the presence of Fraser River sockeye should not be a major factor in pink salmon regulation in 1966.

The following information was extracted from reference no. 63
(Palmer, 1966):

"Sockeye Salmon in 1967

"The timing of the sockeye salmon migration through Johnstone Strait in the 1967 cycle should coincide closely with the migration of study area pink salmon stocks. The timing of sockeye salmon as indicated by catches in Areas 12 and 13 is illustrated in Figure 4 for the last four cycles. Both local and Fraser River sockeye stocks contribute to the Johnstone Strait fishery and these are discussed separately below."

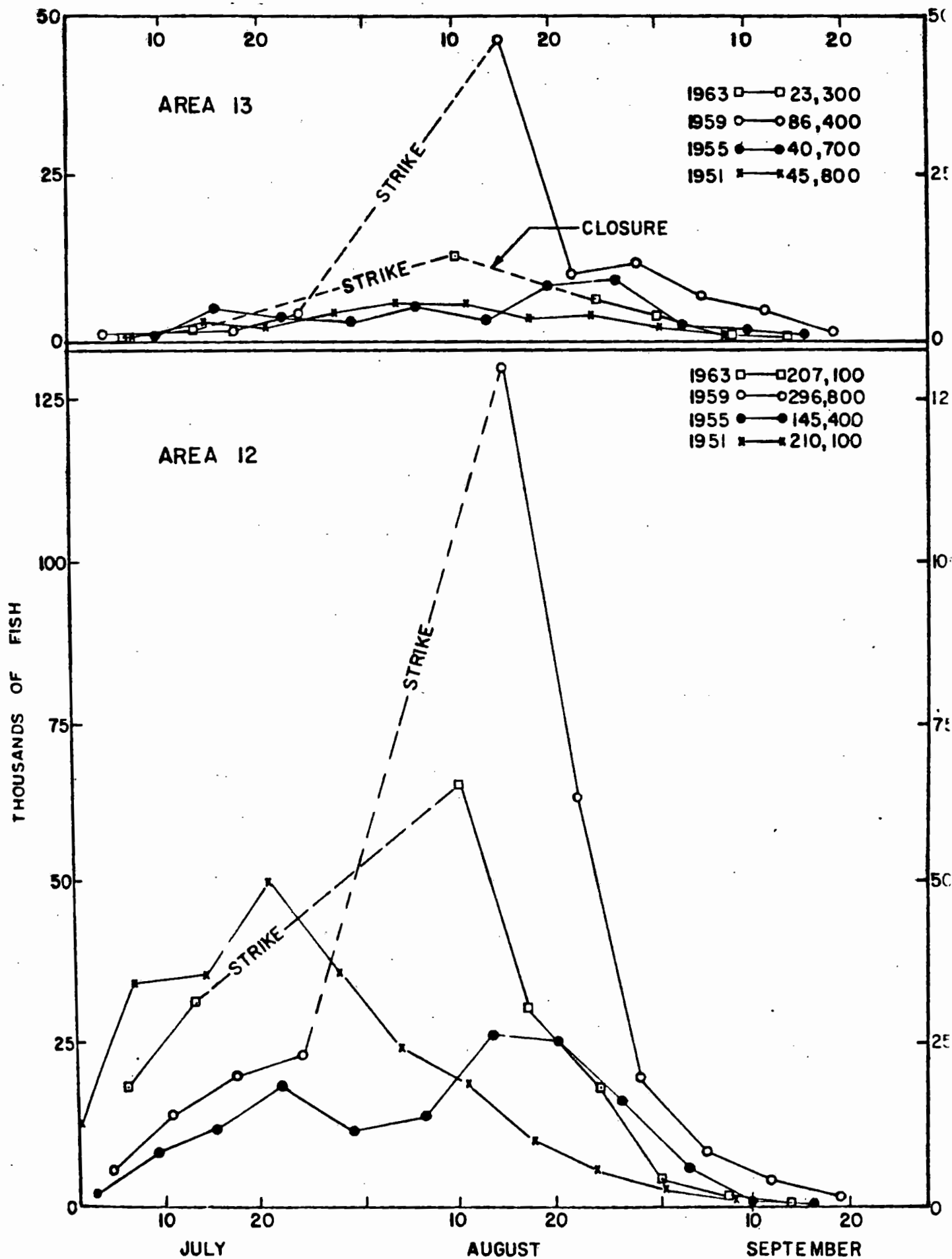


FIGURE 4. Weekly catches of sockeye salmon in area 12 and 13 in the years 1951, 1955, 1959 and 1963.

The following information was extracted from reference no. 27 (Aro and McDonald, 1968):

INTRODUCTION

The Skeena River (Fig. 1) supports the largest run of sockeye and one of the largest runs of pinks in northern British Columbia. These salmon runs have been an important factor in the local economy. The landed value of sockeye and pinks caught in the commercial fishery in the Skeena gillnet area (Area 4) averaged about 1.3 million dollars during the years 1951 to 1966. In addition, large numbers of sockeye and pinks bound for the Skeena River may be caught in adjacent fisheries in British Columbia and Alaska (Shepard et al., 1962). Substantial catches of sockeye and fewer pinks are taken annually by the Native subsistence fishery along the Skeena River.

As early as 1937, concern was expressed about a decline in the catch and apparent total abundance of Skeena sockeye. In the early 1940's the Fisheries Research Board of Canada was requested to initiate a Skeena River Salmon Investigation to determine if there had been a decline in any species of salmon and, if so, what were the causes and what remedial measures were recommended. An important phase of the investigation was to obtain information about the routes of migration towards the river, the times when the runs to the various tributaries passed through the fishing area, and to assess the extent to which each run of each population was exploited. To help obtain this objective, salmon, mainly sockeye, were tagged during the years 1944 to 1948 in the commercial fishing area. Some of the results from these taggings were reported by Pritchard (1944, 1945, 1947 and 1948) and by Milne (1949).

In 1954 the Committee on Management for the Skeena River Salmon Fisheries was established to investigate conditions on the Skeena with a view to improving the management of the runs and to increasing the yield. The need for additional information on times of passage was recognized and subsequently taggings were carried out from 1955 to 1959 by the Fisheries Research Board of Canada.

In 1957 and 1958 the Fisheries Research Institute of the University of Washington under contract with the United States Fish and Wildlife Service tagged salmon in the West Coast District of Southeastern Alaska. Many tags from these tagging experiments were recovered from salmon in the Skeena fishery and on Skeena spawning grounds.

The purpose of this report is to review the information presently available, which bears on the times of passage of the various Skeena sockeye and pink salmon stocks through the commercial fishing area. Also, it is hoped that some of this information may prove useful to those interested in more general questions related to the movements of salmon.

BACKGROUND INFORMATION

A commercial fishery for salmon on the Skeena River began in 1877 when a salmon cannery, the first in northern British Columbia, was established at Inverness on the North Skeena Passage. The sockeye catch in the area rose with

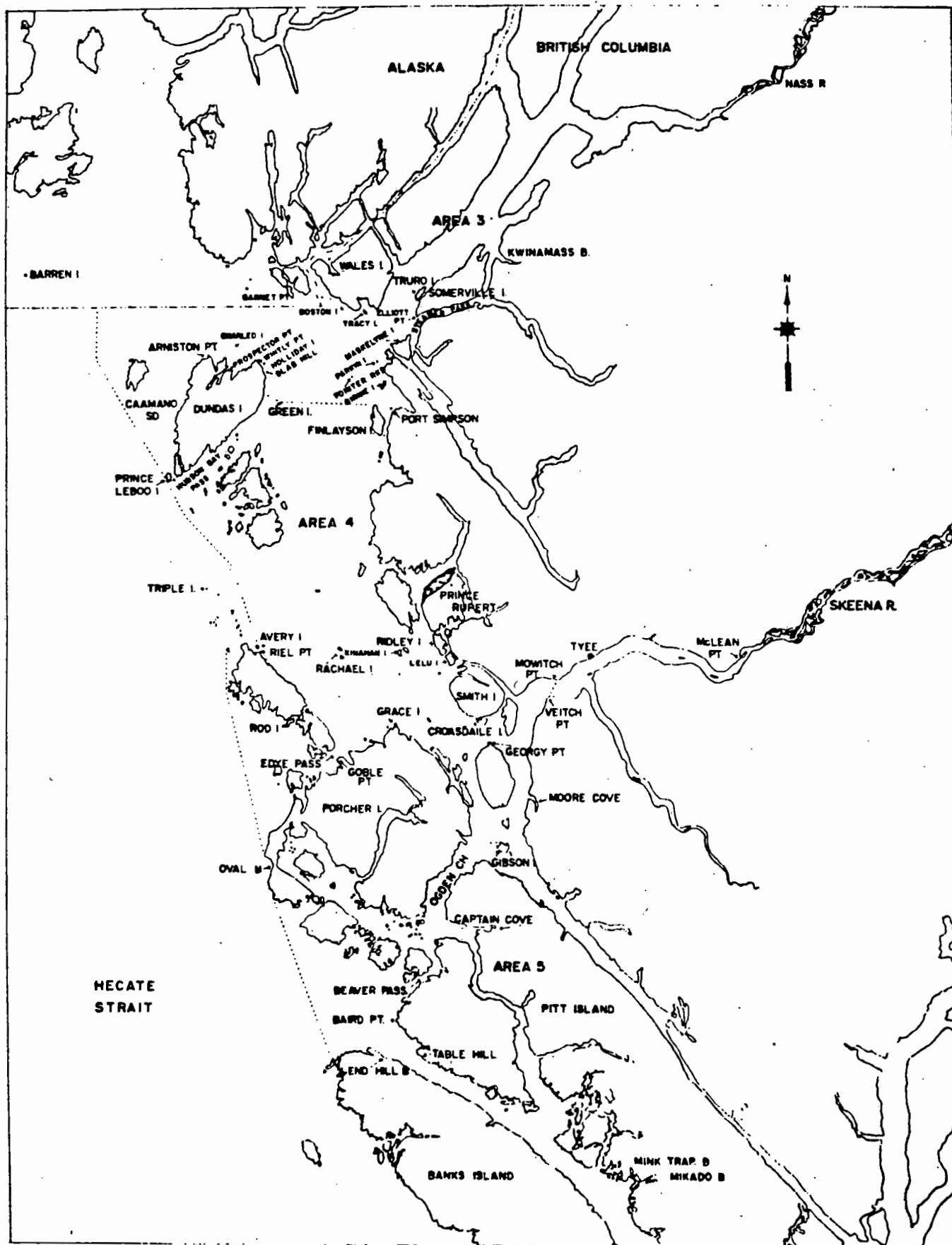


Fig. 3. Tagging locations in northern British Columbia, 1944 to 1948 and 1955 to 1959.

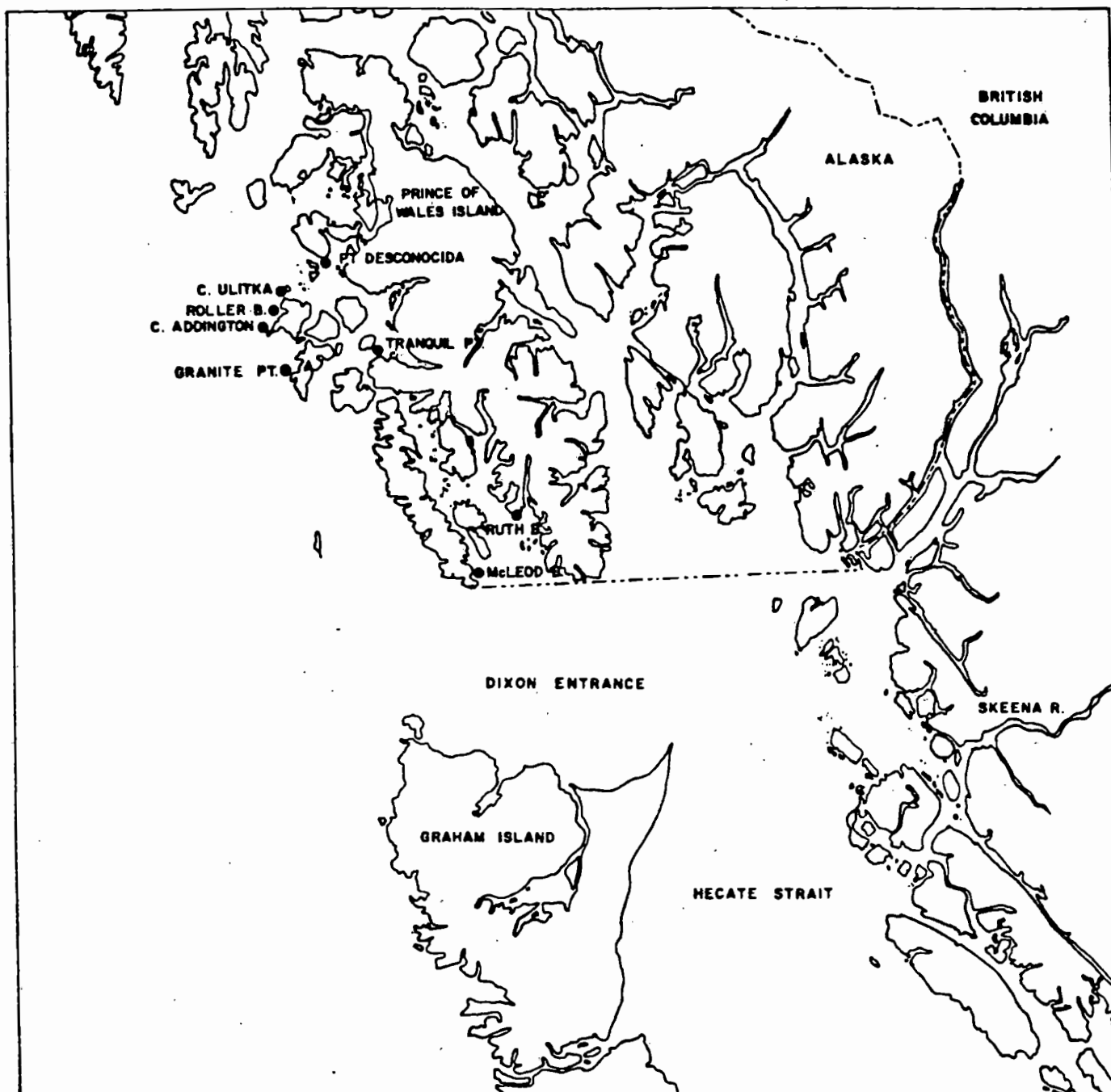


Fig. 4. Tagging locations in the West Coast District of Southeastern Alaska in 1957 and 1958.

the Skeena River itself between Terrace and the upper tidal limit. Smaller but still sizeable runs occur in the Babine, Kitsumkalum, Scotia, and several other rivers in the drainage. Pink salmon also spawn in several coastal streams which drain into Area 4 but which are not part of the Skeena River drainage. The most important of these coastal runs are those which spawn in Moore Cove Creek and in the Oona River.

MATERIALS AND METHODS

Tagging method

The type of tag, tagging equipment, and tagging method employed for the taggings reported here was essentially the same as commonly used for salmon along the Pacific coast of North America for the last three or four decades. These are described in detail by Pritchard and DeLacy (1944).

The tags consisted of two laminated plastic or celluloid discs. For the northern British Columbia and Southeastern Alaska taggings, discs of various sizes and colours, and with a variety of legends were used. The Fisheries Research Board of Canada used discs 1/2" in diameter in 1944, 1945, 1946, 1947, 1948, 1955, 1956 and 1957; 17/32" discs in 1957; 11/16" discs in 1958; and 3/4" discs in 1959. One disc of each pair bore a serial number. One or both discs indicated that the tag originated from and was to be returned to the Fisheries Research Board of Canada at Nanaimo. The Fisheries Research Institute used similar 7/8" tags in 1957 and 3/4" tags in 1958. Like the Canadian tags, the Fisheries Research Institute tags indicated the name of the originating agency where the tag was to be returned.

The actual tagging was accomplished by passing a sharp nickel pin through the numbered disc, then through the flesh of the fish immediately below the insertion of the dorsal fin, and finally through the unnumbered disc or "baffle". The pin was then cut to a suitable length and twisted with the aid of long-nosed pliers into a loop which held the baffle in place.

In 1958 both the Fisheries Research Board of Canada and the Fisheries Research Institute experimented with plastic dart tags. Each dart tag consisted of a short length of flexible plastic tubing, about 1/8" in diameter, which was attached to a barbed plastic shaft. Printed on each tag was a serial number and the name of the originating agency. The barbed end of the tag was inserted into the flesh of the fish near the dorsal fin by means of a sharpened stainless steel tube.

In the tagging operations carried out from chartered seine boats, the seine containing the salmon was pursed and "dried up" alongside the vessel. The salmon were dipped from this retaining bag one at a time, tagged, and released. In the test fishing operations near Tyee, salmon which were in good condition were placed in a live tank on deck from which they were dipped out, tagged and released. Whenever conditions at the test fishing operation permitted, two men operating from a skiff "worked" the gillnet removing the salmon from the

net whenever they were seen to strike. These fish were tagged and released immediately upon removal from the net.

For all taggings a record was kept of the tag number, the species, and the tagging date and location. Each individual fish tagged was thus made identifiable and its history could be outlined from the recoveries. Length data and scale samples for age determinations were taken wherever possible in all years except in 1944 and in the offshore taggings in 1956.

Collection of tags

A concentrated effort was made to secure as complete a collection as possible of recovered tags. Posters were widely distributed throughout the commercial fishing area describing the tag, outlining the information desired, and indicating that a reward would be paid for each tag recovery. Special tag return envelopes were distributed to facilitate the return of tags. The back of these envelopes had spaces where the tag number, place of capture, date of capture, and the name and address of the sender could be recorded. The envelope was addressed to the Biological Station at Nanaimo. Arrangements were made with the canneries in the Prince Rupert area that they would redeem any tags turned over to them. In addition, Fisheries Research Board personnel made regular visits to the Skeena River canneries and to the Prince Rupert waterfront to redeem tags and to maintain contact with the fishermen. Officers of the Department of Fisheries collected any tags from the commercial, sports, and Native subsistence fisheries which came to their notice and collected tags from live and dead salmon during the course of stream surveys. Personnel of the Fisheries Research Board of Canada collected tags from fish at counting weirs and from fish on the spawning grounds.

RESULTS

Tags applied

A. 1944 to 1948

To procure as much information as possible it was evident that large numbers of salmon should be tagged and that the further from the river mouth the fish were tagged, the greater would be the area from which information could be collected. In 1944 a purse seine vessel was chartered to see if salmon for tagging could be captured in the outer (seaward) portions of the fishing area. Catches proved to be small, therefore it was assumed that in these outside areas schooling was not general and thus the numbers which might be captured would be limited. Toward the end of the 1944 season the tagging was carried out closer to the mouth of the Skeena River where more sockeye could be caught.

In 1945, 1946, 1947 and 1948, the tagging program, which in 1944 had only included sockeye, was expanded to include all five species of Pacific

salmon but with special emphasis on sockeye. This time operations of the seiner were restricted to the area off the mouth of the Skeena River except for occasional short trips to the Nass area and to Principe Channel. In 1945 and 1946 a second vessel was chartered to fish offshore in the neighbourhood of Dundas, Banks, Stephens, and Porcher Islands, and in Hecate Strait. Again few salmon could be captured in the outside areas and consequently few outside fish were tagged.

The 1944 to 1948 taggings usually commenced in the first half of June and were discontinued by the end of July. About 70% of the sockeye run and 25% of the pink run had entered the tagging area by the time tagging was discontinued. The numbers of sockeye and pink salmon tagged in 1944, 1945, 1946, 1947 and 1948 are listed by tagging date and location in Tables I, II, III, IV and V respectively. The tagging locations are shown in Fig. 3.

B. 1955 to 1959

From 1955 to 1964, the Fisheries Research Board of Canada chartered two gillnet boats to carry out test fishing at the Aberdeen Drift near Tyee on the Skeena River about four miles above the river boundary for the purpose of estimating the daily escapement of salmon from the fishery. During the course of this operation many salmon were taken in a condition judged suitable for tagging. Accordingly, salmon were tagged from the test fishing nets in 1955, 1956 and 1957 (Table VI). The tagging was carried out throughout the season from early June to early September.

In order to get information on the routes by which Skeena-bound salmon approach the river and the speed with which they migrate through the fishing area, another attempt was made in 1956 to catch salmon for tagging by purse seining in the offshore portions of Areas 3 and 4. This time sufficient salmon were taken at several outside locations to make the operation worthwhile. Consequently, a seining operation was continued in 1957 and 1958 and fish were tagged in the offshore portions of Areas 3 and 4 and in Ogden Channel (Area 5). In 1957 and 1958 all species of salmon were tagged but special emphasis was placed on tagging pink salmon. The 1956 tagging, which was exploratory in nature, was carried out intermittently between mid-July and late August. In 1957 tagging commenced in early June and was discontinued in late August. The 1958 tagging program was carried out from mid-July to mid-August, the period when the main pink runs are in the area. The number of sockeye and pinks tagged in the offshore areas in 1956, 1957 and 1958 are shown by tagging date and location in Tables VII, VIII, and IX respectively. The tagging locations are shown in Fig. 3. The success of the 1956, 1957 and 1958 offshore taggings indicated, contrary to the findings of earlier years, that substantial numbers of salmon could be caught in offshore areas. The lack of success in catching salmon offshore in the earlier years was likely due to the inadequacy of the fishing methods and gear in use at that time. Present day seine boats, which are equipped with drums or Puretic blocks, are able to make more sets per unit time and can operate successfully in locations considered hazardous to the earlier gear.

In 1957 pink salmon were tagged from catches made by a beach seine operated in the Skeena River at McLean Point (Fig. 4) about 20 miles upstream from the river boundary (Table X). The tagging was carried out in the period when the main pink runs should have been passing.

