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THE MIGRATIONS OF PINK SALMON (*ONCORHYNCHUS GORBUSCHA*) IN THE CLARENCE AND SUMNER STRAITS REGIONS OF SOUTHEASTERN ALASKA

By FREDERICK A. DAVIDSON
and
LEROY S. CHRISTEY

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THE MIGRATIONS OF PINK SALMON *(ONCORHYNCHUS GORBUSCHA)* IN THE CLARENCE AND SUMNER STRAITS REGIONS OF SOUTHEASTERN ALASKA [1]

By FREDERICK A. DAVIDSON, Ph. D., *Aquatic Biologist*, and LEROY S. CHRISTEY, *Field Assistant*, *United States Bureau of Fisheries*

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INTRODUCTION

Southeastern Alaska lies on the Pacific shore of North America between latitudes 54° and 60° N. It is composed of a narrow coastal strip and a broken chain of mountainous islands known as the Alexander Archipelago. The geography of that part which includes the Alexander Archipelago is illustrated in figure 1. Owing to the temperate climate and heavy rainfall of this region most of the islands and mainland shore are covered with dense growths of timber and are drained by hundreds of streams that range in size from brooks to small rivers. These streams support one of southeastern Alaska's most valuable natural resources in that they form the breeding grounds for millions of salmon that migrate into them each year to spawn. Through the utilization of these salmon a large and flourishing food-packing industry has developed which is providing nutritious food for the nation as well as a substantial income to the citizens engaged in it.

The Pacific salmon of the genus *Oncorhynchus* spend part of their lives in the sea where they mature and part in the streams where they spawn and then die. The period during which the adults migrate from the sea extends from early summer to

[1] Bulletin No. 25. Approved for publication August 20, 1937.

late fall. The eggs are deposited in the gravel beds of the streams to incubate during the winter months. They hatch out in the following spring and early summer. The young of some of the species remain in fresh water for a few years but they all eventually migrate to the sea where they mature. Since no definite knowledge has yet been obtained as to the location of most species of these salmon during their sojourn in the sea, their spawning migration is of primary importance to the fishing industry for it is only at this time that they are captured in large numbers.

The responsibility of protecting this natural resource of Alaska from overexploitation, so that it may be preserved for future generations, is vested in the Secretary of Commerce who is advised by the United States Bureau of Fisheries. Since the demands of the industry for salmon are usually greater than the supply, the Bureau has found it necessary to regulate the fishery. This regulation aims to provide for an adequate escapement of the adult salmon to the streams so that they may reproduce and maintain their bounteous numbers.

In the life-history studies of the Pacific salmon it was found that they have a high degree of homing instinct; i. e., the majority of the adults return to spawn in the streams of their origin. A discussion of the results of these studies may be found in the following references: Gilbert (1913), Snyder (1921 to 1924), Rich and Holmes (1928), Foerster (1929), Pritchard (1933 and 1934), and Davidson (1934). Owing to this peculiar characteristic of the salmon the population in each stream is self perpetuating and if once destroyed it will not be readily restocked through the straying of salmon native to other streams. Hence, in order to insure the maintenance of the salmon populations in the streams, it was necessary for the Bureau to provide for the protection of the spawning fish each season. In general it imposes definite limitations on the length of time fishing may be carried on in each locality, and prohibits fishing in and near the mouths of the streams and in the small bays that form resting areas for the migrating salmon.[2]

CHANNELS OF MIGRATION

Figure 1 shows six main channels through which salmon may enter the inside waters among the islands on their way to the streams. These are, namely: Icy Strait-Lynn Canal, Chatham Strait-Frederick Sound-Stephens Passage, Sumner Strait, Cordova Bay, Clarence Strait-Ernest Sound, and Revillagigedo Channel-Behm Canal. Most salmon spawning in interior localities migrate through one or more of these channels to reach their destinations. In considering the conservation of the salmon populations in each locality the Bureau realized that some provision had to be made for the protection of these populations during their migration through the channels as well as in the streams. Hence, in order to expedite the patrol and regulation of the commercial fishery, the first and most logical step was to set apart the various spawning localities into fishing districts according to the main channels of entry through which their populations migrated from the sea. Before this could be accomplished satisfactorily, however, it was necessary to make a study of the migratory routes and destinations of the salmon populations passing through each main channel.

[2] For detailed information concerning the regulation of the salmon industry in Alaska see Laws and Regulations for the Protection of the Fisheries of Alaska. Department Circular 251. Department of Commerce, Bureau of Fisheries, Washington, D. C.

TAGGING METHODS

In 1924 the Bureau started a series of salmon-tagging experiments in each of the main channels of entry for the purpose of securing this information. The work of the experiments was carried on as follows: The trap was first closed and the web of the spiller lifted to bring the salmon near the surface. They were then caught with a dip net and slid, one by one, onto the tagging table from which they were guided head first into a small box held on the outside of the table. This box was short and from 3 to 4 inches of the salmon's tail projected beyond the open end. The tagging operator was thus enabled to grasp the tail and clamp a tag, about 1½ inches long and ⅜-inch wide, on it. After tagging, the operator holding the small box tossed the salmon back into the water beyond the trap. The entire operation required but a fraction of a minute and, if conditions were favorable, from 150 to 200 fish could be tagged in an hour (see figs. 2 and 3).

It is assumed that the great majority of the tagged individuals, when released, continue to follow their original course of migration. The recovery of a few tagged fish in areas far distant from the point of liberation does not necessarily indicate that the tagging operation affected them, for it is not improbable that salmon occasionally stray from their normal course of migration. Most of those recovered are picked up by the commercial fishery at various points along the migratory routes. Small numbers have also been recovered on the spawning grounds in streams.

It has never been possible to recover all the salmon that are tagged. Many of them escape the commercial fishery and spawn in the streams unnoticed and even some of those that are caught by the fishery lose their tags in shipment and remain undiscovered. The Bureau has for several years offered a small reward, from 25 to 50 cents, for the recovery of tagged individuals, and in this way has encouraged the search for them in areas where they are being tagged. No tags, however, are accepted by the Bureau unless they are accompanied by information as to the date and place of recapture of the fish. Without this information the tags are worthless as a means of tracing the migratory routes of the salmon.