In the 1957 and 1958 tagging experiments in the West Coast District of Southeastern Alaska by the Fisheries Research Institute obtained salmon for tagging from catches made in salmon traps located at Cape Addington, Cape Ulitka, Point Desconocida, Tranquil Point, McLeod Bay, and Ruth Bay and from seine catches made in Roller Bay and off Granite Point (Fig. 4). The numbers of sockeye and pinks tagged in the West Coast District are listed by tagging date and location in Tables XI and XII for 1957 and 1958 respectively.

Spawning area recoveries of tags

The number of recoveries from the different spawning areas varied considerably. A large number were made in areas where counting weirs were located. It is estimated that at Babine Lake about 85% of the sockeye tags entering the area were stopped at the counting fence located below the lake outlet. Of the tagged sockeye which continued past the Babine fence only about 23%, on the average, were recovered subsequently on spawning streams and in the Native subsistence fishery. Tag recoveries were high from some areas where the Natives were able to fish selectively for tagged salmon in order to collect rewards. Tag recoveries were low from remote areas which were seldom visited, from streams which were difficult to survey, and from areas where the fish become unavailable after spawning. In areas such as Bear, Sustut, Asitka, and Johanson Lakes, where lake spawning occurs, most of the carcasses sink to the bottom and therefore tagged individuals are not readily available. Tag recoveries are low from large rivers and from silty streams which are difficult to survey and where carcasses of spawned out fish may be swept away or obscured.

To determine the timing of the Skeena sockeye and pink runs only those tags which were recovered in definite spawning areas could be used. This eliminated many of the tags recovered by sportsmen and the Native subsistence fishery. In the years 1944 to 1959 a total of 2,324 sockeye and 652 pink tags were recovered in definite spawning areas in the Skeena area (Table XIII).

All sockeye and pink tag recoveries from the 1944 to 1948 and the 1955 to 1959 Canadian taggings in northern British Columbia and the 1957 and 1958 United States taggings in the West Coast District of Southeastern Alaska are tabulated in Tables I to XXVI of the Appendix.

Times of migration through the fishing area

A. Sockeye

To facilitate comparisons of passage times of fish tagged at a large number of different locations, a common point along the migration route (the river boundary area) was chosen and estimates made of the dates at which the

tagged fish reached this point. The time of travel or "days out" from each tagging location to the river boundary was estimated by the median value of the number of days out for tag recoveries in the boundary area from each tagging location.

In the years 1944 to 1948 most of the tagging was done off Smith Island and adjacent locations close to the mouth of the Skeena River. The commercial fishery in these years operated five days weekly, from 6:00 P.M. Sundays to 6:00 P.M. Fridays. Tagging was carried out daily with the exception of Mondays. Examination of the recovery data indicated differences in time-out depending on the day of the week in which the fish were tagged. This difference was due, probably, to the lack of tag recoveries during the weekend closure (6:00 P.M. Friday to 6:00 P.M. Sunday). In 1946 (Table XIV and Fig. 5) the daily number of days out varied between 3 and 7 days. The data suggests that for taggings carried out between Tuesdays and Saturdays the estimate of time-out would be too high because of the weekend closure. Data for Sunday taggings were probably the most accurate because Sunday tags became available to the fishery at 6:00 P.M. Sunday and remained available until 6:00 P.M. Friday, by which time 70% of the recoveries had been made. In addition, more salmon were tagged on Sundays and more tags were recovered from Sunday taggings than any other day of the week. For these reasons the number of days out for sockeye from Smith Island to the boundary area in the years 1944 to 1948 was estimated from recoveries of tags placed on Sundays. The number of days out was estimated to have been 2 in 1944 and 1948, 3 in 1946, and 4 in 1945 (Table XV and Fig. 6).

In 1956, 1957 and 1958, sockeye were tagged at many different locations, most of them some distance from the river mouth. The number of days out between the river boundary area and Dundas Island, Grace Island, and Ogden Channel was estimated to have been 5, 4, and 2 days respectively, by combining tag recoveries in all years (Table XVI and Fig. 7). Tag recoveries in the boundary area from other tagging locations in 1956, 1957 and 1958 were not sufficient to estimate number of days out. For tagging sites in the Nass area (including Steamer Passage, Elliott Point, and Tracy, Boston, Maskelyne, Birnie, and Finlayson Islands) the migration time to the boundary was assumed to be the same as from Dundas Island, which lies roughly the same distance from the Skeena River boundary. Similarly the migration time for sockeye tagged near Rachael and Avery Islands and in Oval Bay was assumed to be similar to that for sockeye tagged at Grace Island. For fish tagged near Smith Island in 1958 it was assumed that the number of days out to the boundary was 3 days, the average time out for the 1944 to 1948 taggings at Smith Island. The time of travel between the boundary area and the test fishing site near Tyce was considered to be less than one day as the test fishing catches reflect changes in the commercial fishery, such as openings and closures, within a few hours. The number of days out between the tagging sites in the West Coast District of Southeastern Alaska and the river boundary and Telegraph Passage was estimated to have been 7 days in 1957 and 10 days in 1958 (Table XVII and Fig. 8).

Tag recoveries from sockeye in spawning areas in the Skeena River drainage during the years 1944 to 1958 are tabulated in Tables XVIII to XXX. In these tables the number of tag recoveries in each spawning area are shown by tagging location, tagging date, and the date at which the fish was estimated to have been in the boundary area.

As mentioned earlier, the recovery rate for tags varied considerably between different areas. Also the number of tags recovered in any one area varied from year to year. Substantial numbers of tags were recovered in most years at Babine Lake and from the Bulkley River (largely Morice Lake fish), both of which were relatively large producers.

Moderate numbers of tags were recovered at Alastair, Lakelse, Kitwanga, and Bear Lakes but only a few tags were recovered at Kitsumkalum and Johanson Lakes and in the Kispiox River system. No recoveries were made at Johnson, McDonnell, Sustut, and Asitka Lakes and other small producing areas.

At Alastair Lake tags were recovered from sockeye in three years, 1947, 1957 and 1958 (Table XXXI, and Fig. 9). The seven tags which were recovered in 1947 during the course of a single survey of Alastair Lake were estimated to have been present in the boundary area between June 18 and 28. This information suggested that the Alastair sockeye run was early. In 1957, during several surveys of Alastair Lake, 21 tags were recovered. These tagged sockeye had been present in the boundary area from June 10 to July 20. A single tag was recovered at Alastair Lake in 1958 from a sockeye which was tagged at Cape Addington in Southeastern Alaska on August 2 and which was estimated to have been in the boundary area on August 12. These data indicate that while the bulk of the Alastair sockeye run is early, a segment of the run has been present in the fishing area as late as early August.

Recoveries of sockeye tags at Lakelse Lake (Table XXXII and Fig. 10) show that in five years when tags were recovered, Lakelse Lake sockeye were present in the fishing area during June and early July. Although tagging continued well into July in most years, no tag recoveries were made at Lakelse Lake from sockeye which had been in the boundary area later than July 3. The Lakelse Lake sockeye run apparently is early and of short duration.

A total of 17 sockeye tags were recovered in the Kitwanga River system in six of the years when tagging was carried out (Table XXXIII and Fig. 11). Of these fish 12 were estimated to have passed the river boundary between July 22 and 31, 2 on June 17, and one each on June 25, July 2 and August 24. The tag recoveries suggest that the Kitwanga sockeye run is present in the fishing area throughout the entire season with the greatest abundance in late July.

The Bulkley River sockeye run, as indicated by spawning estimates and by Native subsistence fishery catches at Moricetown Falls and Hagwilget Canyon, was at a relatively high level of abundance in the earlier years of tagging, 1944 to 1948, and at a very low level in the later years of tagging, 1955 to 1958. The bulk of the tags recovered in the Bulkley River system were made in the earlier period (Table XXXIV and Fig. 12). Bulkley River sockeye spawn in two parts of the drainage: most of them at Morice Lake at the head waters of the Morice River, the main tributary of the Bulkley River; the remainder at Bulkley and Maxan Lakes, the headwaters of the Bulkley River itself. It is not possible to demonstrate any differences in the timing of these two runs as all tag recoveries in the Bulkley River system were made in the Native subsistence fishery at points downstream from the confluence of the Bulkley and

Morice Rivers. In the years 1944 to 1948 Bulkley River sockeye were present in the boundary area from mid-June to late July, the period of the tagging. The data indicate that in no year did the Bulkley River sockeye run have a well defined peak but that in most years the run was present in the fishery in fairly consistent numbers throughout the tagging period. In these earlier years the run may have been present in the boundary area into August, after tagging had been discontinued. The few recoveries of tags from Bulkley River sockeye in the years 1955 to 1958 failed to demonstrate the presence of the run in the fishery during August. However, these data cannot be expected to describe accurately the Bulkley River sockeye run in earlier years because in the years 1955 to 1958 the escapement was at a very low level as were the number of tags recovered and probably the number of Bulkley River sockeye which were tagged. To summarize, the data indicate that the Bulkley River sockeye run has been present in the fishing area from mid-June to late July but are inadequate to show whether it was present or absent during August.

Fifteen tagged sockeye were recaptured at Bear Lake during six years of tagging (Table XXXV and Fig. 13), nine of them in 1947. The tag recovery data suggest that the Bear Lake sockeye run was present in the boundary area from late June to mid-August with the greatest abundance in the last 10 days of July.

A few tags were recovered from sockeye at Kitsumkalum and Johanson Lakes and in the Kispiox River (Fig. 14). The three tagged sockeye recaptured at Kitsumkalum Lake were estimated to have been at the boundary on July 8, 15 and 25, 1957. The single recoveries at Johanson Lake and from the Kispiox River were from sockeye estimated to have passed the boundary on July 25, 1945, and July 30, 1947, respectively.

The Babine sockeye run, which at present forms about 90% of the total Skeena run, has been present in the fishing area throughout the fishing season. A total of 1,983 tags have been recovered from sockeye at Babine Lake from sockeye estimated to have been in the boundary from as early as June 17 to as late as August 24 (Table XXXVI and Fig. 15). The greatest number of recoveries were made from fish which had passed the boundary during the latter part of July when the peak in the Skeena sockeye run usually occurs. Sockeye taggings carried out at Babine Lake (Pritchard, 1953a and 1953b; McDonald, 1967 - unpublished) have shown that the Babine sockeye run is composed of several runs which both pass through the commercial fishery and enter the lake at different times.

The number of sockeye tagged throughout the season was not proportional to the number of fish present in the fishing area. Also tagging in most years was not done throughout the entire season. However, comparison of the distribution of all tag recoveries at Babine Lake with the average sockeye count at the Babine River counting fence throughout the 1946, 1947, and the 1955 to 1958 seasons (Fig. 16) suggests that, with the possible exception of the late run, all segments of the Babine sockeye run were tagged although not in proportion to the size of the different parts. On this basis it is assumed that all the other Skeena sockeye runs were tagged throughout the period of their migration through the tagging area. However, these runs were not tagged proportionately throughout the season or to one another. Despite these limitations in the data,

the tagging information has been combined for all years for each Skeena sockeye run in order to compare the timing of these runs through the boundary area (Fig. 17). This comparison indicates that differences existed in the time of passage among the Skeena runs. However, these runs overlap in their timing and at any one time sockeye from several runs may have been present in the fishery. The earliest runs which entered the river were the Alastair and Lakelse Lake runs. These were followed a short while later by the Babine Lake and Bulkley River runs. The Lakelse Lake run and the main part of the Alastair Lake run were present in the fishery during June and early July. The tagging data indicate that the Bulkley River run continued to the end of July and the Babine Lake run into late August. The limited information on the other Skeena runs suggests that they were present off the river mouth in July.

B. Pink salmon

In the earlier years of tagging, 1945 to 1948, few pink salmon were tagged and only from the early part of the run. In these years the number of pink tag recoveries in the boundary area were so few that to determine the number of days out from Smith Island to the boundary the recoveries from all years were combined. The number of days out was estimated to have been five days (Table XXXVII and Fig. 18).

In 1956, 1957 and 1958 pink salmon were tagged at many different locations, most of them some distance from the river mouth. Pink salmon appeared to be more variable than sockeye in their migration speed through the fishing area. With pinks the days out to the boundary area varied between different tagging locations and between years for each tagging location. Accordingly, the number of days out, wherever possible, was estimated for each tagging location for each year of tagging. The data from some tagging locations suggest that the days out may have varied for taggings carried out on different days of the week. This difference may be the effect of closures in the fishery on tag recoveries (in some weeks only three days fishing was permitted). Tag recoveries in 1957 in the boundary area from taggings in the West Coast District suggest a seasonal change in the number of days out (Table XXXVIII), from about 9 or 10 days in late July to about 8 days in mid-August. Data from other tagging locations are not sufficient to demonstrate any seasonal change in migration rate. In any event, any seasonal change in the migration time probably would have little effect on the analysis. In the Nass area the time out to the Skeena boundary from tagging locations near Dundas Island was estimated to have been 5 days in 1957 and 7 days in 1958 (Table XXXIX and Fig. 19), and from tagging sites near Birnie, Maskelyne, and Finlayson Islands, 3 days in 1957 (Table XL and Fig. 20). In the Skeena area, the days out to the boundary was calculated to have been 4 days from Goble Point and 3 days from the Kinahan Islands in 1957 (Table XLI and Fig. 21), and 3 and 6 days from Grace Island in 1957 and 1958, respectively (Table XLII and Fig. 22). From Ogden Channel to the boundary area the time out was estimated to have been 4 days in 1957 and 3 days in 1958 (Table XLIII and Fig. 23). In 1957 and 1958 the estimated days out from the West Coast District tagging sites in Southeastern Alaska to the Skeena boundary and Telegraph Passage were 9 and 10 days respectively (Table XLIV and Fig. 24). The time of travel between the boundary area and the test fishing site near Tyee is considered to have been less than one day for pinks as well as for sockeye.

SUMMARY

Present sockeye tag recovery information on the Skeena River has demonstrated that while differences do exist in the timing of the Skeena sockeye runs, the timing of these runs overlapped so that at any one time sockeye from several runs were present in substantial numbers in the fishery (Fig. 17). The taggings indicated that during June and early July the sockeye in the fishery were bound mainly for Alastair, Lakelse, and Babine Lakes and the Bulkley River. During the remainder of July the run was made up mostly of Babine Lake and Bulkley River sockeye. The sockeye run in August was composed almost entirely of sockeye bound for Babine Lake.

Similarly, pink tag recoveries on the Skeena River demonstrated that the timing of the major pink runs differ but overlap one another (Fig. 33). The recoveries showed that the earliest pink runs, the Babine, Kispiox, and Bulkley River runs, were present in the fishery in late July and early August. The last of the major pink runs in the fishery was the Lakelse River run which was present from the end of July to the latter part of August. The Kitwanga River run was intermediate in timing, extending from late July to the latter part of August. Tag recoveries from the main stem of the Skeena River suggested that it was present from the end of July to mid-August.

Comparison of tag recoveries from the major sockeye and pink runs indicate that the runs of the two species overlapped in timing to a large degree. The early pink runs, the Babine, Kispiox, and Bulkley runs, and the early parts of the Kitwanga, Lakelse, and Skeena main-stem pink runs coincided with the end of the Bulkley River sockeye run and with a substantial part of the Babine sockeye run. Comparison of the weekly stocks (catch plus the weekly escapement as determined from the test fishing catches at Tyee and from subsequent spawning ground estimates) of sockeye and pink in Area 4 illustrates the amount of overlap of the two runs in the fishing areas (Fig. 34). On the average about 59% of the sockeye run in the years 1956 to 1964 was present in the fishing area during the last two weeks of July and the first week of August. During the same weeks, 67% of the pink run was present in the odd-numbered years 1957 to 1963 and 47% of the pink run in the even-numbered years, 1956 to 1964. The peak of the sockeye run occurred in the last week of July, the peak of the odd- and even-pink runs in the first and second weeks of August respectively (Fig. 34). The difference in the timing of the odd- and even-year pink runs was due to the proportions of early and late pinks in the run.

Tag recoveries have demonstrated for both sockeye and pink, that while the timing of the component runs and of the two species does differ, considerable overlap of the runs in time of migration through the fishery occurs. Therefore, any regulation designed to affect any one run will also affect to a varying degree one or more runs of the same or other species.

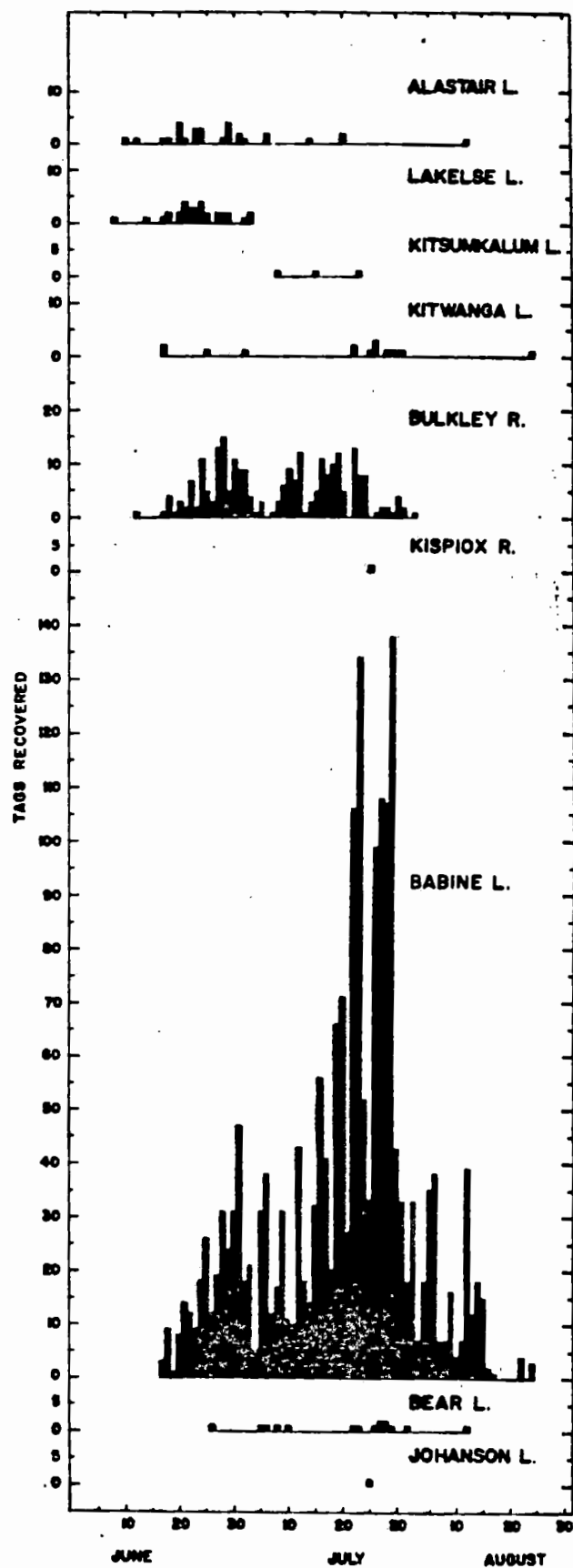


Fig. 17. Comparison of sockeye tag recoveries at various Skeena River spawning areas plotted by the dates when the fish were estimated to have passed the river boundary.

The following information was extracted from reference no. 64 (Palmer, 1968):

Sockeye in 1968

The timing of migration of sockeye salmon entering Johnstone Strait in the 1968 cycle is similar to that of pink salmon. The weekly catches of sockeye salmon recorded in Area 12 for the cycle years 1952, 1956, 1960 and 1964 are illustrated in Figure 3. Both local and Fraser River sockeye stocks contribute to the Johnstone Strait fishery and these are discussed separately below.

a) Local Stocks

Although several local sockeye runs enter Johnstone Strait en route to spawning streams in Areas 12 to 16, only one, the Nimpkish River stock is sufficiently large to be considered in the management of the Johnstone Strait fishery.

In the period 1951 to 1966 the catch of Nimpkish River sockeye, as estimated by field officers on the basis of the time and location of the catch, has ranged from 30,000 to 137,000 and has averaged 70,000. Nimpkish River escapements for the same period have ranged from 75,000 to 150,000 and have averaged 93,000. A native food fishery, located at the mouth of the Nimpkish River, removes an average of 5,000 sockeye annually. The total Nimpkish River stock then, in recent years, has averaged approximately 170,000 sockeye. Examination of Nimpkish River sockeye scales has shown that the stock is comprised mainly of age 4₂ and 5₂ fish, and that either age class may predominate

in any particular year. The 1968 return then, will be produced by the 1963 and 1964 escapements which were estimated at 150,000 and 100,000 respectively.

Although the timing of the Nimpkish River sockeye migration has not been defined precisely, analysis of Area 12 catches combined with the separation of Nimpkish River and Fraser River sockeye by scale characteristics indicate that the Nimpkish River run contributes significantly to the Area 12 catch from mid-June until the end of July, with a peak contribution around mid-July. Consequently, the migration of Nimpkish River sockeye is virtually completed prior to the main migration period of study area pink salmon.

b) Fraser River Stocks

The timing of the Fraser River sockeye salmon migration through Johnstone Strait in the 1968 cycle coincides closely with the peak period of pink salmon migration. The International Pacific Salmon Fisheries Commission has, however, predicted a relatively low return of sockeye salmon to the Fraser River during the coming season. On the basis of this and on the assumption that the proportion of sockeye using the Johnstone Strait route will not be unusually high, the availability of sockeye to the study area fisheries should not constitute any real factor in determining the 1968 fishing pattern.