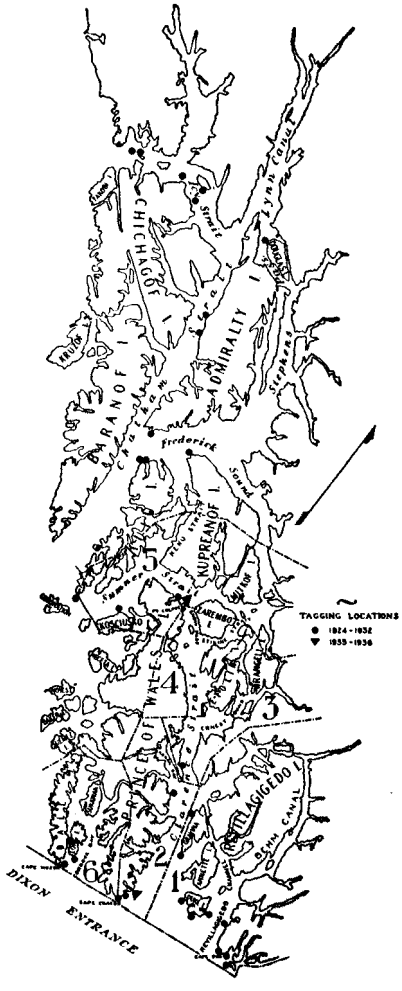

FIGURE 1.—The Alexander Archipelago in southeastern Alaska. The dots indicate the locations of the early pink-salmon tagging experiments from 1924 to 1932. The triangles indicate the locations of the 1935 and 1936 pink-salmon tagging experiments. The boundary lines and included numbers in the Clarence and Sumner Straits region show the geographic areas used in classifying the localities in which the tagged salmon were recovered.

The first tagging experiments that were carried on in southeastern Alaska attempted to locate, as quickly as possible, the general migratory routes and destinations of the salmon migrating through each of the six main channels of entry This necessitated covering the entire region in a comparatively short time and consequently it was not possible to tag more than two or three times at each

location during a season. The locations of these experiments are given in figure 1. The results from them were most valuable and greatly assisted in the formation of the present fishing districts in the region.[3] Plans were made to continue these tagging experiments in a more detailed manner so that the destinations of the salmon passing through each main channel of entry at different times during the migratory season could be determined. Information of this nature is very important, for it provides a basis upon which to regulate the fishery in order to protect the salmon during their migration in the entrance channels as well as in the streams where they spawn.

The grouping of the waters of southeastern Alaska into fishing districts, for the purpose of regulating the commercial fishery, is based upon two separate studies of the life history and habits of the salmon. The first study deals with the determination of the migratory routes of the salmon. This gives a general picture of the channels of entry frequented by the salmon during their migrations to the various spawning localities. The second study—beyond the scope of this paper—deals with the time in the fishing season during which the salmon migrate through each district, and is based upon a study of the daily catch records of the fishing gear in the districts. Information from this study was used to set the opening and closing dates for fishing in the districts so as to provide for the escapement of an adequate proportion of each run of salmon to the streams for reproduction.

Since the pink salmon are by far the most abundant species of the Pacific salmon in southeastern Alaska, the grouping of the various waters in this region into fishing districts and the regulations imposed therein have, to a great extent, been directed toward the conservation of this species. Hence, the more detailed tagging experiments have been limited to the pink salmon.

The results from a study of the salmon catches, as well as from the early tagging experiments in Clarence and Sumner Straits, indicated that each of these large bodies of water formed the migratory channel of distinct runs of pink salmon. Although these waters were originally included in one fishing district, the Bureau realized that each should constitute a separate district and made the change at the first opportunity, which occurred in 1934. After making this change further tagging work was carried on in the summers of 1935 and 1936 to determine the destinations of the pink salmon passing through each of these main channels at different times in the season. In order to give as complete a picture as possible of the pink-salmon migrations in these waters, the results from the earlier tagging experiments will be summarized and compared to those of this later work.

PINK-SALMON TAGGING EXPERIMENTS IN CLARENCE STRAIT AND ADJACENT WATERS, 1924–32

An inspection of the map in figure 1 will show that Clarence Strait and its adjacent waters, Revillagigedo Channel and Cordova Bay, do not open directly into the ocean but into a large body of water known as Dixon Entrance. Early in the development of the salmon fishery in these waters it was found that the first pink salmon to appear each season usually migrated easterly through Dixon Entrance and turned northward and eastward along the mainland shores in the vicinity of Cape Fox. As the season progressed the numbers of salmon following this course of migration became more and more abundant and built up a very definite run into Revillagigedo Channel, Portland Canal, and their contiguous waters. A week to 10 days after the beginning of the

[3] For the results of the early tagging experiments see Rich (1926), Rich and Suomela (1927), Rich and Morton (1929), and Rich (1932). The locations of these experiments are given in figure 1.

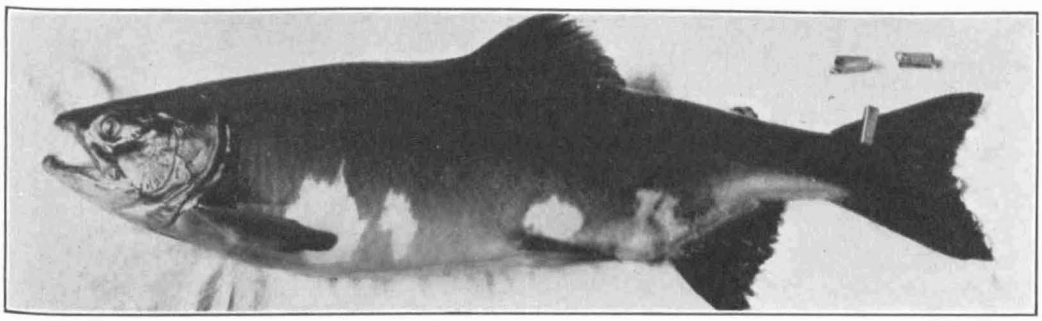

FIGURE 2.—Tagged pink salmon showing relative size of tag and location of attachment.

FIGURE 3.—Tagging pink salmon at a fish trap in southeastern Alaska.

runs in the region of Cape Fox, large numbers of the pink salmon migrating through Dixon Entrance began to turn northward into Clarence Strait along the east shore of Prince of Wales Island in the vicinity of Cape Chacon. Here again, the salmon following this course of migration increased in numbers as the season progressed and built up a separate and definite run into Clarence Strait. From a week to 10 days later a third run of pink salmon began to leave Dixon Entrance and migrate northward; this time into Cordova Bay. This run, like the others, increased in abundance as the season progressed, thus forming three definite runs of pink salmon originating in Dixon Entrance. This information was secured from a study of the daily catches of the fishing gear operating in these waters. Studies of similar recent records by the Bureau indicate that three definite runs of pink salmon continue to appear in these waters.

In order to provide a uniform method for classifying and reporting the recoveries of tagged salmon, the spawning localities of Clarence and Sumner Straits were grouped into definite areas. Although these areas include waters which are similar to those of the fishing districts, they cannot be construed as being identical. They were not formed with any idea of using them to replace the present districts as factors other than the locations of the migratory channels of the salmon enter into their formation. They will be referred to hereafter as geographic areas of recovery which are shown in figure 1 and may be described as follows: Area 1 includes all the waters of Revillagigedo Channel, Portland and Behm Canals, and the waters surrounding Duke, Annette, and Gravina Islands. Area 2 includes all the waters of Clarence Strait along the east shore of Prince of Wales Island from Cape Chacon to Approach Point. Area 3 includes all the waters of Clarence Strait above a line from Approach Point to Caamano Point and below a line from Narrow Point to Ernest Point. This area also includes the waters of Ernest Sound, Zimovia Strait, Bradfield Canal, and Blake Channel. Area 4 includes the remainder of the waters of Clarence Strait above a line from Narrow Point to Ernest Point, and the waters of Snow Passage and Stikine Strait. Area 5 includes the waters of Sumner Strait, Keku Strait, Wrangell Narrows, and the lower extremity of Frederick Sound below latitude 56°30′ N. Area 6 includes the waters of Cordova Bay and contiguous channels.

Since no information was available concerning the localities in which the salmon comprising these migration waves spawned, the Bureau, in 1924, began three series of tagging experiments in the region. The first was in the vicinity of Cape Fox, the entrance to Revillagigedo Channel, and Portland Canal; the second in the vicinity of Cape Chacon, the entrance to Clarence Strait; and the third in the vicinity of Cape Muzon, the entrance to Cordova Bay. The locations at which these tagging experiments were carried on are shown by the black dots in figure 1.

In classifying the results from the tagging experiments summarized in tables 1 to 8, all tagged salmon recovered at the location of tagging were considered as not having migrated from that location and were not included either in the number of individuals tagged, or in the number recovered. The recovery of a tagged salmon cannot be considered as indicating a route of migration unless capture has been made at some distance from the point of tagging. Accordingly, no record is given of the recoveries at the point of tagging nor those where the locality of recapture is doubtful. Hence, the total percentage of tagged fish recovered in the experiments does not represent the entire influence of the intensity of the fishery.

TAGGING EXPERIMENTS IN THE VICINITY OF CAPE FOX

The tagging experiments carried on in the vicinity of Cape Fox in 1924 were continued intermittently through 1932, and a total of 17 experiments were made during this period. Since it was not possible to tag frequently throughout the season at any one location, an effort was made to change the seasonal time of tagging each year. In this way the results from these experiments, as a whole, approximately indicate the final destinations of the salmon migrating into this region at different times during the season. A summary of the results from these experiments is given in table 1.

TABLE 1.—*Pink salmon tagged in the vicinity of Cape Fox, 1924–32, and number recovered* [1]

[Column headings indicate locality and date of tagging]

	Foggy Point, Kanagunut Island, June 24–July 1, 1926	Sitklan and Kanagunut Islands, July 13, 1930	Cape Fox, Sitklan, and Kanagunut Islands, July 25–26, 1930	Foggy Point, July 30–31, 1925	Kanagunut Island, Aug. 7, 1924	Cape Fox, Sitklan, and Kanagunut Islands, Aug. 7–8, 1930	Tree Point, Aug. 8, 1924	Duke Point, Kelp Island, Aug. 5, 1932 [2]	Duke Point, Aug. 8, 1924	Point White, Aug. 8, 1924	Total
Number tagged	137	312	685	1,000	21	667	203	467	245	194	3,931
LOCALITY OF RECOVERY											
LOWER CLARENCE STRAIT.—AREA 1											
East of Cape Fox		13	87	39	3	130	18	10	18	15	333
British Columbia	3	4	10	44		5		13			79
Revillagigedo Channel and Tongass Narrows	17	46	46	241	2	66	35	32	27	21	533
Behm Canal, south arm	2	12	33	33		4	5	4	7	3	103
Behm Canal, north arm	1	3	1			8			1		14
West shores of Gravina, Annette, and Duke Islands	3	2	10	5		8	4		3	4	39
Total recovered	26	80	187	362	5	221	62	59	56	43	1,101
Percent recovered	19.0	25.6	27.3	36.2	23.8	33.1	30.5	12.6	22.9	22.2	28.0
LOWER CLARENCE STRAIT.—AREA 2											
East shore Prince of Wales Island from Cape Chacon to Approach Point:											
Total recovered			2	2	1	4	1	22		3	35
Percent recovered	0.0	0.0	0.3	0.2	4.8	0.6	0.5	4.7	0.0	1.5	0.9
MIDDLE CLARENCE STRAIT.—AREA 3											
Approach Point, Caamano Point to Narrow Point, and Ernest Point			1	2		4		6	1		14
Ernest Sound				5				1			6
Total recovered			1	7		4		7	1		20
Percent recovered	0.0	0.0	0.2	0.7	0.0	0.6	0.0	1.5	0.4	0.0	0.5
UPPER CLARENCE STRAIT.—AREA 4											
Total recovered				3							3
Percent recovered	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1
SUMMARY:											
Total recovered	26	80	190	374	6	229	63	88	57	46	1,159
Percent recovered	19.0	25.6	27.7	37.4	28.6	34.3	31.0	18.8	23.3	23.7	29.5

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647. The original records of the tagging experiments from 1924 to 1930 are given in the reports of Rich (1926), Rich and Suomela (1927), Rich and Morton (1929), and Rich (1932).