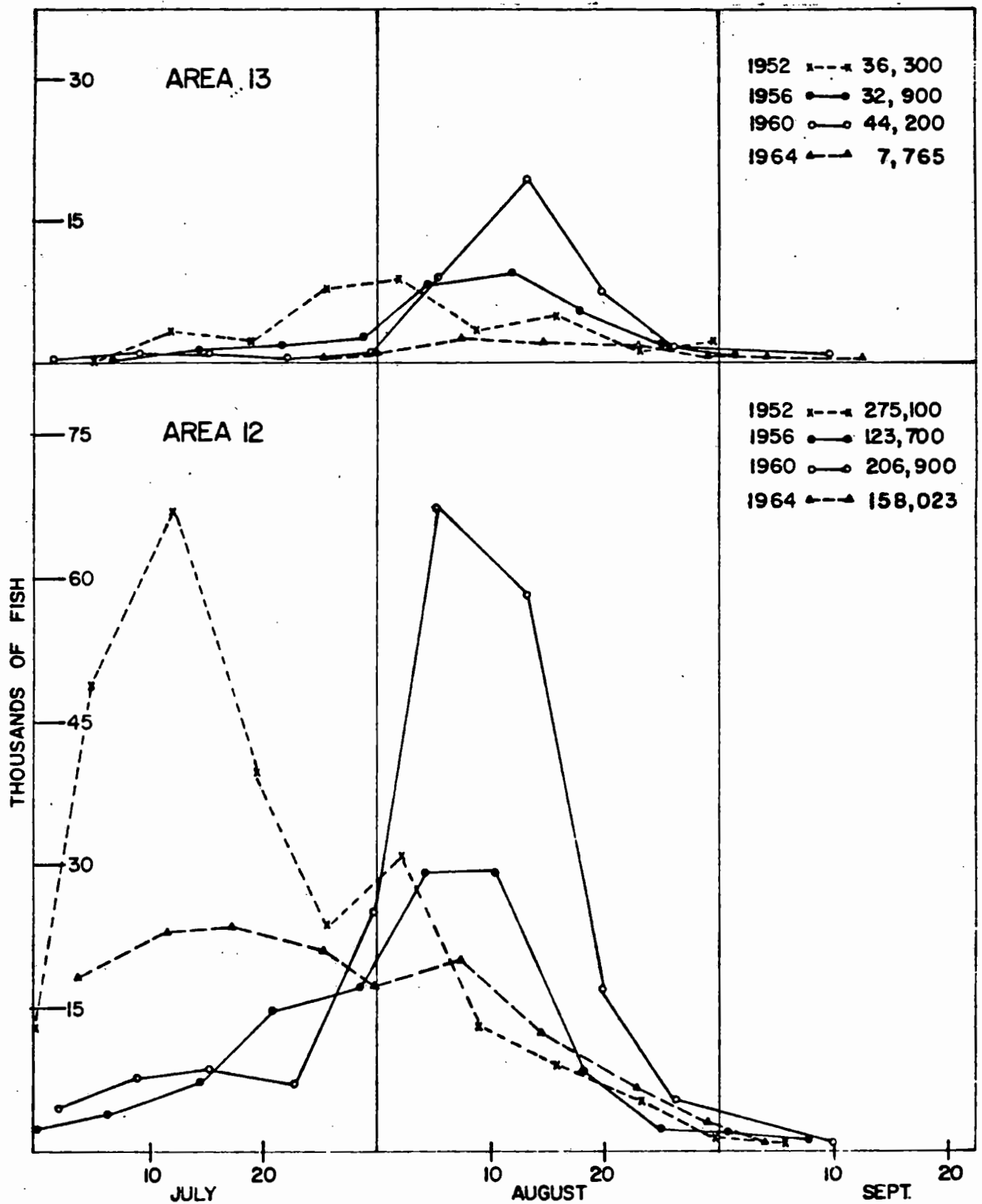


FIGURE 3. Weekly catches of sockeye salmon in Areas 12 and 13 in the years 1952, 1956, 1960 and 1964.

The following information was extracted from reference no. 4a (Alaska Department of Fish and Game, 1968). The publication includes additional information on coho, pink and chum salmon. The emphasis of the publication is on sockeye salmon.

PROGRESS REPORT: PL 89-304

Sockeye Salmon Migratory Behavior and Biological
Statistics Collection, Southeastern Alaska.

INTRODUCTION

Upgrading the general knowledge of red salmon stocks in Southeastern Alaska is necessary at this time for proper management of the resource and the critical international problem of separating stocks of Canadian and Alaska fish over a major portion of Southeastern Alaska.

Information required concerns migration routes, home stream origin of individual races, improved escapement counts, abundance and timing, age composition, and possible racial differences from scale characteristics.

Programs designed for obtaining the necessary information have been conducted in Southeastern Alaska since 1959. Increased funding through PL 89-304 and State management funds has permitted annual expansion of the programs to include adult salmon tagging, estuarine adult scale sampling, installation of additional sockeye salmon counting weirs, and increased commercial catch sampling.

Biological sampling and the weir program will be continued in 1968. The tagging program has been completed, and will not be continued in 1968.

TAGGING PROGRAM

Background

An increasingly efficient drift gill net fishery has developed in Sumner Straits since statehood. From opening in mid-June until mid-July the fishery is supported primarily by sockeye salmon catches. Management information pertinent to these salmon stocks is limited largely to weekly catch statistics and general observation of the fishery.

As part of the overall Southeastern red salmon program, and to obtain management information directly related to the District 6 drift gill net fishery a tagging program was undertaken. The primary goal of the program was to establish migration routes of the various sockeye stocks contributing to the fishery, and to arrive at a migration rate of these stocks through the fishery; the ultimate hope being to obtain estimates of escapement and fishery mortality rates.

Methodology

An Alaska limit seiner Little Lady operated by Neal Mac Donald was utilized to capture the salmon. Releasing viable red salmon from the fine mesh drift gill nets available proved to be completely impractical. The tagging program was undertaken with full realization that capturing significant numbers of sockeye salmon with a purse seine might be extremely difficult. This observation proved correct and was the primary limiting factor of the program. Individual seine sets ranged from complete failure to the largest catch of 87 sockeye, one chum, one coho and two pinks on June 10.

Methods

Although several fishing locations were tried, most of the tagging effort was concentrated in the general area of Point Baker located on the Northeast corner of Prince of Wales Island and at the boundaries of Regulatory Districts 5 and 6. Three sets were made in Northern Clarence Straits but resulted in the capture of only three sockeye.

Tagging was started June 7 and was terminated June 24.

Tagging was accomplished with the relatively new, high speed tagging gun developed by Floy Tag and Manufacturing, Inc. and described in the October 1967 California Fish and Game, using four inch yellow spaghetti dart tags inscribed, ADF&G-Juneau and numbered consecutively from 3001.

Tag recovery was basically from the gill net fishery.

Tag Returns

A total of thirteen fishing days produced a total of 349 tagged fish, 259 of which were sockeye salmon. The species breakdown of tagged fish by fishing day is shown in Table I. Despite the disappointingly small number of tagged fish released, a high percentage of tag returns were received. Eighty tags were received for 22.9% recovery of all species. Of the 259 sockeye tagged, 73 were returned for a 28% return. Tables II through V indicate the tag returns, by tagging day, by species. (Not included in this report.)

Summary

Sockeye salmon were tagged and released near Point Baker, Alaska during June 1967 as one segment of a Southeastern Alaska sockeye salmon study. The adult salmon were captured by salmon purse seine gear and tagged with 4 inch plastic spaghetti dart tags. 259 sockeye were tagged, 73 or 28% were recovered. The main source of recoveries was the drift gill net fisheries in District 6 and 8.

A summary of all returns from these two fisheries indicated that the average time at liberty was 4 days. The average rate of migration was 7.2 miles per day.

Sixteen freshwater returns were received, two from Alaska, fourteen from British Columbia. These stream recoveries indicated an average of 33 days at liberty and an average migration rate of 8 miles per day.

Other species of salmon were tagged incidentally to sockeye and this limited information is included.

TABLE I
Salmon Tagged by Day

1st Week	Reds	Chums	Coho	Pinks	Total
6/7	4				4
6/8	8				8
6/9	27	1	1		29
6/10	<u>86</u>	<u>2</u>	<u>1</u>	<u></u>	<u>89</u>
Weekly Total:	125	3	2	0	130
2nd Week					
6/14	17				17
6/15	8	3	1		12
6/16	16	0	2	1	19
6/17	<u>1</u>	<u>13</u>	<u></u>	<u>1</u>	<u>15</u>
Weekly Total:	42	16	3	2	63
3rd Week					
6/21	9	12	3	0	24
6/22	7	0	1	1	9
6/23	33	18	3	6	60
6/24	<u>43</u>	<u>10</u>	<u>3</u>	<u>7</u>	<u>63</u>
Weekly Total:	92	40	10	14	156
Grand Total:	259	59	15	16	349

TABLE II

Sockeye Salmon Tag Recoveries
by Day of Tagging

1st Week	Tagged	Recovered	Percent Recovery
6/7	4	0	0
6/8	8	2	25
6/9	27	11	41
6/10	<u>86</u>	<u>29</u>	<u>34</u>
	125	42	33.6
2nd Week			
6/14	17	3	17
6/15	8	1	12
6/16	16	5	31
6/17	<u>1</u>	<u>1</u>	<u>100</u>
	42	10	23
3rd Week			
6/21	9	0	0
6/22	7	1	14
6/23	33	6	18
6/24	<u>43</u>	<u>14</u>	<u>32</u>
	92	21	23
Grand Total:	259	73	28%

TABLE III

Chum Salmon Tag Recovery By
Day of Tagging

	Tagged	Recovered	Percent Recovery
1st Week	<u>3</u>	1	.33
2nd Week	16	3	18
3rd Week	<u>40</u>	<u>2</u>	<u>5</u>
	59	6	10%

TABLE IV

Pink Salmon Tag Recoveries By
Day of Tagging

1st Week	0	0	
2nd Week	2	0	
3rd Week	<u>11</u>	<u>1</u>	
	16	1	6%

TABLE V

Coho Salmon Tag Recoveries By
Day of Tagging

1st Week	2	0
2nd Week	3	0
3rd Week	<u>10</u>	<u>0</u>
	15	0

The following information was extracted from reference no. 35a (Department of Fisheries, MS 1969). The information is contained in a letter (including 19 tables) from the Director of Fisheries, Vancouver, B. C. to the Director of the Biological Research Station in Nanaimo, B. C. Hollett (1970) (reference no. 49), in another publication, stated that the "analysis of salmon tagging research fishing results from studies conducted in Dixon Entrance in 1966 and 1967 revealed racial differences between stock compositions and migration patterns of pink salmon entering the region in these two years." The information is contained in a report titled "A summary of the 1966 and 1967 results of the Dixon Entrance salmon investigations", Canada Department of Fisheries, Vancouver, B. C. (typescript, 14 pp.). This document is not available from the library. The report referred to in reference no. 49 appears to be a different report from reference no. 35a.

The figure of tagging areas (from 35a) is extracted from the letter report. A tabled summary of the tagging data and commercial recaptures was compiled from the report. Freshwater recovery data is available in tables in the original document. Also included in table form are the recapture data by statistical areas for each of the 5 species of Pacific salmon tagged in northern British Columbia during 1967.

Table: Summary of the tagging data by location and the commercial recaptures () of salmon species tagged in a northern British Columbia program during 1967.

Location	Sockeye	Pink	Chum	Coho	Chinook
Dundas Island, 3X	181(97)	24(3)	28(6)	1284(160)	
Dundas Island, 3Y	141(58)	376(142)	217(73)		
Dundas Island, 3X&3Y				19*3)	68(16)
Zayas Island	210(95)	216(65)	21(6)		
Cape Chacon	105(56)	121(28)	22(0)		
Cape Muzon	185(71)	591(89)	89(5)		
Langara Island	162(74)	2157(421)	96(14)		
North Q.C.I .	367(168)	1276(285)	109(10)		
Hecate Strait & Browning Ent.		47(7)		180(14)	54(4)

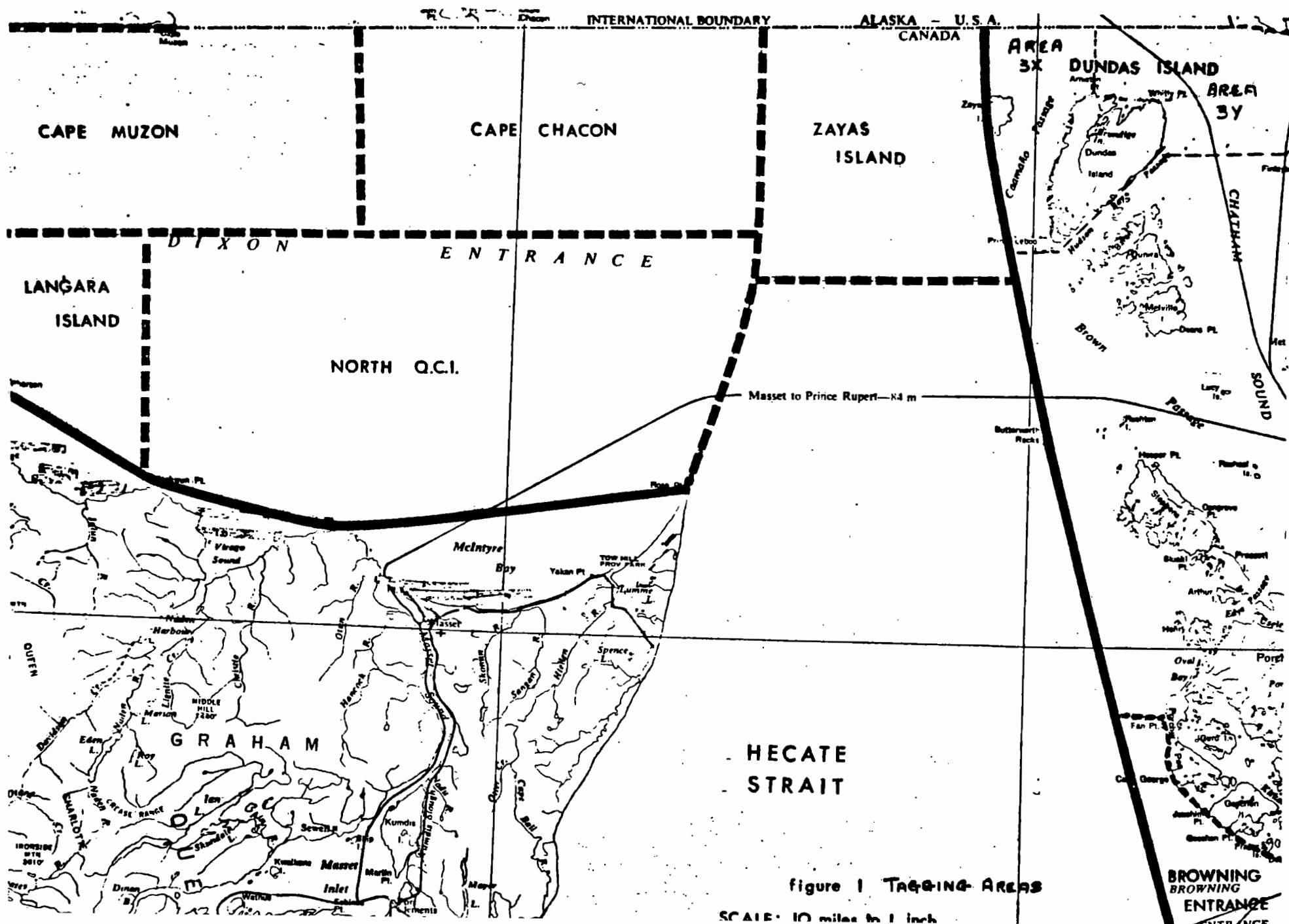


Table: Tag-recovery data by statistical area for sockeye salmon tagged in northern British Columbia during 1967.

		Recovery Sites by Areas																
Location	Dates	Total Tagged	Area 3														Total Recap.	Alaska
			1	2	X	Y	Z	4	5	6	9	10	11	12	29	?		
Dundas Island (3Y)	Jun 22-Aug 5	141			2	4	4	43	3	2							58	4
Dundas Island (3X)	Jun 30-Aug 6	181															97	0
North Q.C.I .	Jul 6-Aug 20	367				41		121	2			1		2	1		168	3
Cape Muzon	Jul 1-Aug 15	185				12		50		1	1			5	1		71	4
Cape Chacon	Jul 2-Aug 15	105				13		43									56	2
Langara Island	Jun 29-Aug 22	162				11		59						2		2	74	2
Zayas Island	Jul 12-Aug 16	210				18		74	1	1						1	95	5

Tag-recovery data () by statistical area for pink salmon tagged in northern British Columbia in 1967.

<u>Location</u>	<u>Dates</u>	<u>Total Tagged</u>	<u>Recovery Sites by Area</u>
Dundas Is. (3Y)	Jul 2-Aug 5	376	3X(2); 3Y(17); 3Z(113); 4(9); Unknown(1); Total(142); Alaska(6).
Dundas Is. (3X)	Jul 7-Aug 6	24	3Z(3); Total(3); Alaska(1).
Zayas Island	Jul 12-Aug 22	216	Area 3(26); 4(28); 6(1); 7(1); 8(1); 12(1); 13(1); 29(2); Convention waters(1); Total(62); Alaska(3).
Langara Island	Jun 29-Aug 25	2157	1(9); 3Y(113); 4(117); 5(8); 6(4); 7(4); 8(6); 9(2); 10(2); 11(2); 12(74); 13(30); 16(2); 20(16); 29(10); Unknown(4); Convention waters(12); Total(421); Alaska(20).
Muzon Island	Jul 1-Aug 17	591	Area 3(20); 4(40); 5(6); 6(5); 8(2); 9(1); 10(1); 12(8); 13(2); 16(1); 20(2); Convention waters(1); Total(89); Alaska(12).
North Q.C. I.	Jul 6-Aug 24	1276	1(5); Area 3(91); 4(80); 5(5); 6(17); 7(2); 8(2); 9(2); 11(3); 12(46); 13(12); 20(7); 21(2); 24(1); 29(4); Unknown(2); Convention waters(5); Total(285); Alaska(14).
Browning Ent.	Jun 30-Aug 18	47	3Y(1); 4(5); 12(1); Total(7).

Tag-recovery data () by statistical area for chum salmon tagged in northern British Columbia in 1967.

<u>Location</u>	<u>Dates</u>	<u>Total Tagged</u>	<u>Recovery Sites by Area</u>
Dundas Island (3Y)	Jun 22-Aug 5	217	3X(1); 3Y(14); 3Z(52); 4(4); 5(2); Total recap.(73); Alaska(8).
Dundas Island (3X)	Jun 30-Aug 6	28	3Y(1); 3Z(4); 4(1); Total recap.(6); Alaska(2).
North Q.C.I.		109	2(4); Area 3(2); 4(1); 6(1); 7(2); Total recap.(10); Alaska(2).
Muzon Island	Jul 1-Aug 15	89	2(3); 7(2); Total recap.(5); Alaska(1).
Langara Island	Jun 29-Aug 23	96	2(8); Area 3(3); 4(1); 6(1); 7(1); Total recap.(14); Alaska(1).
Cape Chacon	Jul 2-Aug 15	22	0
Zayas Island	Jul 3-Aug 7	21	Area 3(4); 4(2); Total recap.(6); Alaska(2).

Tag-recovery data () by statistical area for coho salmon tagged in northern B. C. in 1967.

<u>Location</u>	<u>Dates</u>	<u>Total Tagged</u>	<u>Recovery Sites by Area</u>
Dundas Island (3X and 3Y)	Jun 30-Aug 6	19	4(3); Total recap.(3); Alaska(0).
Dixon Entrance	Jun 29-Aug 27	1284	1(15); 2(2); Area 3(44); 4(73); 5(5); 6(9); 7(3); 8(3); 9(1); 10(2); 11-19(3); Total recap.(160); Alaska(14).
Hecate Strait and Browning Entrance	Jun 30-Aug 18	180	Area 3(2); 4(7); 6(2); 9(1); 10(2); Total recap.(14); Alaska(0).

Tag-recovery data () by statistical area for chinook salmon tagged in northern B. C. in 1967.

<u>Location</u>	<u>Dates</u>	<u>Total Tagged</u>	<u>Recovery Sites by Area</u>
Dundas Island (3X & 3Y)	Jun 22-Aug 6	68	3X(1); 3Y(1); 3Z(6); 4(8); Total recap.(16); Alaska(0).
Dixon Entrance	Jun 29-Aug 20	139	Area 3(2); 4(4); 5(1); 7(1); 11(1); 26(1); 27(1); 29(2); Total recap. (12); Alaska(1); Wash.(3); Oregon(1).
Browning Entrance	Jun 30-Aug 18	54	Total recaptured(3); Alaska(0); Wash.(1); Oregon(2).

The following information was extracted from reference no. 78 (Todd and Dickson, 1970):

"I. Introduction

"The Nass River is British Columbia's fourth largest producer of sockeye salmon. Commercial exploitation of the sockeye stocks of the Nass was initiated in 1881 with the opening of the Nass River Cannery at Nass Harbour, and a major fishery still prevails although canneries are no longer operated in the area. Catches have ranged as high as 450,000 sockeye and until the early 1940's averaged approximately 250,000 annually. Since that time major changes have occurred in the fishery, and the stock, as reflected by catches in the estuarine region, has declined substantially in abundance.

"The Resource Development Branch of the Department of Fisheries and Forestry of Canada in 1963 initiated a biological program designed to provide the information required for precise management of the Nass River sockeye stocks. The purpose of this report is to review the history of the Nass River sockeye fishery and to present the results of the biological programs conducted to date.

"D. Interception of Nass River Sockeye by Other Fisheries

"Canadian fishermen have periodically stated that the Alaskan fishermen catch much of the Nass River sockeye run, and in poor years, such as 1917, 1928 and 1935, they often blamed Alaska for their reduced catch. In 1917 the Alaskans first operated traps located outside Pearse Canal and north along the Alaska coast to Cape Fox. Tagging operations conducted at Cape Fox in 1926 (Rich and Suomela, 1927) showed that some Nass bound sockeye are intercepted by this Alaskan fishery. Further tagging operations since that date indicated that in some years the Alaskans catch a substantial percentage of Canadian fish bound for the Nass and Skeena areas at Cape Fox and in other areas as well, as shown in a report submitted to the Governments of Canada and the United States concerning exploitation of salmon bound for one country by fishermen of the other in northern B. C. and southeastern Alaska (Anon, MS 1965). In 1959 the Alaskans stopped operating most of these traps, but net fishing is pursued in these areas and presumably interception of Nass-bound sockeye still occurs.