[2] From unpublished data, U. S. Bureau of Fisheries.

From an inspection of table 1 it will be seen that, regardless of the time in the season in which the salmon were tagged, practically all those recovered were captured in area 1. A total of 3,931 pink salmon were tagged in all of the experiments, of which 1,159, or 29.5 percent, were recovered. Of the total number recovered 1,101 were captured in area 1, 35 in area 2, 20 in area 3, and 3 in area 4.

The tagging experiments conducted on the east, south, and west shores of Duke Island were included with those on and near the mainland shore in the vicinity of Cape Fox because the percentage of recoveries from these experiments shows a greater relation to those carried on near Cape Fox than to those carried on elsewhere in this general region. It will be noted in table 1 that the total number of tagged individuals recovered in areas 2 and 3 are composed largely of the recoveries reported from the Kelp Island experiment carried on in 1932. A further analysis of the recoveries reported from area 1 shows that of those captured east of Cape Fox 333 were taken in Alaskan waters and only 79 in Canadian waters. Of those captured north of Cape Fox 533 were taken in the waters of Revillagigedo Channel and Tongass Narrows, 103 in the south arm of Behm Canal, 14 in the north arm of Behm Canal, and 39 off the west shores of Duke, Annette, and Gravina Islands. Although far greater numbers were captured in the south arm of Behm Canal than in the north arm, it cannot be definitely assumed that these results represent the exact ratio of distribution, for many of the salmon bound for the north arm of Behm Canal may have been picked up enroute in Revillagigedo Channel and Tongass Narrows. However, it may be definitely assumed that most of the pink salmon migrating through Dixon Entrance to the mainland and island shores in the vicinity of Cape Fox are bound for the localities in some part of area 1; i. e., those of Portland Canal and other waters east of Cape Fox, and those of Revillagigedo Channel and Behm Canal.

TAGGING EXPERIMENTS IN THE VICINITY OF CAPE CHACON

The early tagging experiments carried on in the vicinity of Cape Chacon were not as numerous, nor as varied in the time of the season they were conducted, as those in the vicinity of Cape Fox. A total of six experiments, five in 1925 and 1 in 1926, were made during the second week of August of each year, which is beyond the middle of the migratory season for pink salmon in this region. However, the results are sufficient to show that there is a distinct difference between the final destinations of the pink salmon migrating northward from Dixon Entrance into Clarence Strait in the vicinity of Cape Chacon, and those migrating northward from Dixon Entrance along the mainland shores in the vicinity of Cape Fox.

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TABLE 2.—*Pink salmon tagged in the vicinity of Cape Chacon, 1925 and 1926, and number recovered* [1]

[Column headings indicate locality and date of tagging]

	Cape Chacon, Aug. 8, 1925	Stone Rock Bay, Aug. 9, 1925	Stone Rock Bay, Aug. 9, 1926	Cape Chacon, Aug. 11, 1925	Stone Rock Bay, Aug. 12, 1925	Cape Chacon, Aug. 13, 1925	Total, Cape Chacon and Stone Rock Bay	Kaigani Strait, Aug. 10–11, 1926	Cape Muzon, Aug. 15, 1925	Kaigani Point, Aug. 16–21, 1925	Total, Kaigani Strait and Cape Muzon
Number tagged	36	504	479	546	609	455	2,629	1,354	579	1,876	3,809
LOCALITY OF RECOVERY											
LOWER CLARENCE STRAIT.—AREA 1											
East of Cape Fox		2		3	3		8				
British Columbia			1				1	1	1	1	3
Revillagigedo Channel and Tongass Narrows	1	6	7	11	17	10	52	13	2	1	16
Behm Canal, south arm	1	1		2	2	3	9				
Behm Canal, north arm		2	4	9	4	6	25	3			3
West shores of Gravina, Annette, and Duke Islands	1	23	25	42	39	21	151	18	11	6	35
Total recovered	3	34	37	67	65	40	246	35	14	8	57
Percent recovered	8.3	6.7	7.8	12.3	10.7	8.8	9.4	2.6	2.4	0.4	1.5
LOWER CLARENCE STRAIT.—AREA 2											
East shore Prince of Wales Island, from Cape Chacon to Approach Point (all points):											
Total recovered	4	63	38	55	50	51	261	64	26	32	122
Percent recovered	11.1	12.5	7.9	10.1	8.2	11.2	9.9	4.7	4.5	1.7	3.2
MIDDLE CLARENCE STRAIT.—AREA 3											
Approach Point, Caamano Point, to Narrow Point, and Ernest Point	3	11	10	34	23	16	97	23	3		26
Ernest Sound		7	1	11	10	2	31		1	1	2
Total recovered	3	18	11	45	33	18	128	23	4	1	28
Percent recovered	8.3	3.6	2.3	8.2	5.4	4.0	4.9	1.7	0.7	0.1	0.7
UPPER CLARENCE STRAIT.—AREA 4											
Narrow Point, Ernest Point to Point Harrington, and East Island		4	1	8	7	7	27		1	3	4
Snow Passage and Stikine Strait		2			2	4	8				
Total recovered		6	1	8	9	11	35		1	3	4
Percent recovered	0.0	1.2	0.2	1.5	1.5	2.4	1.3	0.0	0.2	0.2	0.1
WEST COAST PRINCE OF WALES ISLAND (ALL POINTS).—AREA 6											
Total recovered		51	45	18	101	26	241	249	115	391	755
Percent recovered	0.0	10.1	9.4	3.3	16.5	5.7	9.2	18.4	19.8	20.8	19.8
OUTLYING AREAS											
Chatham Strait and Frederick Sound (all points):											
Total recovered		1					1	2			2
Percent recovered	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1
SUMMARY:											
Total recovered	10	173	132	193	258	146	912	373	160	435	968
Percent recovered	27.7	34.3	27.6	35.3	42.4	32.1	34.7	27.6	27.6	23.2	25.4

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647. The original records of the tagging experiments in 1925 and 1926 are given in the reports of Rich (1926), and Rich and Suomela (1927).

A total of 2,629 pink salmon were tagged, of which 912, or 34.7 percent, were recovered. Of the total number recovered 246 were captured in area 1, 261 in area 2, 128 in area 3, 35 in area 4, 241 in area 6, and 1 in Chatham Strait, an outlying district. Of the 246 salmon captured in area 1, 151 were taken by the fishery on the west shores of Annette and Gravina Islands, 25 in the north arm of Behm Canal, 9 in the south arm of Behm Canal, and the remaining 61 in Revillagigedo Channel and waters east of Cape Fox. It will be recalled that the results from the Cape Fox taggings showed more recoveries from the south arm of Behm Canal than from the north arm, whereas the results from the Cape Chacon taggings show just the reverse. That larger numbers of the salmon migrating through Clarence Strait are bound for the north arm of Behm Canal, than for the south arm, will be definitely demonstrated later in the discussion of the 1935 and 1936 taggings near Cape Chacon. Although only 35 tagged salmon were captured in area 4 it cannot be assumed that this represents the exact proportion bound for this area. Since the salmon bound for area 4, at the extreme upper end of Clarence Strait, must run the gauntlet of all the fishing gear along the shores of the strait from Cape Chacon northward, it is not unlikely that some of the tagged salmon captured in areas 1, 2, and 3 were destined for area 4 but were intercepted en route. This is one of the difficulties that make it impossible to determine the exact distribution of the salmon migrating through a main channel of entry by tagging experiments conducted near the entrance to the channel. By tagging at different points along the channel part of the difficulty encountered from interception of the tagged individuals may be overcome. However, in using this system of tagging in a channel such as Clarence Strait, where the fish are migrating in both directions, further difficulties arise that far offset the advantages gained. From the results of these experiments it appears that the pink salmon migrating into Clarence Strait during the latter part of the season are bound mainly for localities in areas 1, 2, and 6.

TAGGING EXPERIMENTS ON GRAVINA ISLAND AND IN THE VICINITY OF KASAAN BAY

The results from the early tagging experiments carried on at points in the vicinity of Kasaan Bay and along the west shore of Gravina Island will be considered next. Three experiments were carried on in the latter region; one at Nelson Cove early in July 1926, and one each at Nelson Cove and Dall Head early in August 1927. The exact locations of these points are shown by dots on Gravina Island in figure 1. Nelson Cove was reported by Rich (1927–29) as located at the north end and Dall Head at the south end of the island, and the results from the experiments are given in table 3.

TABLE 3.—*Pink salmon tagged in the vicinity of Kasaan Bay, 1926–30, and number recovered* [1]

[Column headings indicate locality and date of tagging]

	South Entrance to Kasaan Bay, July 29, 1930	South Entrance to Kasaan Bay, Aug. 14, 1930	Windfall Harbor, Aug. 3, 1930	Windfall Harbor, Aug. 14, 1930	Nelson Cove, July 6–7, 1926	Dall Head and Nelson Cove, Aug. 5–6, 1927
Number tagged	146	125	423	425	284	321
LOCALITY OF RECOVERY						
LOWER CLARENCE STRAIT.—AREA 1						
Revillagigedo Channel and Tongass Narrows	3	4	4	6	8	8
Behm Canal, south arm	1		4	2	1	1
Behm Canal, north arm		1	8	1	24	14
West shores of Gravina, Annette, and Duke Islands	6		11	6	6	13
Total recovered	10	5	27	15	39	36
Percent recovered	6.8	3.7	6.4	3.5	13.7	11.2
LOWER CLARENCE STRAIT.—AREA 2						
East shore Prince of Wales Island, from Cape Chacon to Approach Point:						
Total recovered	16	49	5	40	1	4
Percent recovered	10.9	36.2	1.2	9.5	0.4	1.2
MIDDLE CLARENCE STRAIT.—AREA 3						
Approach Point, Caamano Point to Narrow Point, and Ernest Point	9	9	20	93	13	19
Ernest Sound					4	11
Total recovered	9	9	20	93	17	30
Percent recovered	6.2	6.7	4.7	21.9	6.0	9.4
UPPER CLARENCE STRAIT.—AREA 4						
Narrow Point, Ernest Point to Point Harrington, and East Island			10	1		2
Snow Passage and Stikine Strait					1	
Total recovered			10	1	1	2
Percent recovered	0.0	0.0	2.4	0.2	0.4	0.6
WEST COAST PRINCE OF WALES ISLAND (ALL POINTS).—AREA 6						
Total recovered	1		1			
Percent recovered	0.7	0.0	0.2	0.0	0.0	0.0
OUTLYING AREAS						
Chatham Strait			1			
Stephens Passage					2	
Total recovered			1		2	
Percent recovered	0.0	0.0	0.2	0.0	0.7	0.0
SUMMARY:						
Total recovered	36	63	64	149	60	72
Percent recovered	24.6	46.6	15.1	35.1	21.1	22.4

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647. The original records of the tagging experiments from 1926 to 1930 are given in the reports of Rich and Suomela (1927), Rich and Morton (1929), and Rich (1932).

From an inspection of column 5 in table 3 it will be seen that most of the pink salmon migrating along the west shore of Gravina Island early in July are bound for the northern localities in area 1 and the general localities in areas 3 and 4, there being only a small percentage of them taken in area 2. From an inspection of column 6 in table 3 it will be seen that most of the salmon migrating along this shore in the early part of August are also bound for the northern localities in area 1 and the general localities in areas 3 and 4. However, there is the appearance of a tendency for the fish to turn back from this shore to localities in area 2, which becomes quite marked later on in August. Evidence of this is afforded by the slight increase in the number of tagged individuals recovered from area 2 as reported from the August taggings. Further reference will be made to this tendency in the discussion immediately follow-

ing. In all three of these experiments the small number of recoveries in area 4 may have been due partially to interception in area 3.