"In 1956 the Nass fishing area, B. C. Statistical Area 3, was divided into three sub-areas, 3X, 3Y and 3Z (Figure 2). Tagging programs had indicated that considerable numbers of Skeena bound sockeye and some sockeye bound for Alaska are intercepted in sub-areas 3X and 3Y, and to a lesser extent in 3Z. Thus, from 1956 onwards in an effort to rehabilitate Skeena sockeye stocks, which had been greatly reduced as a result of the Babine River slide in 1951 (Godfrey et al., 1956), sub-areas 3X and 3Y have been placed under Skeena management for the period of each year that Skeena stocks predominate in these areas. Sockeye caught within sub-area 3Z were found to be almost wholly Nass River fish although some sockeye bound for the Skeena are intermingled in the seaward portion of sub-area 3Z.

"In recent years Skeena sockeye stocks have recovered from the effects of the Babine slide and at present range between 1,000,000 and 2,000,000 annually. Conversely, the Nass River stock declined to less than 250,000 sockeye annually during the same period. It now appears to be necessary to adopt regulatory procedures in sub-areas 3X and 3Y similar to those of sub-area 3Z in order to provide protection to the Nass River sockeye stocks as they migrate through the area. Reduction of fishing time in sub-areas 3X and 3Y will not affect regulation of Skeena bound sockeye, since the Area 4 fishery is more than adequate to exploit stocks of the present magnitude at any desired level.

"E. Trends in Catch

The Nass River catch increased steadily from the first recorded pack of 87,000 sockeye in 1881, reached a maximum of approximately 450,000 during the 1910-1915 period, and declined slowly to 200,000 or less by the late 1940's (Figure 3, Table I). Since the early 1950's catches recorded in B. C. Statistical Area 3 in total have fluctuated broadly but on the average have increased slightly over that of the previous few years."

Table I. Nass River Sockeye Fishery: Catches¹, Canneries and Gillnet Licenses, 1881-1969.

Year	Sockeye Pack	Sockeye (pieces) ²	Number Canneries Operating	Number Gillnet Licenses	Year	Sockeye Pack	Number Sockeye Per Case	Sockeye (pieces)	Number Canneries Operating	Number Gillnet Licenses	Subarea 32 Sockeye (pieces)
1881	7,700	87,395	1		1926	15,929		180,794	4	316	
1882	16,100	182,735	2		1927	11,986		136,041	4	302	
1883	20,393	231,347	2		1928	5,558		63,083	3	263	
1884	8,500	96,475	1		1929	16,347		185,539	3	240	
1885					1930	26,500		300,775	3	282	
-87	Data Not Available				1931	16,929		192,144	1	235	
1888	12,318	139,809	1		1932	15,138		171,816	3	278	
1889	19,410	220,304	3		1933	10,173		115,464	3	297	
1890	23,906	271,333	3		1934	36,242		411,346	3	335	
1891	10,323	117,166	3		1935	12,712		144,281	3	310	
1892	25,434	288,676	3		1936	28,562		324,179	3	349	
1893	15,190	172,407	3		1937	17,590	12.24	215,302	2	321	
1894	19,587	222,313	1		1938	21,746	12.24	266,171	2	309	
1895	19,550	221,893	1		1939	24,425	11.77	287,482	2	289	
1896	14,649	166,266	1		1940	13,810	10.17	140,448	2	254	
1897	20,847	236,614	1		1941	24,876	11.94	297,019	2	281	
1898	18,953	215,117	1		1942	24,461	11.25	275,156	2	170	
1899	19,443	220,678	1		1943	13,413	12.00	160,956		199	
1900	18,238	207,001	1		1944	13,318	11.58	154,222	1	186	
1901	14,790	167,867	1		1945	9,751	12.07	117,695	1	158	
1902	20,353	237,817	2		1946	12,511	13.43	168,000		171	
1903	12,100	137,335	1		1947	10,877	11.68	127,000		204	
1904	15,000	170,250	2		1948	13,181 ⁴	11.83	156,000			
1905	24,462	277,644	3		1949	9,268	11.65	108,000			
1906	22,166	251,584	3		1950	27,286 ⁴	10.22	278,956			
1907	17,813	202,178	3		1951	24,405 ⁴	9.24	225,464			
1908	27,584	313,078	3		1952	29,492	10.32	304,500			
1909	28,246	320,592	3		1953	18,162 ⁴	10.92	198,400			
1910	30,810	349,694	4	240	1954	10,285	9.88	101,600			
1911	37,327	423,662	3	240	1955	13,654 ⁴	11.34	154,904			
1912	36,037	409,020	3	265	1956	22,505	11.32	254,800			165,768
1913	23,574	267,565	3	265	1957			143,113			64,863
1914	31,327	355,562	4	265	1958			398,550			226,591
1915	39,349	446,611	4	265	1959			226,696			135,984
1916	31,411	356,515	4	265	1960			132,943			89,442
1917	22,188	251,834	4	265	1961			281,161			151,090
1918	21,816	247,612	6	265	1962			217,899			68,457
1919	28,259	320,740	5	300	1963			29,218			9,867
1920	16,740	189,999	5	342	1964			169,883			68,570
1921	9,364	106,281	5	338	1965			136,190			75,565
1922	31,277	354,934	5	304	1966			174,252			68,765
1923	17,821	202,268	5	244	1967			439,552			101,650
1924	33,590	381,247	4	210	1968			259,034			71,289
1925	20,351	230,984	3	210	1969			200,539			85,811

¹Figures from 1881 to 1956 from Canada, Department of Fisheries Annual Reports.

Figures from 1957 to 1969 from B. C. Catch Statistics.

²From 1881 to 1936 the pack was converted to pieces on basis of a mean of 11.35 sockeye per case (calculated from 1937 - 1956 catches).

The following information was extracted from reference no. 90 (Wood, 1970). The table from reference no. 88 (Wood et al., 1970) shows the 1948 to 1968 sockeye salmon escapements to Rivers Inlet. This table is included for descriptive purposes with the information extracted from reference no. 90. Also included in this section are figures extracted from reference no. 91 (Wood and Mason, 1971) to indicate migration timing of Rivers Inlet sockeye as indicated by echo sounder enumeration studies (1968 to 1970).

"Introduction

"Although Rivers Inlet is physically typical of the many inlets of the B. C. coast, the sockeye salmon stocks of this inlet make it unique. After that of the Fraser River, the commercial sockeye catch of the Rivers Inlet area is second largest in B. C. From its start in 1882, the commercial fishery in Rivers Inlet grew rapidly in a pattern similar to the other major sockeye fisheries on the coast; rapid increase, levelling off for a period, followed by recent declines in catch.

"The isolated location of the region, along with the size and rugged coastal nature of the spawning and rearing areas have impeded the acquisition of much of the quality data necessary for precise regulation of the commercial fishery and enhancement of the salmon stocks. Several basic parameters necessary for management of these stocks have yet to be accurately quantified - these include measurement of exploitation rates of the individual stocks, accurate definition of racial timing, definition of optimum escapements, and definition of areas in which stocks destined to Rivers and Smith inlets could be exploited separately.

"Analysis of past catch data suggests that the strength of the combined Rivers and Smith inlets sockeye stock has undergone a long term decline.

"Timing and Migration

"In conjunction with pre-exploitation population and escapement sampling in 1965 and 1966, fish were tagged to provide data on migration routes, rate of travel, and timing of Rivers Inlet sockeye. Tags were recovered in the commercial fishery and on the spawning grounds. Return of tags from fish caught by the commercial fishery provided information from which the number of days out from tagging and the distance travelled from the tagging site was calculated. By using the mean number of days to recovery at various locations, a map

of possible migration routes through the inlet can be drawn (Figs. 12, 13). The central line indicates the path of the main portion of the stocks while the branch lines may represent fish following local current patterns in the bays and thereby spending a longer time migrating to the head of the inlet. The modal number of days out to the various sites provides a reasonably accurate estimate of the rate of migration of the fish through the inlet (Fig. 14, 15). The mode is used because it is indicative of rate of migration of the largest number of fish.

"It was hoped that timing of the various stocks through the fishery could be determined from the recovery of tags on the spawning grounds. However, in 1965 severe flooding of the spawning areas limited the total tag recovery to 35 tags. In 1966, 150 tags were recovered. The recoveries from both years are plotted as tagging date against recovery location (Fig. 16). The rivers are arranged as to their time of spawning (top = early). The slight displacement between the timing of the upper and lower streams suggests that all stocks pass through the inlet together. There are, however, indications that the timing of the various stocks through the fishery is governed to some extent by lunar periodicity. Under certain conditions differential timing may occur. With only mixed stocks in the inlet it is impossible to adjust the regulations to protect a single stock."

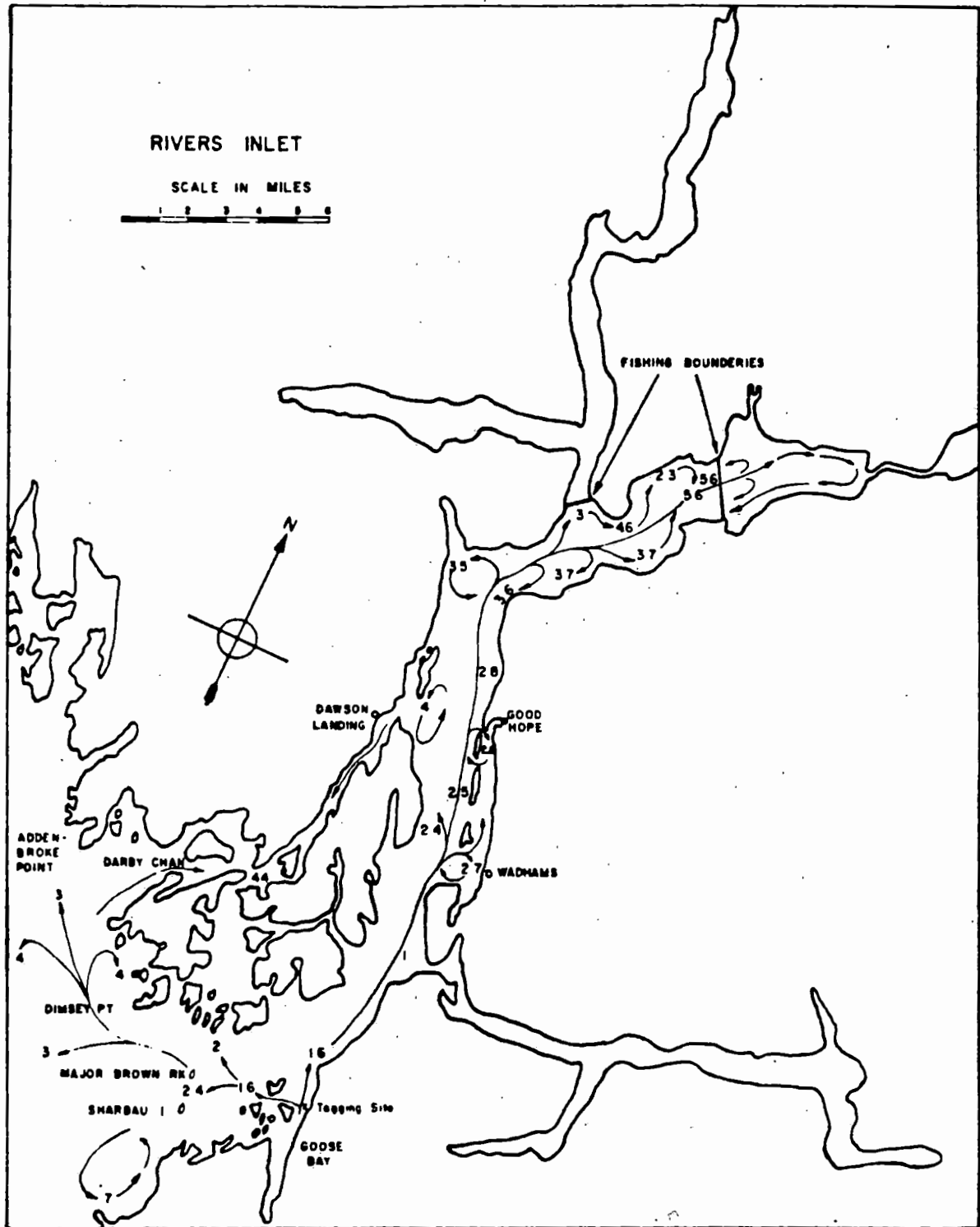


Figure 12. Mean number of days to recovery site of fish tagged at the mouth of Goose Bay. Interconnecting lines represent possible migration pattern of sockeye through the inlet in 1965.

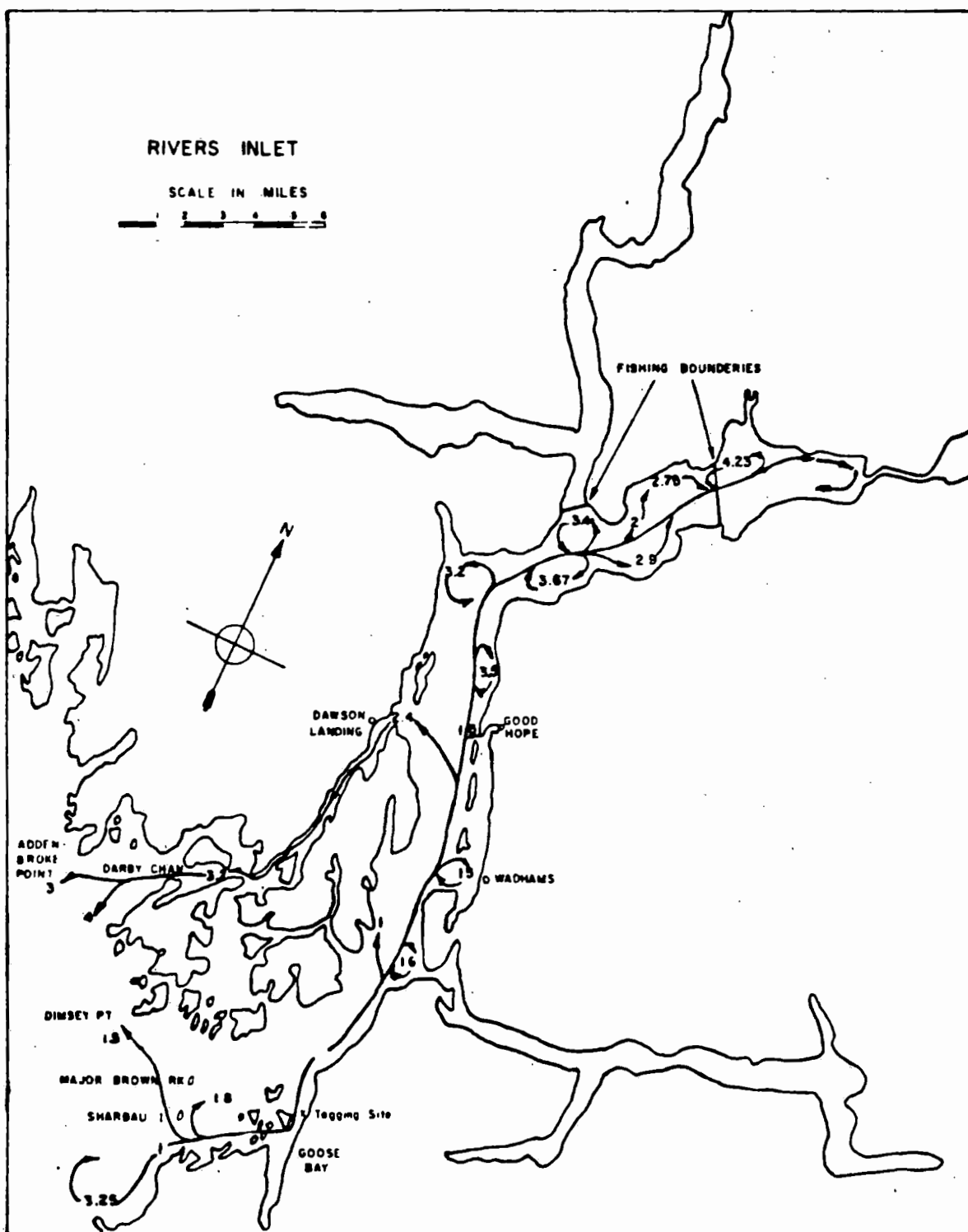


Figure 13. Mean number of days to recovery site of fish tagged at the mouth of Goose Bay. Interconnecting lines represent possible migration pattern of sockeye salmon through the inlet in 1966.

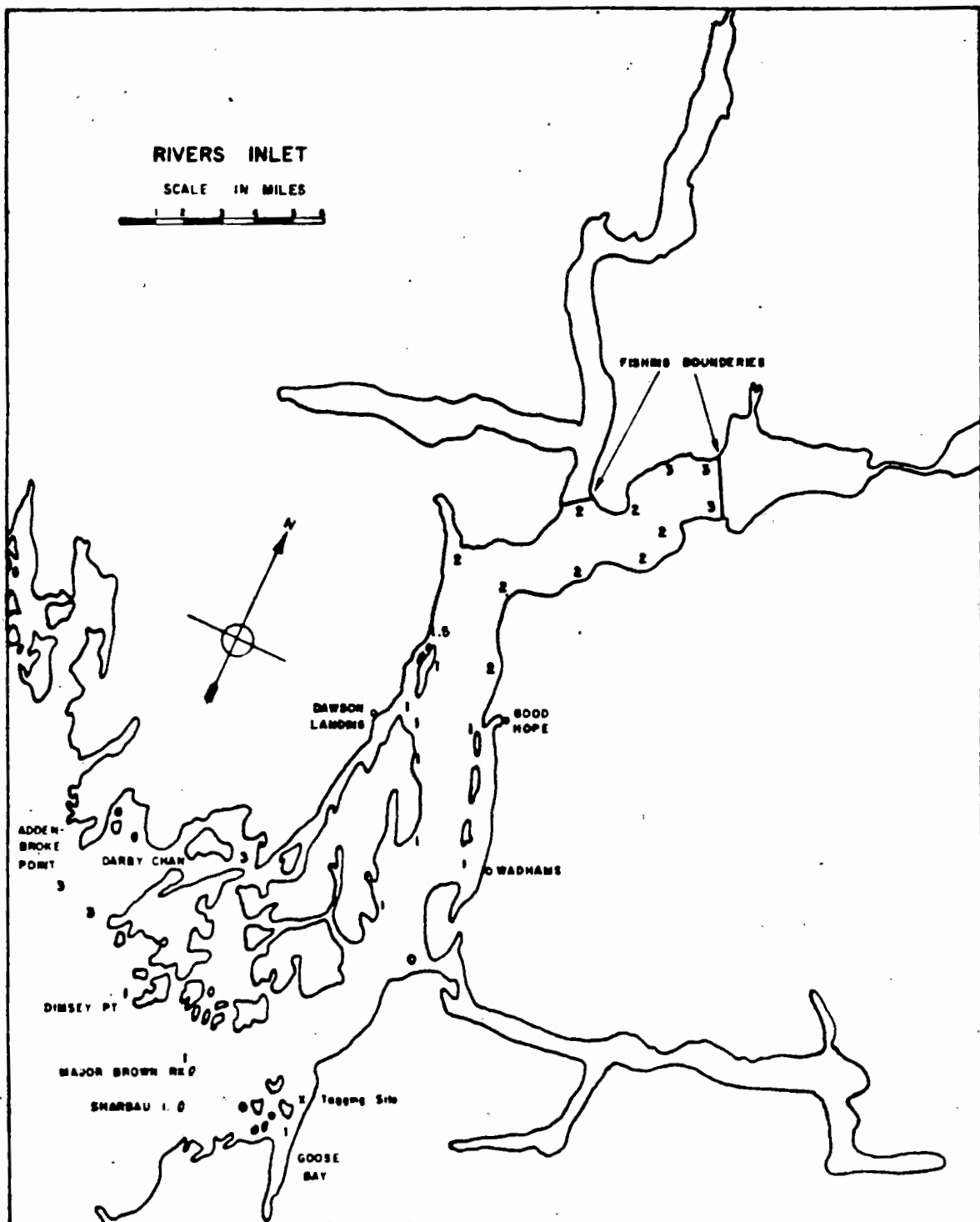


Figure 14. Modal number of days to recovery site of fish tagged at the mouth of Goose Bay (x). Figure is representative of the rate of migration of the bulk of the fish in 1965.

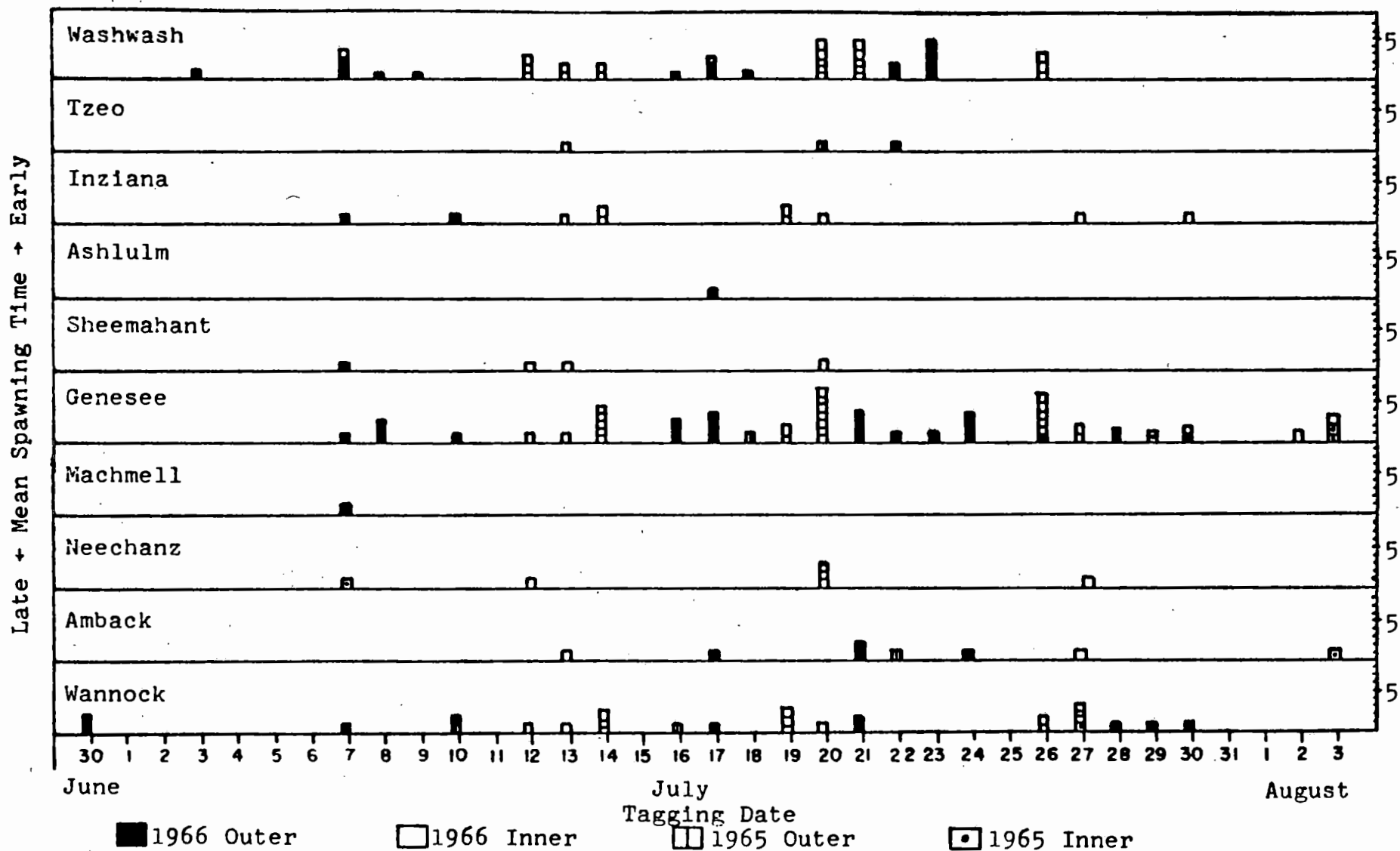


Figure 16. Tags recovered on the spawning grounds, recorded as to location of recovery and time and location of tagging: outer refers to fish tagged at the mouth of the inlet, inner refers to those tagged at the head of the inlet.

The following information was extracted from reference no. 88 (Wood et al., 1970).

1948 to 1968 Escapements to the major Rivers Inlet Sockeye Salmon Spawning Areas.

Year	Amback River	Askum River	Dallery River	Genesee River	Inziana River	Machmell River	Nee-chanz River	Shee-mahant River	Shee-mahant Flats	Tzeo River	Tzeo Flats	Wannock R & Flats	Wash-wash River	Annual Total
1948	G	G	F	F	L		E	K		H		L	G	105,250
1949	M	G	K	K	K		H	L		G		L	L	236,500
1950	M	H	M	H	L		K	M		K		M	M	445,000
1951	L	L	L	G	L		K	L		H		L	M	291,000
1952	M	L	N	K	M		L	M		H		M	N	529,500
1953	L	K	M	K	M		H	L		H		M	N	438,500
Mean	59,000	19,200	59,400	11,200	47,000		29,500	49,000		7,900		59,000	73,000	400,700
1954	H	C	M	F	L		F	L		G		K	D	155,300
1955	H	G	N	G	G		G	L		D		G	H	167,900
1956	K	K	M	G	K		H	L		K		L	H	223,500
1957	L	K	L	D	H		H	L		H		L	L	212,900
1958	L	L	K	G	H		H	L		H		E	M	221,750
Mean	20,000	13,760	58,000	2,480	11,700		5,600	35,000		6,780		17,850	25,100	196,270
1959	M	G	N	G	M		H	M	H	K	G	M	K	455,500
1960	K	D	L	G	G		H	L		D		L	G	138,800
1961	K	G	L	G	H		H	L	D	G	C	L	K	161,100
1962	M	G	L	L	L		K	L	H	G	F	N	M	421,000
1963	M	L	N	M	N		L	M	H	L	F	N	N	739,000
Mean	51,000	9,180	61,000	24,100	44,200		14,500	51,000	4,580	11,480	1,340	69,000	41,700	383,080
1964	M	G	N	K	M		K	M	L	K	K	M	M	573,500
1965	G	B	K	H	K		H	K	E	F	D	M	H	148,925
1966	K	F	K	K	H		K	L	K	H	G	L	L	190,250
1967	G	E	G	K	F		H	M	M	G	K	N	N	482,000
1968	G	L	K	L	N		L	M		K	L	M	N	555,000
Mean	23,700	8,165	29,700	17,100	39,800		16,000	52,000		8,500	11,070	77,000	585,000	389,935
O.A.														
Mean	38,425	12,576	52,025	12,970	37,425		16,400	46,750		8,665	6,205	55,712	206,000	342,496

A = 1-50

B = 50-100

C = 100-300

D = 300-500

E = 500-1000

F = 1000-2000

G = 2-5000

H = 5-10,000

K = 10-20,000

L = 20-50,000

M = 50-100,000

N = 100,000+

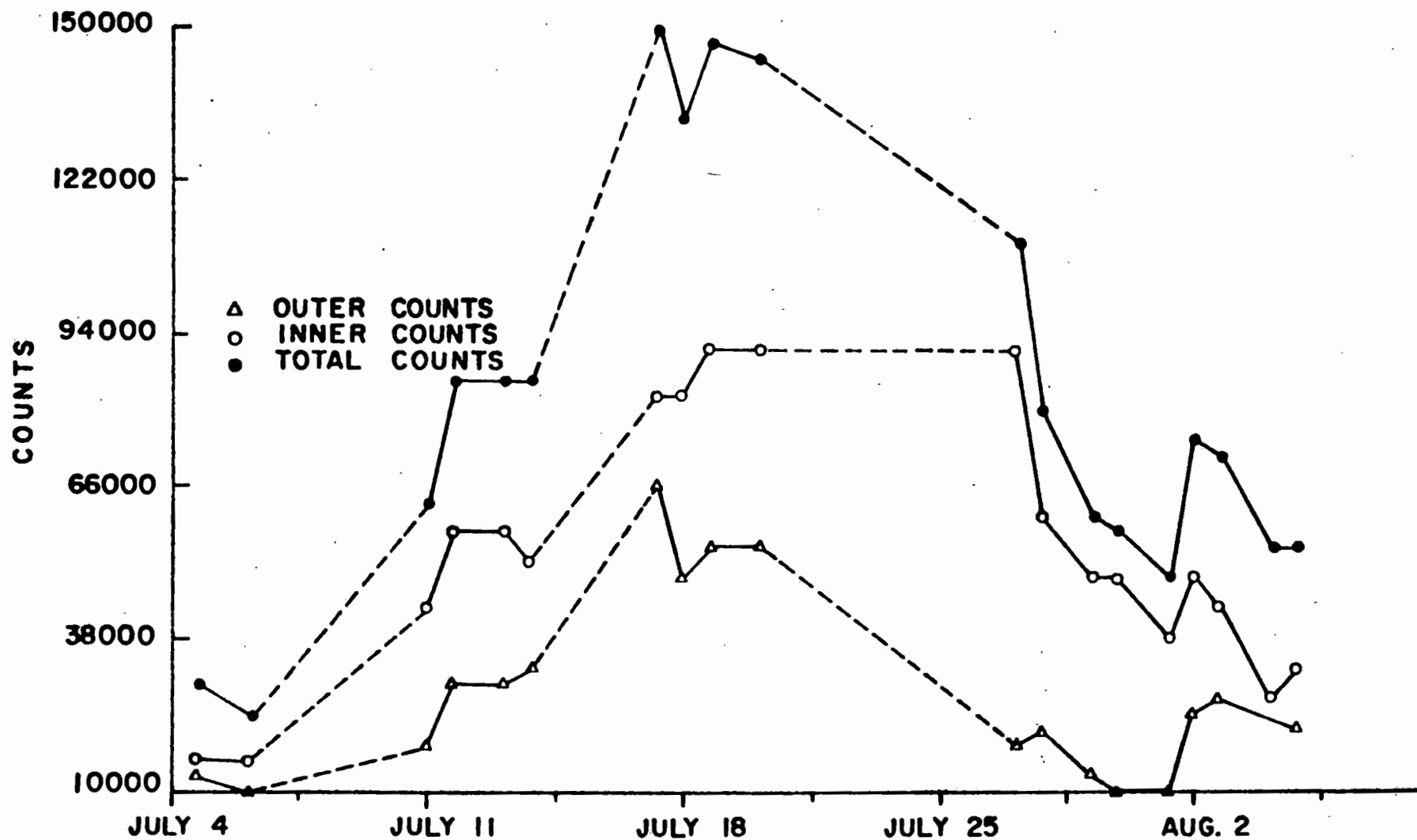


Figure 3. 1968 daily counts of sockeye salmon in Rivers Inlet estimated by echo sounding techniques.
(From Wood and Manson, 1971.)

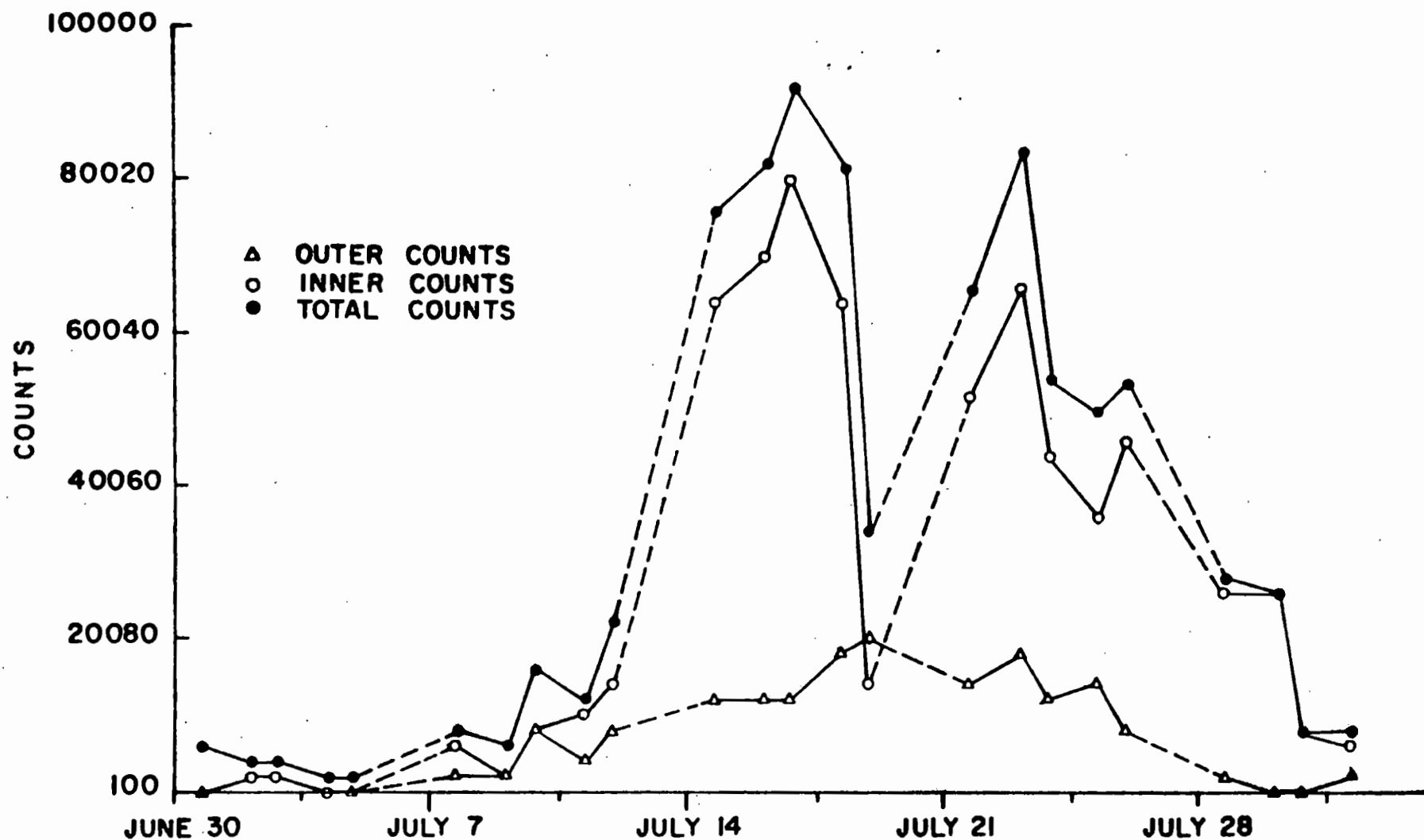


Figure 9. 1969 daily counts of sockeye salmon in Rivers Inlet estimated by echo sounding techniques.
(From Wood and Manson, 1971, reference no. 91.)

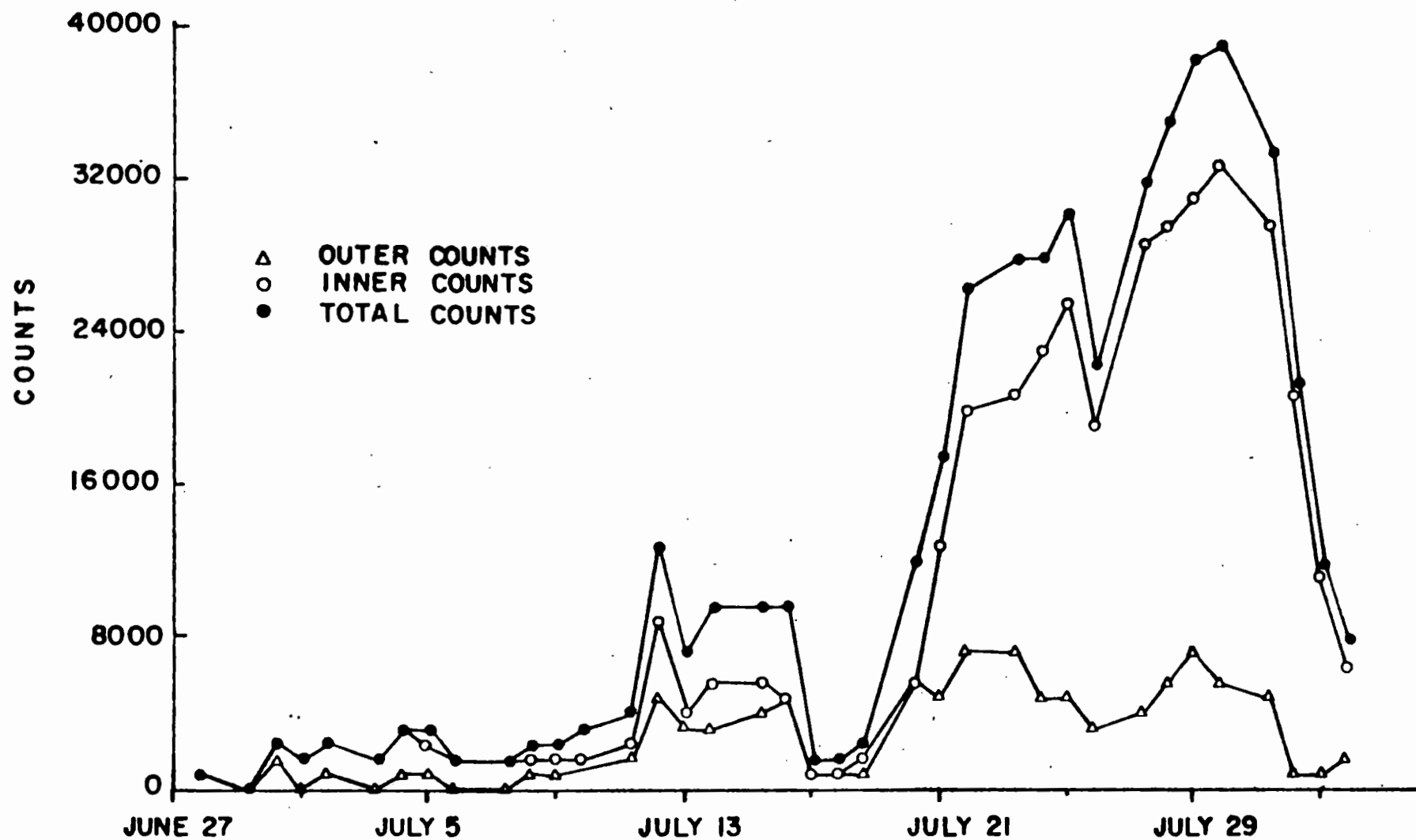


Figure 10. 1970 daily counts of sockeye salmon in Rivers Inlet as estimated by echo sounding techniques.

(From Wood and Manson, 1971, reference no. 91.)

The following information was extracted from reference no. 89 (Wood, 1970):

"Introduction

"A sockeye salmon enumeration program was initiated in July 1963, on the Long Lake system (Figure 1) in order to obtain an early indication of the strength of the escapement. It was considered that an early indication of the magnitude of the escapement would permit more effective management of the commercial sockeye fishery in Smith Inlet. Sockeye normally appear at the entrance to Wyclees Lagoon as early as late June, and migrate through the lagoon and into Long Lake during July. In past years the magnitude of the escapement has not been assessed until the fish have appeared on the spawning grounds in early September.

"The commercial fleet distribution and its catches suggest that Smith Inlet sockeye stocks on spawning migration enter Smith Sound from numerous directions but migrate predominantly along the north shore of the sound past Margaret Bay into Smith Inlet (see Figure 1). There are indications that a significant percentage of the fish entering Smith Inlet migrate as far up the inlet as Burnt Island (Figure 1) before returning to the mouth of Quashella Creek (Figure 1). The length of time which the fish hold off the mouth of this creek appears to be quite variable. In most years, the upstream migration is initiated when large tides occur, i.e., on the new or full moon."

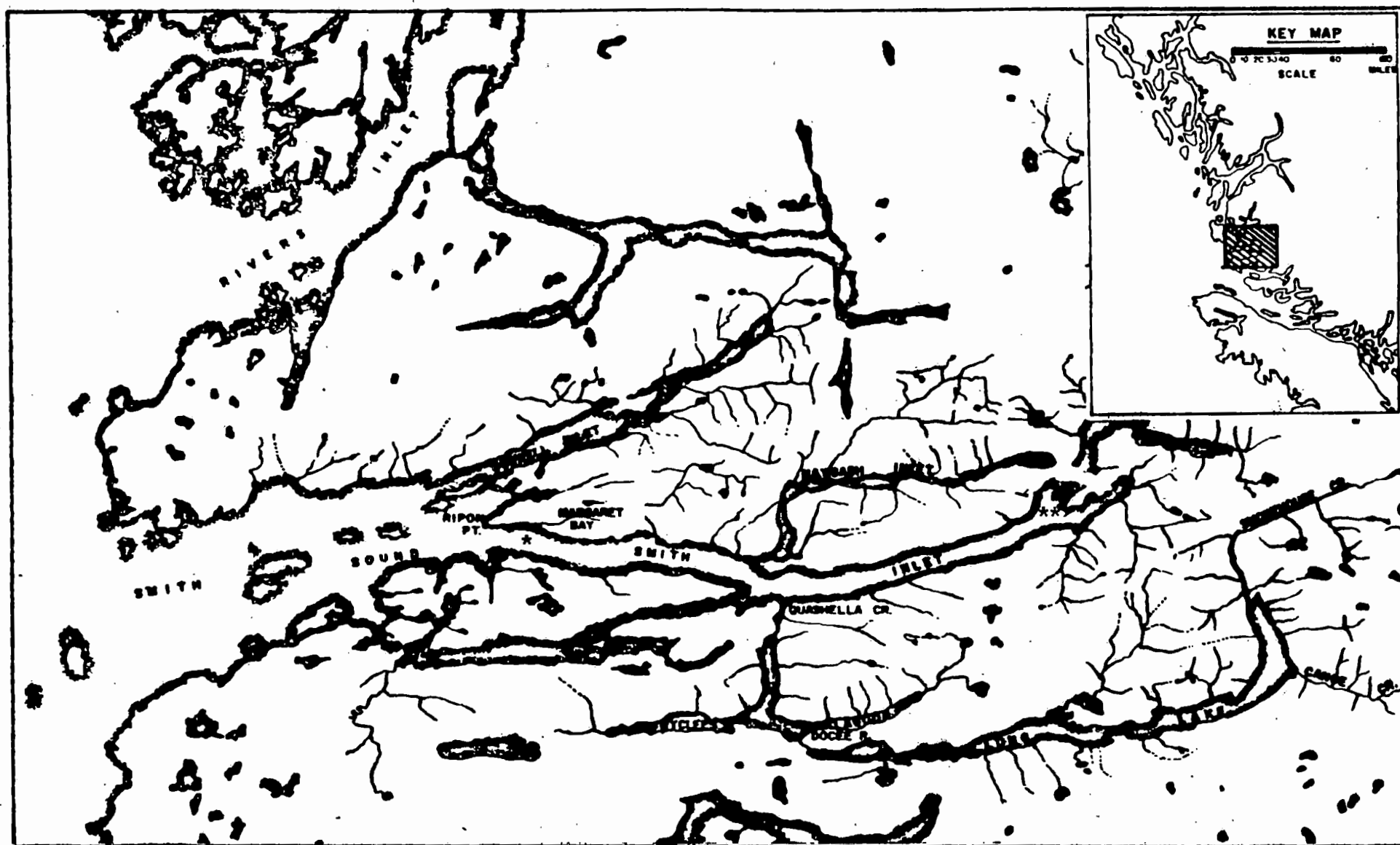


Figure 1. Location map of Smith Inlet and adjacent areas.
*Margaret Bay; **Burnt Island.