Four lots of salmon were tagged in the vicinity of Kasaan Bay in 1930, 2 just south of the entrance to the bay near Island Point, 1 on July 29, and 1 on August 14, 2 just north of the bay at Windfall Harbor on August 3 and 14. The results are given in columns 1–4 in table 3. The tagged salmon recovered from the July 29 tagging just south of the bay were captured in areas 1, 2, and 3, in almost equal proportions. The largest number, however, came from area 2. Those recovered from the August 14 tagging at the same location were captured also in areas 1, 2, and 3, but this time by far the greater part were captured in area 2. In both of these experiments the localities in which the salmon were recovered in area 2 extended as far south as Cape Chacon. It is evident, then, that the majority of the pink salmon reaching the eastern shore of Prince of Wales Island, in the vicinity of Kasaan Bay, during the second week in August are migrating southward rather than northward.

The individuals recovered from the August 3 tagging at Windfall Harbor, north of Kasaan Bay, were recaptured mainly in areas 1, 3, and 4, with only a relatively small number coming from area 2. Of the 64 tagged individuals recovered, 33 came from areas south of Kasaan Bay, 27 from area 1, 5 from area 2, and 1 from area 6, while 30 came from areas north of the bay, 20 from area 3, and 10 from area 4. Thus, it may be assumed that the pink salmon at this time of the season are migrating in equal numbers in both directions from their point of tagging at Windfall Harbor. The recoveries from the August 14 tagging at this point, however, show a much different picture. Of the 149 tagged salmon recovered from this experiment, 15 were captured in area 1, 40 in area 2, 93 in area 3, and 1 in area 4. Here we find 94 of the recoveries made in areas 3 and 4, north of the point of tagging, and only 55 made in areas 1 and 2, south of the point of tagging. Hence, it may be assumed that in the latter part of the season the pink salmon reaching the shores of Clarence Strait, in the vicinity of Windfall Harbor, are migrating northward in greater numbers than southward. It is also interesting to note that the recoveries from area 2 in this experiment were more numerous than from area 1, 40 as compared to 15, whereas the reverse was true in the August 3 tagging, 5 as compared to 27. This, together with the fact that the majority of the recoveries from the tagging south of Kasaan Bay on August 14 were recovered in area 2, leads to the conclusion that most of the salmon reaching the shores of Clarence Strait below Approach Point, during the latter part of the season, are bound for localities along the east shore of Prince of Wales Island, in area 2, as far south as Cape Chacon. Where do these salmon come from? Are they part of a population migrating southward from Sumner Strait, or do they come from the populations migrating northward in Clarence Strait that have turned near Kasaan Bay and move southward? A review of the tagging experiments carried on in Sumner Strait at Point Colpoys (see table 7) will show that most of the salmon migrating southward from Sumner Strait at this time of the season are bound for localities in area 4, with only a few migrating as far south as area 2. Therefore, considering the large volume of salmon caught in area 2 from Kasaan Bay south at this time of the season, there is only one probable origin of these southward-bound salmon. They must come from populations migrating northward in Clarence Strait that have turned westward and southward from the west shore of Gravina Island and the lower shore of Cleveland Peninsula just above Caamano Point. This turning back of the salmon from the west shore of Gravina Island during the latter part of the season was indicated in the discussion of the taggings carried on along this shore in 1926 and 1927. Further

evidence in support of this conclusion will be presented in the discussion of the 1935 and 1936 taggings near Cape Chacon.

TAGGING EXPERIMENTS IN THE VICINITY OF CAPE MUZON

In discussing the tagging experiments in the immediate vicinity of Cape Chacon it was pointed out that a considerable number of the recoveries were reported from area 6 and the localities of Cordova Bay and contiguous channels. Of the 924 salmon recovered from the experiments near Cape Chacon, 241 were captured in area 6. It would appear that considerable numbers of the pink salmon migrating into Clarence Strait during the latter part of the season are bound for the localities of Cordova Bay and are milling about in an attempt to find them. A review of the results from the tagging experiments carried on late in the season at Cape Muzon, Kaigani Point, and Kaigani Strait points (see table 2), located at the entrance to Cordova Bay, will show that part of the pink salmon migrating into Cordova Bay are bound for areas 1, 2, 3, and 4. The results from these experiments are given in the last four columns of table 2. A total of 3,809 pink salmon were tagged at these three locations, of which 968, or 25.4 percent, were recovered. Of the total number recovered 57 were captured in area 1, 122 in area 2, 28 in area 3, 4 in area 4, 755 in area 6, and 2 in an outlying area. Since these taggings were carried on at approximately the same time in the fishing season as those near Cape Chacon, it is not surprising to find considerable numbers of the tagged individuals captured in area 2.

In summarizing the results from the tagging experiments carried on in the vicinity of Cape Chacon and Cape Muzon, it is evident that during the latter part of the season the pink salmon move in from Dixon Entrance to the southern shores of Prince of Wales Island, and after milling about for some time separate into populations that are bound for the localities in area 6, and populations that are bound for the localities in areas 1, 2, 3, and 4.

PINK-SALMON TAGGING EXPERIMENTS IN CLARENCE STRAIT IN 1935 AND 1936

In the summers of 1935 and 1936 series of consecutive weekly taggings of pink salmon were carried on in Clarence Strait in the vicinity of Cape Chacon. These taggings were made from a trap at McLean Point, located on the east shore of Prince of Wales Island, approximately 7 miles north of Cape Chacon. The taggings at McLean Point were all made from the trap operated at this location by the Alaska Pacific Salmon Co., and the Bureau of Fisheries wishes to express its appreciation for the cooperation of this company in furnishing these facilities, and the salmon that were tagged.

In Alaska, commercial fishing for salmon is prohibited by law from 6 p. m. Saturday to 6 a. m. Monday during the entire fishing season. All of the taggings in both series, with the exception of the first and fourth in 1935, were carried on at the beginning of the weekly closed periods. This provided an opportunity for the tagged individuals to migrate from the location at which they were tagged for at least 34 hours before they were again subject to capture. By following this procedure only a few were recaptured in the trap from which they had been tagged. The dates of the weekly experiments, and the number of pink salmon tagged in each, are given in table 4 for the 1935 series and in table 5 for the 1936 series of experiments.