The following information was extracted from reference no. 73 (Schutz, 1970). See pink salmon section for introduction.

"Sockeye Salmon Prospects

"Only two major stocks of sockeye are exploited in the Johnstone Strait fishery. These are Fraser and Nimpkish River stocks.

"(1) Fraser River Stocks: The International Pacific Salmon Fisheries Commission has predicted a run of 6,800,000 Fraser River sockeye in the 1970 season. The timing of Fraser River sockeye through Johnstone Strait overlaps broadly with that of the pinks, but no management problems are expected if both species return at the anticipated high levels of abundance.

"(2) Nimpkish River Stock: The Nimpkish River sockeye escapement since 1950 has averaged approximately 95,000 fish and the contribution to the commercial and native food fisheries has averaged 70,000 and 5,000 fish respectively. The total annual stock has, therefore, averaged approximately 170,000 sockeye. Examination of Nimpkish River sockeye scales has shown that the stock is comprised mainly of age 4₂ and 5₂ fish, and that either age class may predominate in any particular year. The 1970 return then, will be produced by the 1965 and 1966 escapements which were estimated at 30,000 and 120,000 respectively. An average return is expected in 1970.

"Analysis of the available data indicates that the Nimpkish River run contributes significantly to the Area 12 catch from mid-June until late July, with a peak contribution around mid-July. Consequently, the migration of Nimpkish River sockeye is virtually complete prior to the main migration period of study area pink salmon."

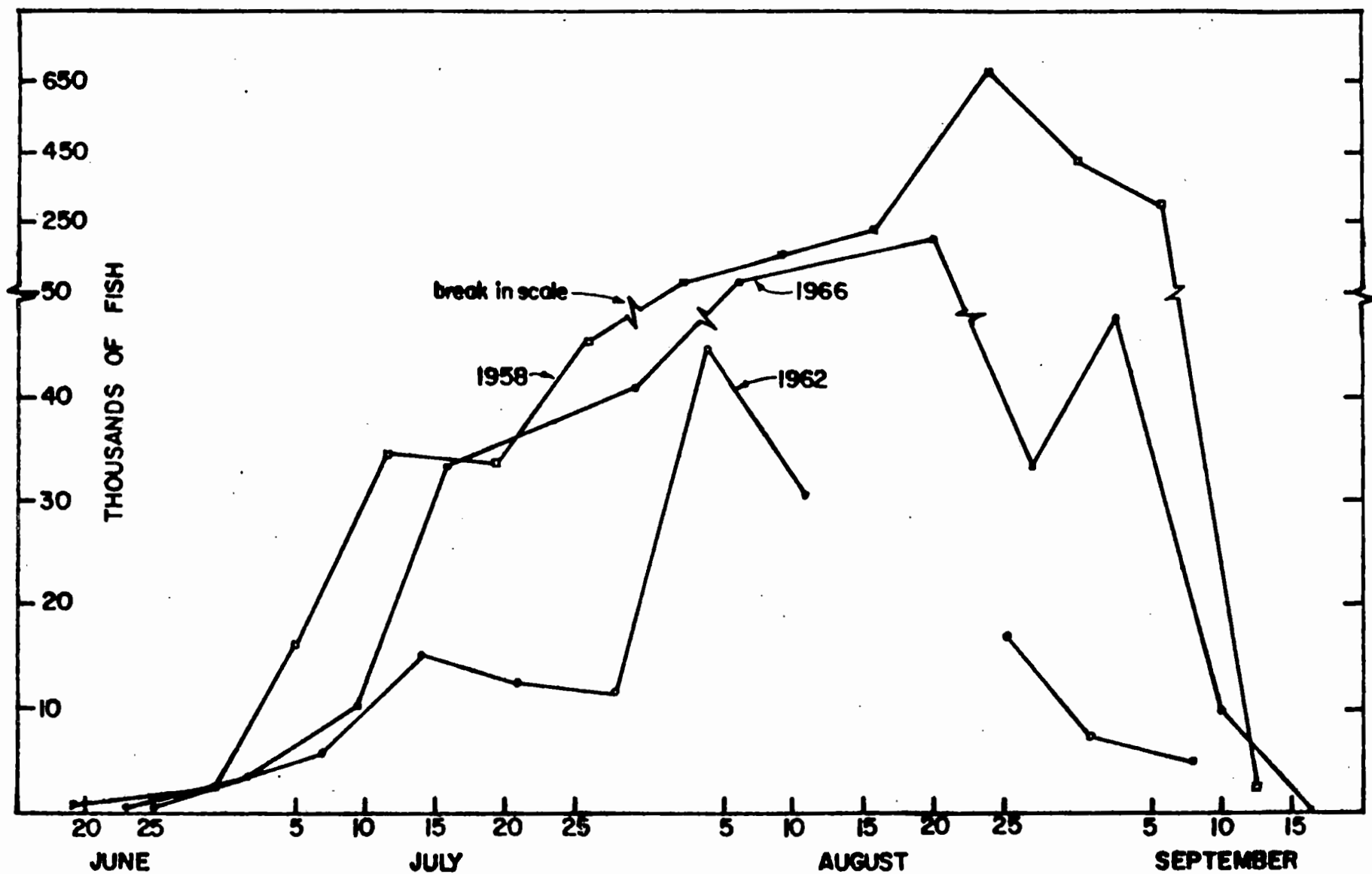


FIGURE 4 Weekly catches of sockeye salmon in Area 12 in the years 1958, 1962 and 1966.

The following information was extracted from reference no. 22 (Argue, 1970):

FACTORS AFFECTING EXPLOITATION

A. Seasonal Timing of Exploitable Salmon

1. Introduction and Methods.

In a gantlet fishery where multiple species are highly exploitable, it is clearly important to determine timing of each run¹ if each species' escapement is to be realized. When the fishery is composed of competing gear types of different harvesting capabilities and species preferences (for example, commercial net fisheries versus sport fisheries), regulations can be adjusted to benefit the least efficient gear if catch sacrificed by more efficient gears is not excessive. Such manipulation would depend, in part, on seasonal timing of each gear's "exploitable salmon."

Emphasis is placed on seasonal timing of exploitable runs through Juan de Fuca fisheries as inferred from commercial and sport catch statistics, tagging data (chinook and coho only) and as reported in previous studies. Exact

¹ As used here, a run refers to a single species' appearance in the fishery. Each run is an assemblage of stocks where each stock is a group of fish that should be treated as a homogeneous unit in an optimum management program (Paulik and Greenough, 1966). In practice, identification techniques usually only allow definition of clusters of stocks, called major races: for example, Henry (1961) defined certain major Fraser River sockeye races using scales. The more popular definition of race is a population of salmon which will spawn in a particular river or tributary at a particular time of the year (Mason, 1965). This is often an impractical definition for purposes of fishery regulation.

timing of runs and peak abundance within runs can seldom be precisely forecast because of fluctuating abundance of distinctly timed stocks, oceanographic and climatological variations, and in some cases, biases due to differences in availability of different species to indexing gears. Variability between species in such characteristics as sharpness of the period of peak abundance, number of peaks, symmetry of the distribution and mean date of time-abundance curves is related to differences between species in such characteristics as number of component stocks, diversity of geographical areas and spawning times represented by component stocks, and so on.

For the Strait of Juan de Fuca fisheries, coho timing may be estimated from weekly Area 20 gillnet plus seine catches (1951 to 1968), weekly Sport Area 19B and 20 catch per unit effort (CPUE), 1967 test trolling CPUE, and 1968-1969 CDFP tagging. Chinook timing may be estimated from weekly net catches (1963 to 1968), 1969 CDFP tagging and weekly troll CPUE (1963 to 1967). Pink, sockeye and chum timing may be estimated by weekly Area 20 net catches (1959 to 1968). Appendix A details field methods for test trolling.

d) Sockeye

The majority of exploitable sockeye passing through Juan de Fuca Strait are of Fraser River origin (Verhoeven and Davidoff, 1962; Killick and Clemens, 1963); however, since 1968 an artificially enhanced stock from Lake Washington has increased in importance.

Juvenile sockeye leave the Fraser in spring of their second year of life (Killick and Clemens, 1963) and apparently undergo rapid out-migration as few are captured inshore during the summer months

(Ricker, 1966). Sockeye at this age are not caught by sport or troll gear; in fact, Juan de Fuca hook and line catch of sockeye is negligible at all times.

Based on sampling from Sooke traps, sexually maturing sockeye return through Juan de Fuca Strait between mid-June and the first week in September (Killick and Clemens, 1963). Peak timing of the Fraser run depends on stock composition. Since 1959 various combinations of the Horsefly, Chilko, late Stuart and Adams River stocks produced considerable variability in peak net catch (Figure 11). Killick and Clemens, based on scale analyses by Henry (1961), place peak abundance of Horsefly, Chilko, late Stuart at Sooke traps between July 26 and August 1. Horsefly sockeye arrive about five days before Chilko and late Stuart sockeye. Early Stuart sockeye peak first, on approximately July 4; Adams River sockeye peak last, about August 20.

Gilhousen (1960) assessed annual variation in peak migration date of Adams sockeye passing through San Juan Island fisheries. For nine cycle years (every four years) between 1926 and 1958, peak occurrence varied between August 7-10 in 1926 and September 2 in 1958; six cycles peaked between August 24 and 31.

With the exception of Adams River sockeye, the stocks proceeding to areas above Hell's Gate appear earliest in the Strait and are followed by stocks which spawn below Hell's Gate, with exception of Pitt River sockeye (Killick and Clemens, 1963). Timing of peak spawning (Aro and Shepard, 1967) shows closer correspondence with migration timing

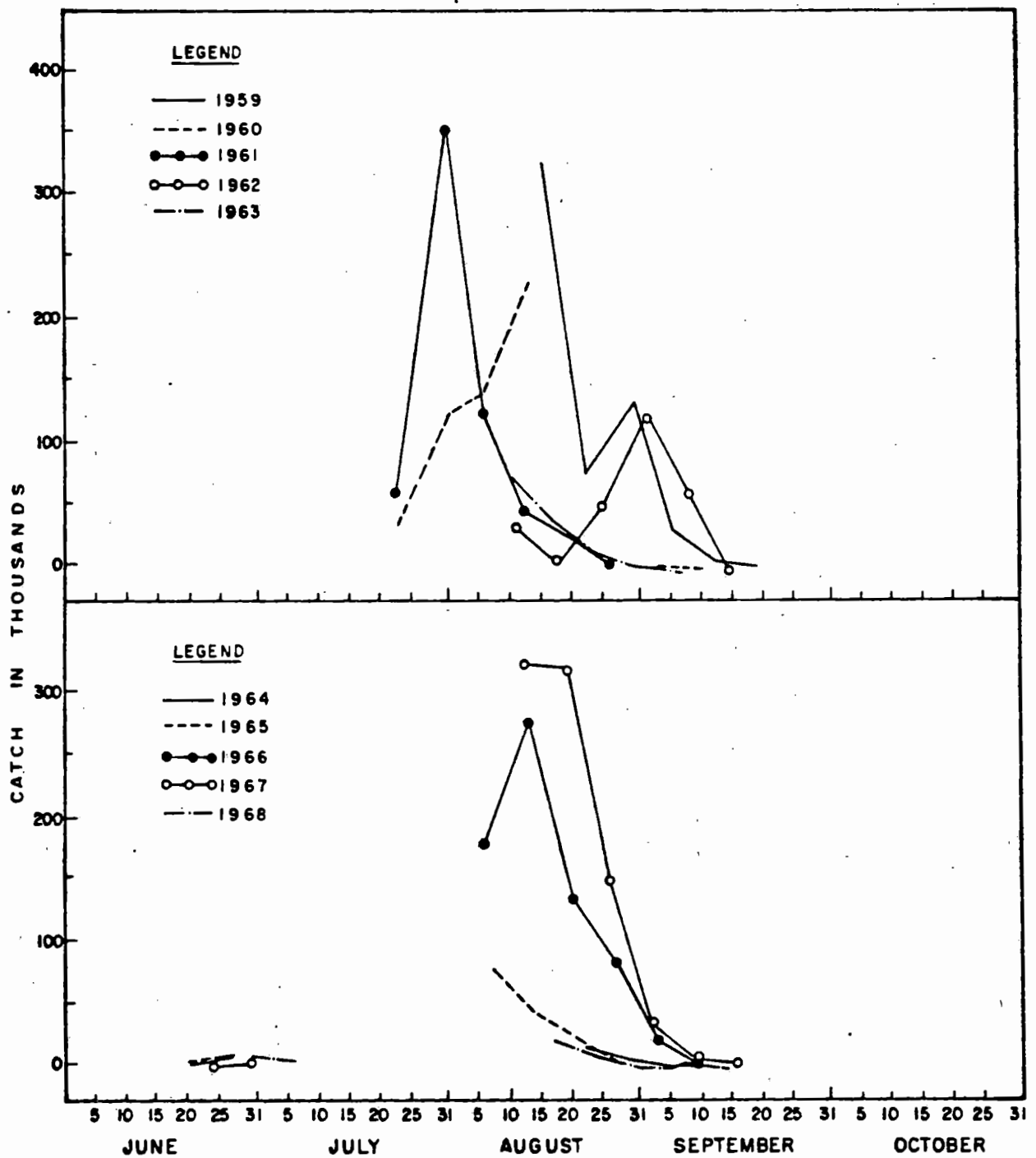


Figure 11. Weekly net catch (gillnet plus seine) of sockeye salmon in Area 20, 1959 to 1968.

through Juan de Fuca Strait. For instance, early Stuart stocks spawn during early August, Horsefly sockeye peak in late August, Chilko and late Stuart peak during September and Adams River sockeye peak in late October.

Approximately 90 per cent of Fraser sockeye return as age class 4_2 (Killick and Clemens, 1963); only four minor stocks have significant representations of older sockeye. The 3_2 age class (usually less than 3 per cent of the run) generally peaks one year prior to expected large returns of 4_2 sockeye.

Since 1961, Canadian net fisheries in Juan de Fuca Strait have been closed between June end and the beginning of August to conserve early migrating Fraser stocks (notably early Stuart). Consequently, on years when Horsefly, Chilko, late Stuart and Adams River stocks are in low abundance (1964, 1965, 1968), relatively few sockeye are taken by net gear and weekly catches progressively decline after the fishery opens. On Adams River "big years" (1958, 1962, 1966) and "sub-dominant years" (1959, 1967), weekly catches are high during August. In 1967 Fraser pink salmon and Adams sockeye overlapped in timing, seriously complicating IPSFC management of the fisheries to the extent

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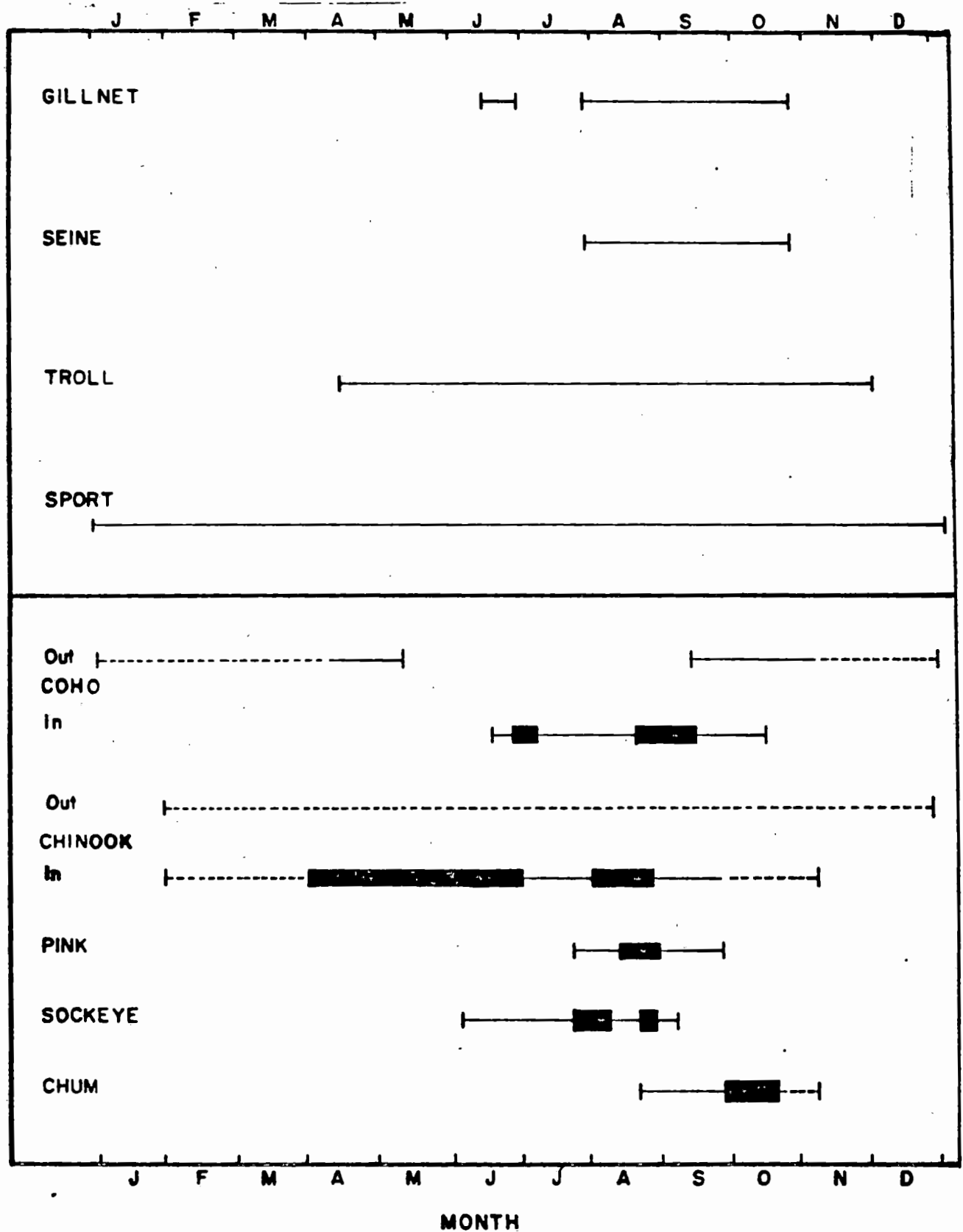


Figure 13. Seasonal timing of Juan de Fuca gear types and exploitable salmon species. For salmon dotted line refers to possible timing, solid line known timing, and bar, timing of abundance peaks.

The following information was extracted from reference no. 49 (Hollett, 1970). Five salmon species are discussed in the report; pink salmon are emphasized. Refer to the pink salmon section for the introduction of the report and a summary of tags applied by area.

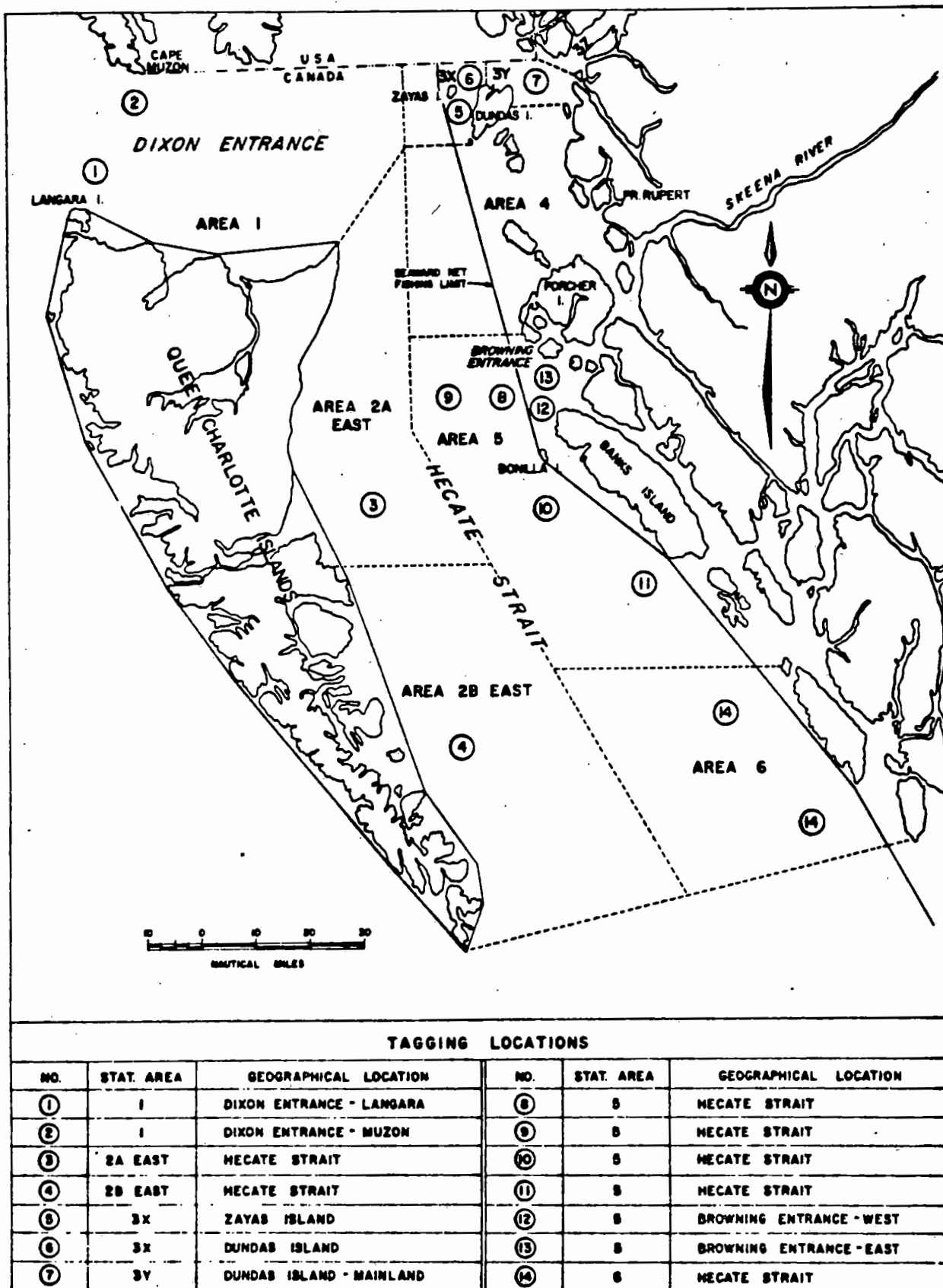


Figure 1. Tagging locations

TABLE VIII Distribution of commercial recoveries of sockeye
salmon tagged near Dundas Island
(tagging locations 5, 6 & 7).