TABLE 4.—*Pink salmon tagged at McLean Point in 1935* [1]

[Column headings indicate date and number tagged]

Locality of recovery	Salmon recovered and average time en route											
	July 22, 381		July 27, 395		Aug. 3, 395		Aug. 12, 389		Aug. 17, 297		Total, 1,857	
	Number	*Days*	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*
LOWER CLARENCE STRAIT.—AREA 1												
East of Cape Fox:												
Kanagunut Island			1	12							1	12
Sitklan Island					1	4					1	4
Revillagigedo Channel and Tongass Narrows:												
Cape Fox	2	14			1	9					3	12
Foggy Bay					1	3	1	5			2	4
Duke Point	2	6	3	10			6	6	2	2	13	6
Boca de Quadra			1	3							1	3
Lucky Cove			6	4							6	4
Thorne Arm			8	4			3	3			11	4
Carrol Point									1	0	1	0
Annette Island, north and east shores			9	6	1	9			1	1	11	6
Behm Canal, south arm:												
Roe Point									1	?	1	?
Smeaton Bay									1	?	1	?
Rudyerd Bay									1	?	1	?
Chickamin River			2	5							2	5
General			1	5							1	5
Behm Canal, north arm:												
Point Higgins	1	4									1	4
Clover Pass	1	8	2	3	3	7					6	6
Smugglers Cove	1	8			1	3					2	6
Bond Bay	8	7	9	7	3	6					20	7
Helm Bay	1	?									1	?
Naha River									1	26	1	26
Indian Point			4	6	4	3	1	4			9	4
Escape Point	6	7	3	3	3	4	1	7			13	5
Neets Bay					2	4					2	4
Yes Bay	3	4									3	4
Robinson Creek	3	12									3	12
Belle Island	1	?									1	?
General			2	8			2	3			4	6
West and south shores of Gravina, Annette, and Duke Islands:												
Percy Islands	1	7	7	5	1	4					9	5
Davidson Point	2	5									2	5
Annette Island, south shore			12	4	3	6	6	6	3	3	24	5
Annette Island, northwest shore			1	5			3	3	1	4	5	4
Seal Cove	2	19	1	0	1	?	3	5	2	4	9	8
Gravina Island, west shore	27	5	23	5	19	7	11	5	18	4	98	5
Total recoveries	61		95		44		37		32		269	
Percent recoveries	16.0		24.0		11.1		9.5		10.8		14.5	
LOWER CLARENCE STRAIT.—AREA 2												
Prince of Wales Island from Cape Chacon to Approach Point:												
Kendrick Bay	4	2	5	7	6	11	18	4	8	3	41	5
Polk Island					3	14	22	5	10	4	35	5
Moira Sound					2	15	4	5	5	4	11	6
Point Adams	5	3	2	7	1	10	19	6	6	4	33	5
Wedge Island			1	4					2	4	3	4
Windy Point	1	9	3	13	2	9	1	4			7	10
Chasina Point			1	13							1	13
Cholmondeley Sound			1	3			1	9			2	6
Island Point	1	?			2	8	1	4	4	5	8	5
Skowl Arm	1	7					1	7	2	5	4	6
Total recoveries	12		13		16		67		37		145	
Percent recoveries	3.1		3.3		4.1		17.2		12.5		7.8	
MIDDLE CLARENCE STRAIT.—AREA 3												
Approach Point, Caamano Point, to Narrow Point, and Ernest Point:												
Caamano Point	3	9	3	6	5	5	1	13			12	7
Grindall Island and Niblack Point	7	6	10	6	4	4	3	7	6	3	30	5
Niblack Point	3	5									3	5
Ship Island and Streets Island	3	8	5	10	8	6	1	14	8	7	25	8
Meyers Chuck	14	9	9	5	17	5	4	4	8	5	52	6
Ernest Sound:												
Union Point							1	13	1	8	2	
Eaton Point	4	9			4	4					8	10
Watkins Point			1	25							1	6
Santa Anna	1	4									1	25
Point Warde	3	27									3	4
Olive Cove					1	6					1	27
Total recoveries	38		28		39		10		23		138	6
Percent recoveries	10.0		7.0		9.9		2.6		7.7		7.4	

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647.

TABLE 4.—*Pink salmon tagged at McLean Point in 1935*—Continued

[Column headings indicate date and number tagged]

Locality of recovery	Salmon recovered and average time en route											
	July 22, 381		July 27, 395		Aug. 3, 395		Aug. 12, 389		Aug. 17, 297		Total, 1,857	
UPPER CLARENCE STRAIT.—AREA 4												
Narrow Point, Ernest Point to Point Harrington, East Island:	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*	*Number*	*Days*
Ernest Point	2	5			1	4					3	5
Screen Islands	3	34					2	15	1	8	6	23
Lincoln Rock					2	3					2	3
Eagle Creek			1	11			1	4	2	4	4	6
Whale Passage									1	3	1	3
Snow Passage and Stikine Straits:												
Snow Passage							1	3			1	3
Total recoveries	5		1		3		4		4		17	
Percent recoveries	1.3		0.3		0.7		1.0		1.3		0.9	
SUMNER STRAIT.—AREA 5												
Boulder Point			1	6							1	6
Total recoveries			1								1	
Percent recoveries			0.3								0.1	
WEST COAST PRINCE OF WALES ISLAND.—AREA 6												
Brownson Bay	3	6			2	11			1	9	6	8
Shipwreck Point							2	2	1	7	3	4
Total recoveries	3				2		2		2		9	
Percent recoveries	0.8				0.5		0.5		0.7		0.5	
Summary of all recoveries	119		138		104		120		98		579	
Percent of all recoveries	31.2		34.9		26.3		30.8		33.0		31.2	

In 1935, five weekly taggings were carried on from July 22 to August 17. In 1936, because of a heavy storm on the week end of August 8, only four weekly taggings were carried on over a similar period of time; July 18 to August 15. It was for this reason that twice the usual number of salmon were tagged on August 15.