Tagging location	5(Area 3X West)		6(Area 3X East)		7(Area 3Y)	
Tagging month	July	August	July	August	July	August
Number tagged	334	182	375	43	84	9
Number recovered	119	36	145	6	38	1
Recovery location	percent of recoveries by statistical area					
British Columbia						
Area 1	1.7					
3	25.2	22.2	21.4	50.0	31.6	
4	54.6	55.6	69.0	33.3	60.5	
5	2.5		2.1			
6	.8	2.8	2.8			
7			.7			
9			.7			
12		2.8	.7			
unknown			.7			
totals	84.9	83.3	97.9	83.3	92.1	
Southeast Alaska						
Area 101	10.9	11.1	1.4	16.7	7.9	100.0
102	.8		.7			
107	1.7					
111	.8					
115		2.8				
unknown	.8	2.8				
totals	15.1	16.7	2.1	16.7	7.9	100.0

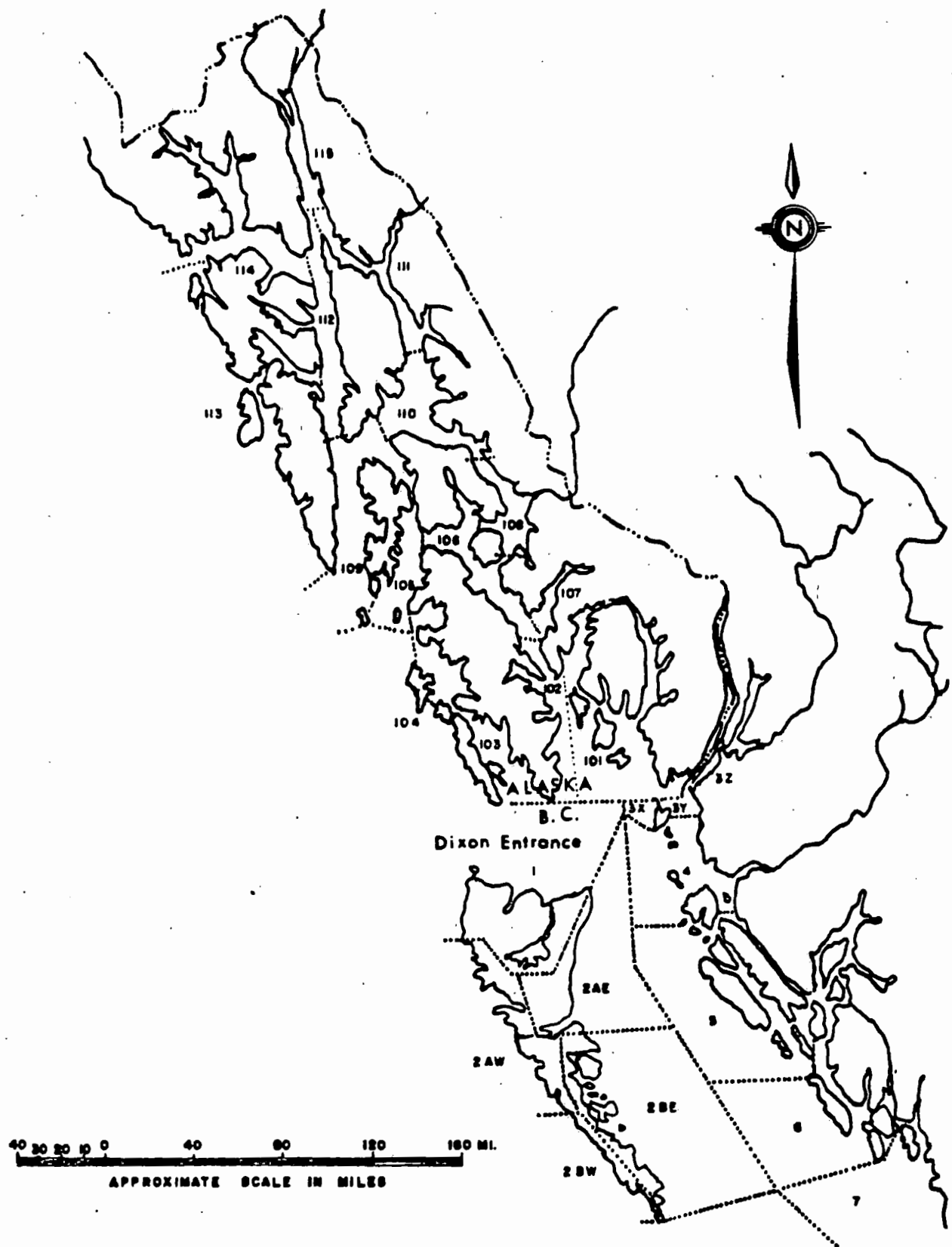


Figure 2. Statistical areas in northern British Columbia and southeast Alaska

The following information was extracted from reference no. 93 (Zyblut, 1971). Refer to pink salmon section for introduction to the report.

Sockeye Salmon Prospects

The timing of the sockeye salmon migration through Johnstone Strait in the 1971 cycle, will coincide very closely with the migration of study area pink salmon stocks. The timing of sockeye salmon stocks as indicated by catches in Areas 12 and 13, is illustrated in Figure 6 for the last three cycles. Both local and Fraser River sockeye stocks contribute to the Johnstone Strait fishery.

(a) Local Stocks

Although several local sockeye runs enter Johnstone Strait en route to spawning streams in Areas 12 to 16, only one, the Nimpkish River stock, is sufficiently large to be considered important to the Johnstone Strait fishery.

Since 1950 the Nimpkish River sockeye escapement has averaged approximately 95,000 fish and the contribution to the commercial and native food fisheries has averaged 70,000 and 5,000 fish respectively. The total annual stock has, therefore, averaged approximately 170,000 sockeye. Examination of Nimpkish River sockeye scales has shown that the stock is comprised mainly of age 4₂ and 5₂ fish, and either age class may predominate in any particular year.

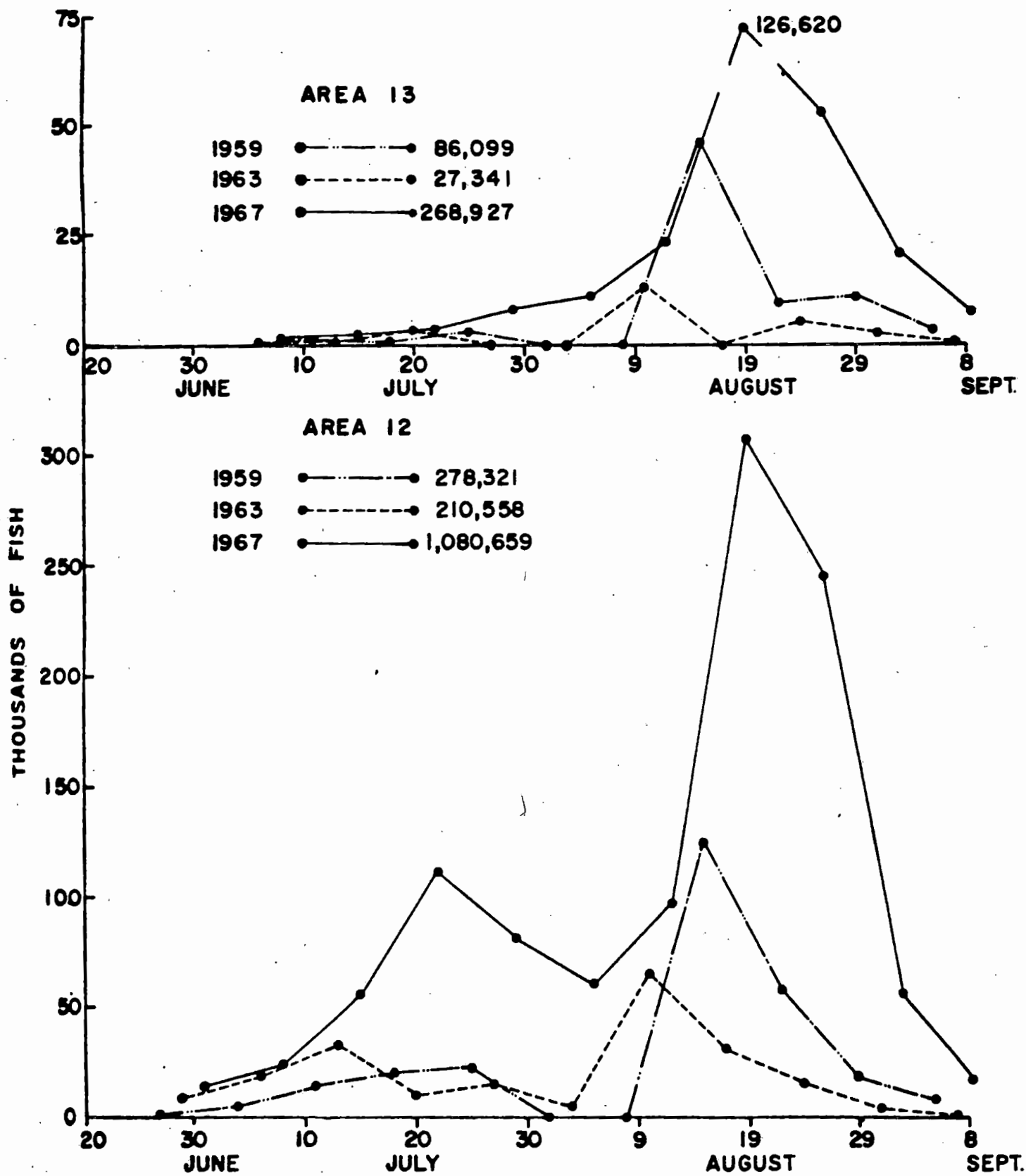
The 1971 return then, will be produced by the 1966 and 1967 escapements which were estimated at 120,000 and over 100,000 respectively. Consequently, the 1971 return is expected to be better than average.

Available data indicates that the Nimpkish River run contributes significantly to the Area 12 catch from mid June until late July, with a peak contribution around mid July. Consequently, the migration of Nimpkish River sockeye is virtually complete prior to the main migration period of study area pink salmon.

(b) Fraser River Stocks

The timing of the Fraser River sockeye migration through Johnstone Strait in the 1971 cycle is expected to coincide closely with the peak period of the study area pink salmon migration (Figures 5 and 6). The peak of abundance in Areas 12 and 13 occurs during mid August. During 1959 and 1963, the Johnstone Strait sockeye catch was small, however in 1967 a catch of over 1,250,000 fish was recorded.

The International Pacific Salmon Fisheries Commission predicts that the size of the 1971 Fraser River sockeye return will approximate 4,800,000 fish. In comparison the 1967 Fraser River sockeye stock totalled in excess of 6,000,000 fish.



The following information was extracted from reference no. 57 (Mac-Leod, 1974):

"CIRCULAR

10-2-12-1

"A REPORT ON THE 'OUTSIDE' CLOSURES IN AREAS 9-11 AND
ASSOCIATED BIOLOGICAL STUDIES DURING THE 1972 AND
1973 SOCKEYE SEASONS

Prior the 1971 fishing season in Rivers Inlet, predictions were made for a very poor return of sockeye. An escapement goal of not less than 500,000 was set and a fishing pattern established which limited the fishery to the inside waters of Rivers Inlet. The Area 10 fishery was confined within Smith Sound and Inlet to further reduce interception of sockeye bound for Rivers Inlet. In effect, the approach waters of both inlets were closed to fishing. The purpose of this was to manage Smith Inlet and Rivers Inlet sockeye as separate stocks, in an effort to achieve more favourable escapements.

During and following the 1971 season, there was considerable opposition from some fishermen to the "outside" closures. However, after meetings between Fisheries Service personnel and gillnet fishermen from the Vancouver-Fraser River Area, Pender Harbour, Alert Bay, Sointula, Bella Bella and Bella Coola, most groups agreed (reluctantly at times) to similar type fisheries in 1972 and 1973, provided that biological studies were undertaken to study timing, migration routes, and stock separation of the Rivers Inlet and Smith Inlet sockeye. The need for continued closures of the "outside" was to be reviewed at the end of the 1973 season.

The biological studies in both years involved tagging programs in the Egg Island-Table Island vicinity. In 1972 both Rivers and Smith Inlet sockeye runs were poor (Table I) and few fish were available for tagging in "outside" waters. In 1973, the returns to both inlets were outstanding and no problem was experienced in tagging large numbers of sockeye.

Table I: Area 9 and 10 sockeye runs in 1972 and 1973

<u>Area</u>	<u>1972</u> <u>catch</u>	<u>1972</u> <u>escapement</u>	<u>1972</u> <u>total stock</u>	<u>1973</u> <u>catch</u>	<u>1973</u> <u>escapement</u>	<u>1973</u> <u>total stock</u>
9	379,000	250,000	629,000	1,700,000	1,000,000	2,700,000
10	59,000	76,000	135,000	293,000	170,000	463,000

Only 73 tags were applied near Egg Island in 1972. Recoveries are listed in Table II

Table II: Tags recovered in 1972 commercial fisheries

<u>Statistical area of recovery</u>	<u>Number of tags recovered</u>	<u>Percent of total recovered</u>
9	16	76
10	4	19
13	1	5
Total	21	100%

Total recovery rate (21/73) = 29%.

Two thousand five hundred and eighty six tags were applied near Egg Island in 1973 and 578 were recovered (Table III).

Table III: Tags recovered in 1973 commercial fisheries

<u>Statistical area of recovery</u>	<u>Number of tags recovered</u>	<u>Percent of total recovered</u>
4	5	1.0
5	1	0.2
6	5	1.0
8	19	3.8
9	375	74.7
10	93	18.5
11	1	0.2
16	1	0.2
29	2	0.4
Total	502	100.0%

Total recovery rate (502/2586) = 19%.

Although the number of tags applied and recovered in 1972 was disappointingly low, the combined programs of 1972 and 1973 produced considerable information:

(a) Mixture of Stocks in Tagging Area (Egg Island)

The 1972 tag recoveries were four times as numerous in Rivers Inlet as in Smith Inlet, but this was partially due to much greater fishing effort in Rivers Inlet. Since recoveries were few (20) it is possible only to conclude that during the tagging period (July 6-13), in excess of 50% of the sockeye passing through the tagging area were migrating to Rivers Inlet.

In 1973 the fisheries in both Rivers and Smith Inlets caught approximately 60% of the fish available to them. Four times as many tags were recovered in Rivers Inlet, and since fishing effort (fleet efficiency) was no greater than in Smith Inlet, it may be concluded that Rivers Inlet sockeye were four times as numerous as Smith Inlet sockeye in the tagging area, during the period June 30-July 13.

(b) Duration of Area 9 and 10 Stock-mixture in "Outside" Waters

Tagging in both 1972 and 1973 terminated on July 13 when a mixture of Rivers and Smith Inlet stocks still existed on the "outside". However, accurate daily counting-tower or counting-fence statistics have been accumulated for six seasons in Smith Inlet on the Docee River. From these it is apparent that in most years by the 20th or 21st of July few Smith Inlet sockeye remain outside the Inlet.

(c) Migration Rates

The rate of migration of Rivers Inlet sockeye appears to vary slightly from year to year, depending on tides and weather. Tagging studies in 1965 indicated that sockeye took four days to travel from Goose Bay to the present McAllister Point-Scandinavia Bay "inside" boundary. In 1966 and 1973, the average time for the same distance was three days. A summary of the 1973 results is illustrated in Figure 1. Fish tagged near Egg Island took approximately 3 days to reach Goose Bay, 5 days to Wadhams, and 6 days to the "inside" boundary. The significant point here is that Rivers Inlet sockeye fished outside of Smith Inlet in a particular week are still available to the fishery inside Rivers Inlet the second week.

(d) Timing of Individual Races of Rivers Inlet Sockeye

The sockeye escapement to the Owikeno Lake watershed is composed of 10 or more separate races, each spawning in a different river or section of the lake. One of our goals has been to determine when each race passed through the fishery. With this information it would be possible to increase fishing effort during periods that abundant races were available, and decrease it when races needing protection were passing through. In 1972, nearly 2000 early-run fish were tagged inside Rivers Inlet in the first week of July. Another 1000 were tagged in mid-July. Fish from both tagging periods were found on all the spawning grounds. There was no evidence that individual races arrived in the Inlet at different times. On the contrary, they appeared to be thoroughly mixed. Wannock River sockeye have long been thought to be the last to enter Rivers Inlet. In 1972, tag recoveries revealed that significant numbers of Wannock River fish were amongst the run in early July. Previous

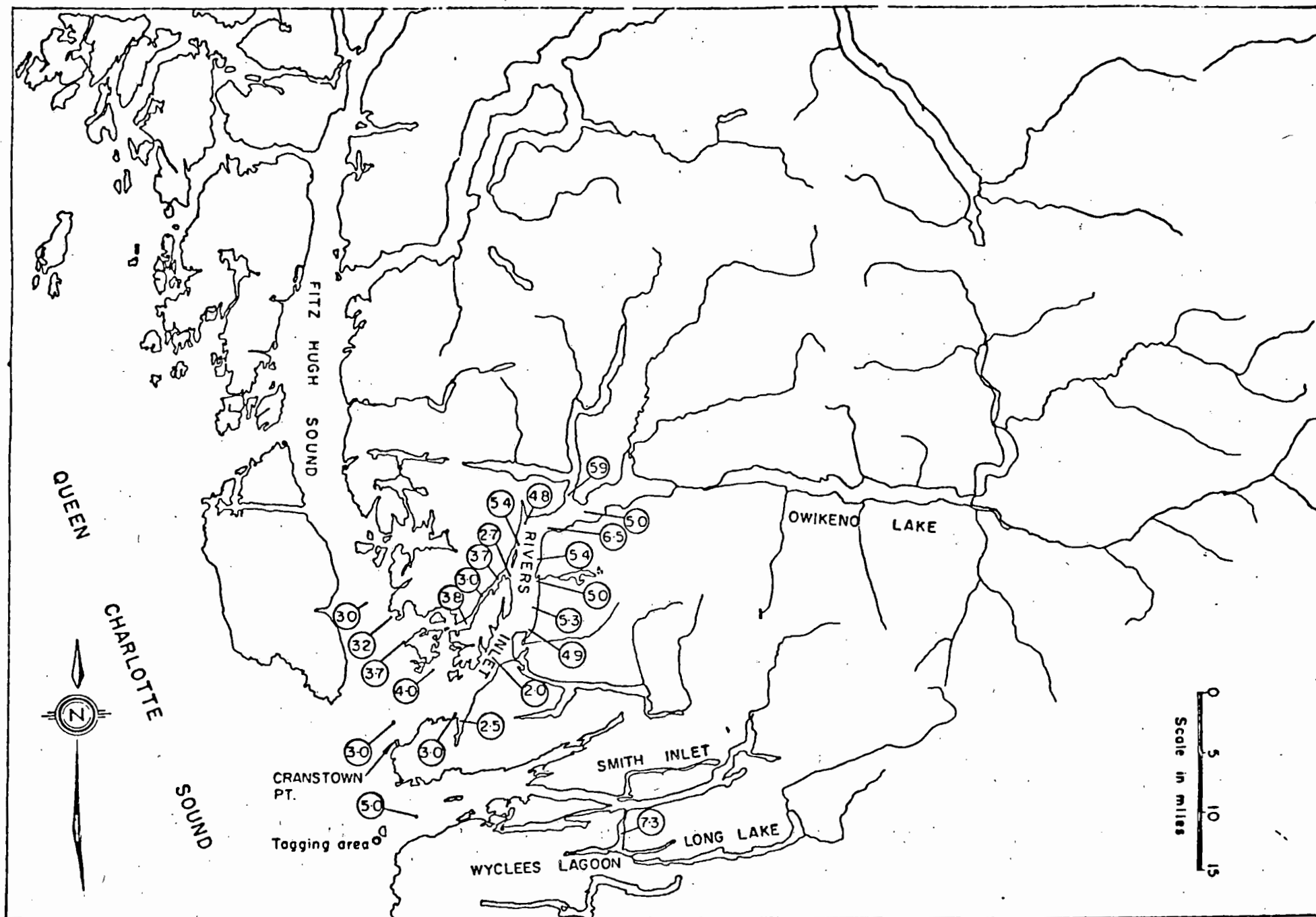


Figure 1: Average migration time in days from Egg Island to recovery locations. Sockeye - 1973.

tagging programs in 1965 and 1966 also failed to identify a difference in timing of the various races. The consequences of this situation is that weak stocks (races) are overfished and strong stocks underfished in a normal fishery. At present there is no way to avoid this result.

(e) Other Studies

Efforts were made to identify Rivers Inlet sockeye from Smith Inlet sockeye through detailed scale analysis. The results were positive and correct identification could be made about 80% of the time. However, the analysis is time-consuming and requires the expertise of scale-laboratory staff and equipment in Vancouver. This technique is presently not practical for day to day or week to week identification and management during the fishery.

Conclusion

Results of the 1972 and 1973 studies confirmed previous speculation that a mixture of Rivers and Smith Inlet sockeye is present in the "outside" waters of Area 10 during the first three weeks of July. The proportion of Rivers to Smith Inlet fish in these waters varies between weeks and from one year to the next. Therefore, it is exceedingly difficult to effectively manage both stocks when they are fished together, rather than separately. A below average return to one inlet is easily masked early in the season if returns to the other inlet are strong. By the time a true picture emerges for each stock, the weak stock may already be over-exploited --- particularly since the length of migration from "outside" to the sanctuary permits exploitation in two successive weeks.

During the past three seasons, management of the Rivers and Smith Inlet fisheries has improved. Escapement goals in Rivers Inlet were not achieved in 1971 and 1972, but escapement to catch ratios were more satisfactory than those obtained on similar sized runs in previous years. We are confident that our recent experiences will enable us to obtain adequate escapements in the next few years, necessary to rebuild the runs to historic levels.

The present "inside" fishing pattern permits considerable flexibility. In 1973 when it became obvious that both Inlets had strong returns, the "outside" waters were opened to fishing. On the other hand, weak runs can be detected and protected under the present system to ensure satisfactory escapements. There has been no need to change the historical practice of gillnets only in the Inlets during the sockeye fishery. We are prepared to move boundaries when required, as illustrated by the 1973 fishery in Wyclees Lagoon.

We are convinced that the present system of fishing inside the Inlets only is the best approach. Small and large runs can be harvested adequately within the Inlets in two to four day fishing weeks. The wasteful fishery on poor-quality, immature coho has also been reduced.

However, there are alternatives. If the "outside" waters are re-opened to fishing, it will, of necessity, be accompanied by a reduction in fishing time, or a further seaward movement of the present inside boundaries. These are the alternatives, although in our opinion, not good alternatives to the present system.

The following information was extracted from reference no. 46 (Groot et al., 1975). Sonic tagging is becoming more common as a means of tracking migrating salmon, and this paper provides a good first reference.

Movements of adult sockeye salmon (*Oncorhynchus nerka*) entering the Skeena River were examined in 1969 and 1970 by ultrasonic tracking methods. Fifteen of 18 sockeye released in the lower river seemed to move passively in and out with flood and ebb streams. Two fish moved upstream independent of tides and one salmon swam against ebb and flood currents. Ground speeds in both years of operation were 1.6 km/h during rising and 2.1 km/h during falling tides, causing the fish to be transported downstream by about 3 km per tidal cycle. Three salmon released outside the river mouth in salt water also seemed to ride the tidal flows passively. Ground speeds during ebb (3.6 km/h) were again greater than during flood (2.0 km/h), indicating a net offshore movement. We conclude that these passive movements are not an artifact but that sockeye salmon normally slow down or pause upon reaching the "home river" and drift for a period in tidal currents in the estuary and river mouth before migrating upstream.

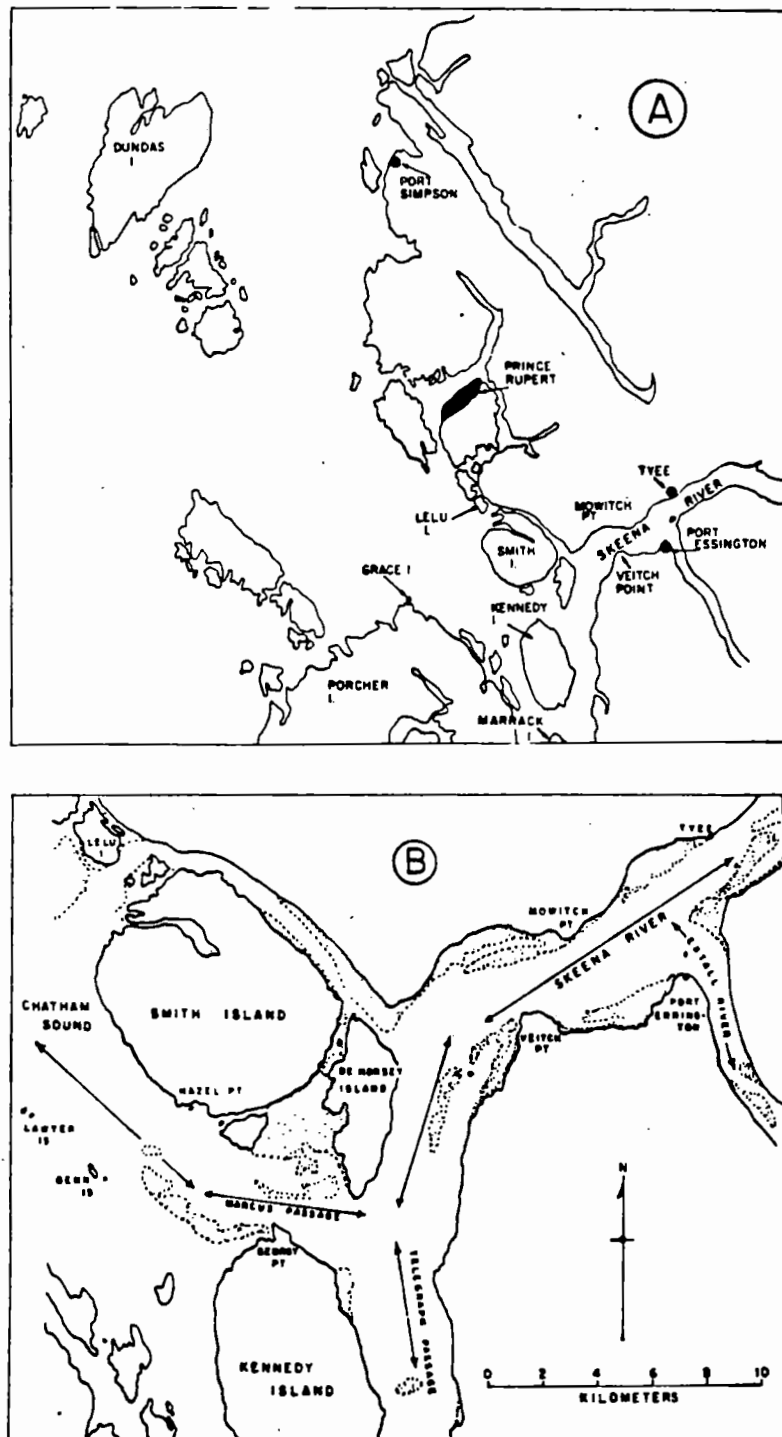


FIG. 1. Skeena River estuary. A, The area around Prince Rupert in north-western British Columbia, Canada, with the entrance to the Skeena River. B, The Skeena estuary with approximate current directions during ebb and flood indicated by arrows (from hydrographic charts). Grey areas represent shoals.

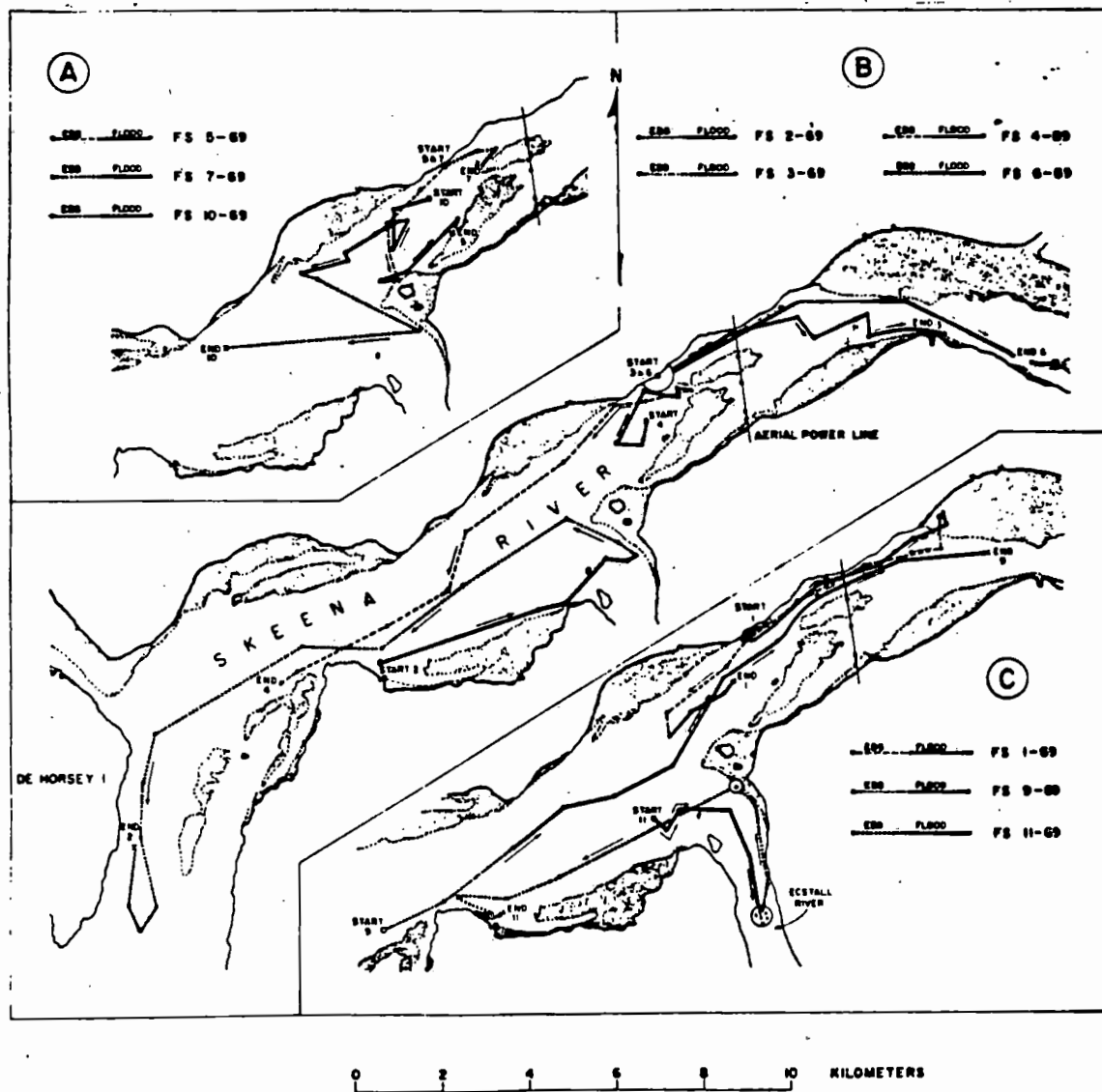


FIG. 2. Sonic tracks in 1969 in the lower Skeena River.

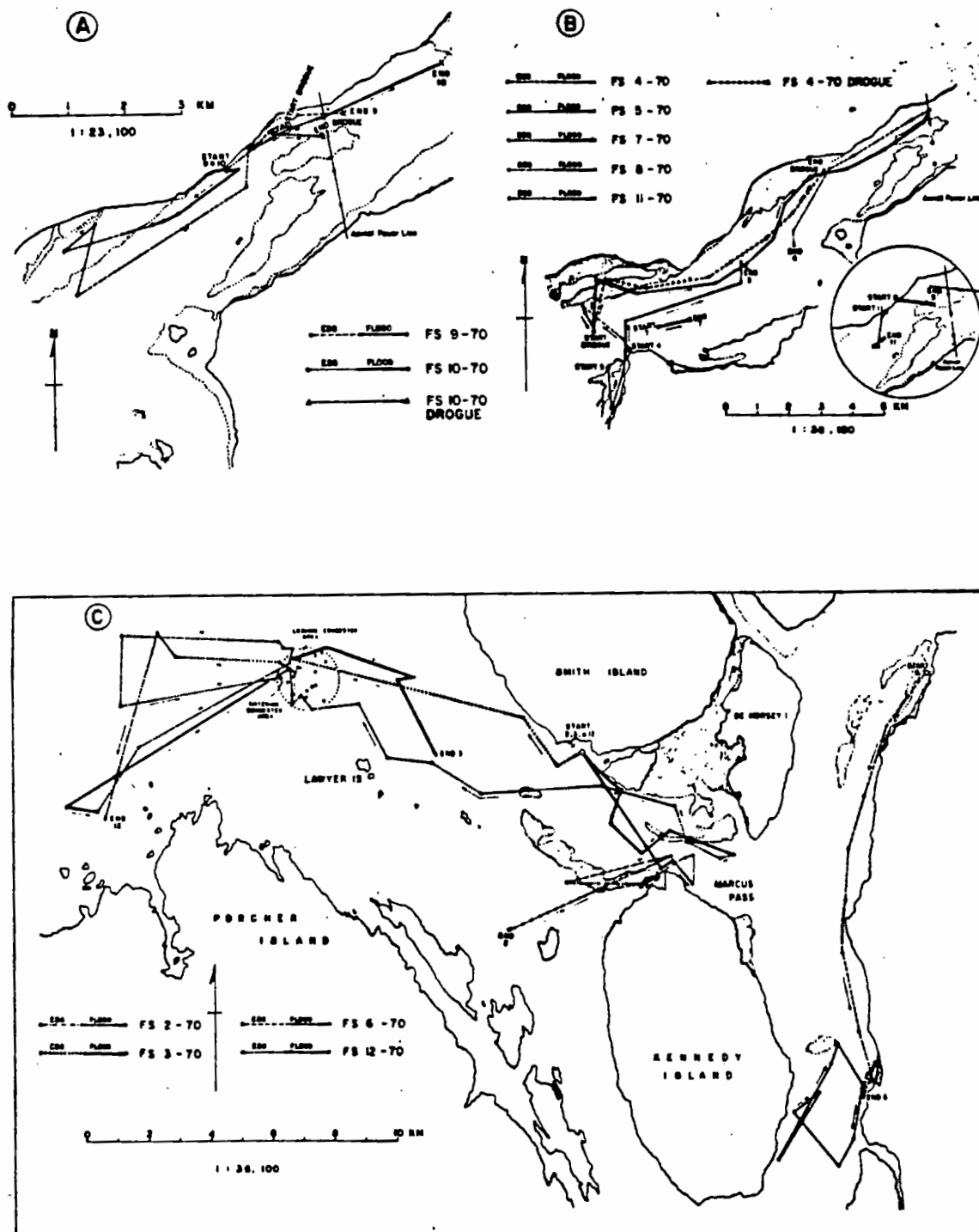


FIG. 3. Sonic tracks in 1970. A and B in lower Skeena River, C in Skeena mouth and offshore.

The following information was extracted from reference no. 7
(Anderson, 1975):

Sockeye Salmon Prospects

The abundance of other salmon, particularly sockeye which migrate through Johnstone Strait during the same period as pink salmon, must be considered in the over all management program of the study area.

Only two major sockeye stocks are exploited in Johnstone Strait. These are the Fraser River and Nimpkish stocks.

(1) Non-study area stocks

The International Pacific Salmon Fisheries Commission has predicted the 1975 Fraser River sockeye salmon return will total 5.5 million fish. Spawning requirements of the Fraser stock in 1975 will be 950,000 sockeye. Seven races should constitute about 85 percent of the 1975 return: Chilko sockeye, 1,800,000; Adams, 1,000,000; Early Stuart, 750,000; Stellako, 200,000; Birkenhead, 500,000; Weaver, 200,000; and Seymour, 175,000. It is expected that the proportion of Fraser River sockeye which will migrate through Johnstone Strait in 1975 will be similar to that of 1971 cycle year.

(2) Johnstone Strait study area stocks

Although several study area sockeye stocks enter Johnstone Strait en route to spawning grounds in Areas 12 to 16, only Nimpkish River sockeye is important to the Johnstone Strait fishery.

Since 1950 Nimpkish River sockeye escapements have averaged 90,000, ranging from 35,000 to 150,000 and on the average has contributed about 70,000 pieces to the commercial fishery and 5000 pieces to native food fishery. Examination of Nimpkish River sockeye scales has shown that the stock is comprised of mainly four and five year old fish and that either age class may predominate in any particular return year. The 1975 return will be the progeny of the 1970 and 1971 escapements which were estimated at 50,000 and 75,000 respectively. On this basis a below average return is expected in 1975.

(3) Timing

The timing of sockeye in Johnstone Strait during the cycle years of 1963, 1967 and 1971 is indicated by the catches in Fig. 4. In 1975 the timing of the Fraser River sockeye return will be influenced mainly by the Chilko and Adams run. In the 1971 cycle year the Chilko and Adams components constituted about 30 and 39 percent, respectively, of the return. In 1975 the Chilko, an earlier run, and Adams, a later run, should constitute about 33 and 18 percent, respectively, of the return. It is anticipated the timing of the 1975 return should be earlier than the 1971 cycle year. The expected timing of the run would place the major proportion in convention waters during the last week of July and the first two weeks of August. On this basis the major proportion of the Fraser River Sockeye in Johnstone Strait during 1975 is expected to occur during a three week period ending August 2.

Although the timing of the Nimpkish River sockeye migration has not been defined precisely, analysis of the Area 12 catches combined with the separation of Nimpkish River from Fraser River sockeye by scale characteristics indicate that Nimpkish River sockeye contribute to the Area 12 catch from mid-June until early August with a peak contribution occurring about mid to late July.

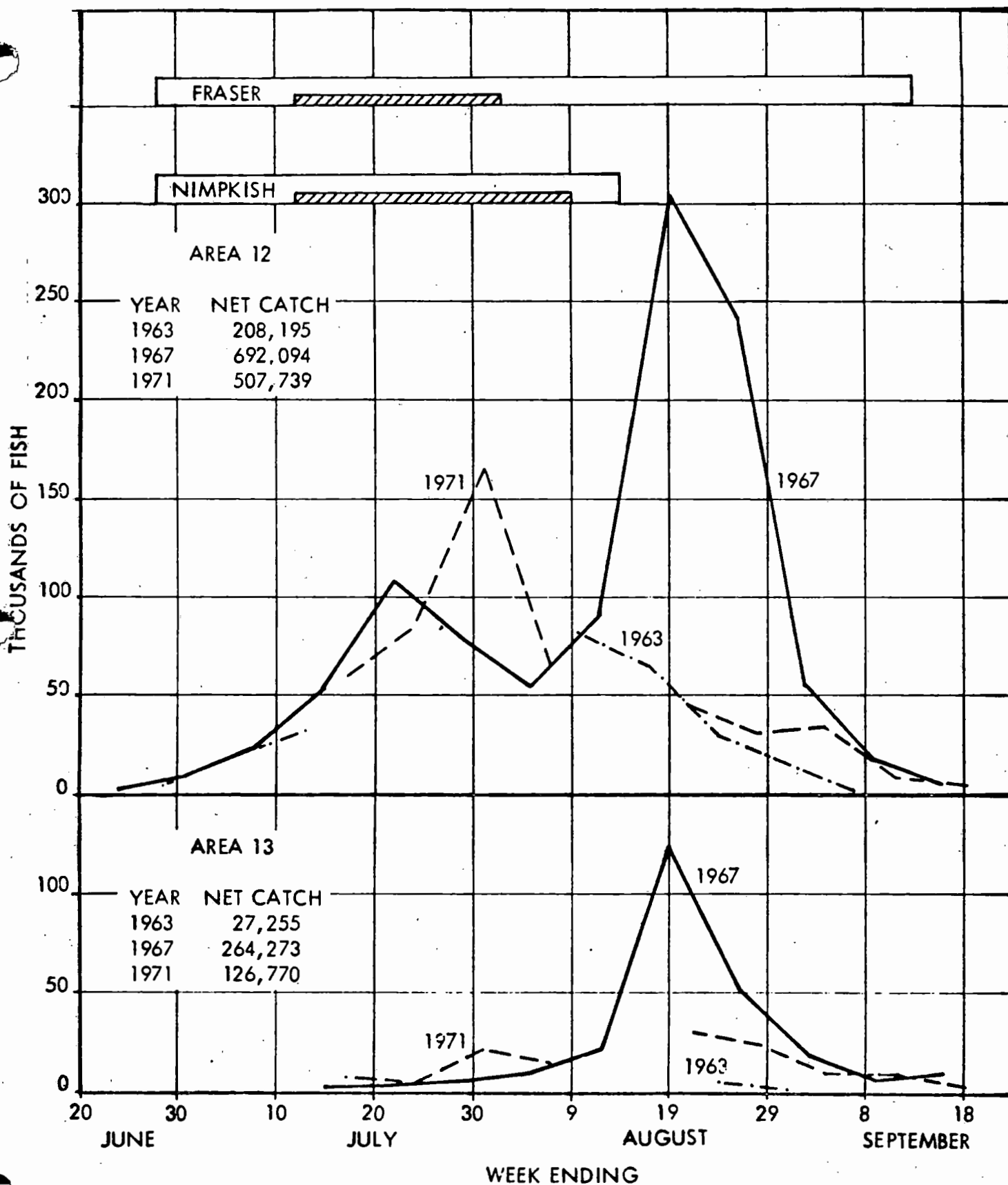


Figure 4. Weekly net catches of sockeye in Statistical Areas 12 and 13 for cycle years 1963, 1967 and 1971. (Bars indicate occurrence and expected peak abundance for 1975).

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

"Adult Tagging - Bella Bella, 1976

"The following is a general synopsis of the results obtained from last year's tagging. I will be getting a formal report together, but in the meantime, I thought a review of the highlights for each species would be useful.

"Sockeye: Tagged 335, mostly (83%) in the Purple Bluff and St. John's Harbour areas and mostly (77%) during the second and third week of July. We have received 73 recapture reports for an overall 22% return rate. 95% were taken commercially with the remaining three being from the Skeena system (2) and the Dean River (1).

"The returns ranged from the Skeena to Alberni Canal, but only 8 (11%) were captured outside the Central Coast. The recapture sites with the greatest number of returns from all tagging were Rivers Inlet with 43 tags (59%) and Area 8 with 15 tags (21%). Only 4% (3 fish) were recaptured in Area 7.

"The two main tagging areas gave very similar results with over 60% of the St. John's Harbour fish recaptured in Rivers and Smith Inlets and 80% of the Purple Bluff fish recovered in Rivers and Smith Inlets. These two tagging areas also contained fish bound for the B.C.G.N.A. with 13% of St. John's Harbour and 6% of Purple Bluff returns coming mainly from Upper Dean Channel.

"It, therefore, appears that of the 34,000 sockeye caught in Area 7 in the second and third week of July 90% were Area 8, 9, and 10 bound fish."