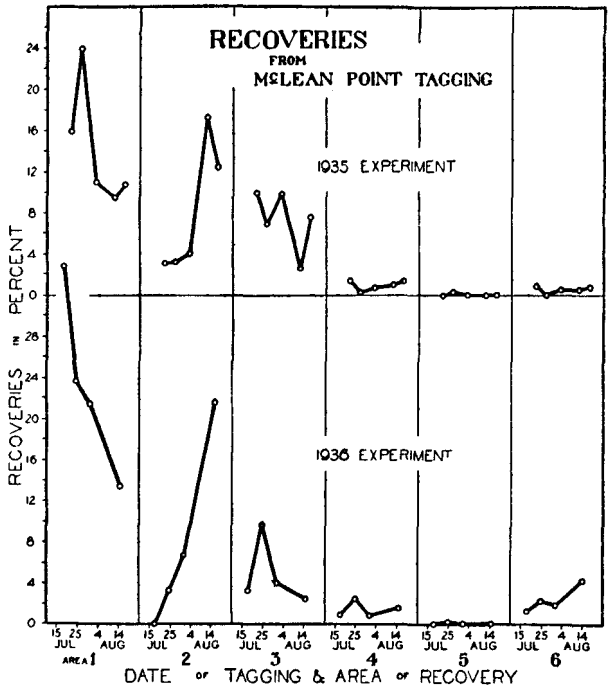

FIGURE 4.—Trends in the percentage recoveries of tagged pink salmon from the weekly tagging experiments in 1935 and 1936 at McLean Point.

Tables 4 and 5 also give the number and percent of tagged salmon recovered from each of the experiments and the localities in which they were captured. These localities, as stated in tables 1, 2, and 3, are listed under the geographic areas in which they occur. The average number of days the tagged salmon were en route before recapture are also reported but, owing to the extreme variability in the rate of travel, as indicated by the dates the salmon were recaptured, the authors do not feel justified in drawing definite conclusions about this phase of the salmon migrations. However, since this information is of general interest, it is reported in the tables. The seasonal trends in the percentages of salmon recovered in the geographic areas, as

indicated by the results from the weekly taggings, are shown in figure 4 for both the 1935 and 1936 series of experiments.

TABLE 5.—*Pink salmon tagged at McLean Point in 1936* [1]

[Column headings indicate date and number tagged]

Locality of recovery	Salmon recovered and average time en route									
	July 18, 339		July 25, 625		Aug. 1, 493		Aug. 15, 984		Total, 2,441	
LOWER CLARENCE STRAIT.—AREA 1										
East of Cape Fox:										
Nakat Bay	2	18							2	18
Revillagigedo Channel and Tongass Narrows:										
Cape Fox	1	11			1	5	17	3	19	3
Tree Point					2	7			2	7
Foggy Bay	11	3	10	4	5	5	1	3	27	4
Duke Point			3	23	4	11			7	16
Slate Island	2	5							2	5
Black Island			2	11	1	3			3	8
Point Alava			2	16	3	8			5	11
Lucky Cove	1	14	5	7	2	9			8	8
Thorne Arm					1	13	5	4	6	5
Carrol Point	2	7	1	2			4	4	7	5
Annette Island, north and east shores	4	9							4	9
General	12	?	23	?	4	?			39	?
Behm Canal, south arm:										
Point Sykes					1	4			1	4
Smeaton Bay	1	7					2	3	3	4
Chickamin River	1	14							1	14
Behm Canal, north arm:										
Point Higgins	5	2							5	2
Bond Bay	3	6	5	7	4	9	3	4	15	7
Clover Passage					3	7			3	7
Betton Island							3	4	3	4
Traitors Cove	1	21			2	6			3	11
Belle Island	5	6	1	10	3	8			9	7
General					2	10			2	10
West and south shores of Gravina, Annette, and Duke Islands:										
Percy Islands	2	13							2	13
Annette Island, south shore			1	20			1	4	2	12
Annette Island, northwest shore	14	5	28	4	24	5	11	5	77	5
Point McCartey	3	3	2	4					5	3
Warburton Island	3	7	2	7	1	9	2	5	8	7
Seal Cove	1	21	1	3	1	3	12	5	15	6
Blank Point	1	5			1	11			2	8
Gravina Island, west shore	43	7	62	7	41	5	72	7	218	7
Total recoveries	118		148		106		133		505	
Percent recoveries	34.8		23.7		21.5		13.5		20.7	
LOWER CLARENCE STRAIT.—AREA 2										
Prince of Wales Island from Cape Chacon to Approach Point:										
Kendrick Bay			9	8	9	3	97	5	115	5
Polk Island, Scott Point, Rip Point, and Hidden Point			2	21	15	9	59	6	76	7
Moira Sound							2	6	2	6
Point Adams					3	3	10	6	13	5
Wedge Island			3	4	1	18	6	3	10	5
Chasina Point							21	4	21	4
Island Point							10	4	10	4
Patterson Island					1	21			1	21
Skowl Arm			4	10	7	8	1	4	12	8
Twelve Mile Arm			2	23			1	7	3	18
Kasaan Bay					1	22	5	4	6	7
Total recoveries			20		37		212		269	
Percent recoveries			3.2		7.5		21.6		11.0	
MIDDLE CLARENCE STRAIT.—AREA 3										
Approach Point, Caamano Point, to Narrow Point, and Ernest Point:										
Caamano Point and Grindall Island			21	8	3	6	15	8	39	8
Niblack Point	4	12	10	7	7	15	5	6	26	10
Ship Island and Street Island					1	9			1	9
Meyers Chuck			3	5	8	10	4	6	15	8
False Island	2	14	15	6					17	7
Ernest Sound:										
Vixen Point	5	5							5	5
Union Point and Watkins Point			11	6					11	6
Total recoveries	11		60		19		24		114	
Percent recoveries	3.2		9.6		3.9		2.4		4.7	

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647.

TABLE 5.—*Pink salmon tagged at McLean Point in 1936*—Continued

[Column headings indicate date and number tagged]

Locality of recovery	Salmon recovered and average time en route									
	July 18, 339		July 25, 625		Aug. 1, 493		Aug. 15, 984		Total, 2,441	
UPPER CLARENCE STRAIT.—AREA 4										
Narrow Point, Ernest Point to Point Harrington, and East Island:										
Ernest Point							3	10	3	10
Narrow Point	1	25	1	18	1	11			3	18
Olson Cove			2	16					2	16
Eagle Creek			5	9	1	25	4	11	10	11
Lincoln Rock					1	29	2	9	3	16
Marsh Island	1	26	3	12			5	7	9	11
Steamer Rock	1	32			1	12			2	22
Snow Passage and Stikine Strait:										
Snow Passage			4	7			1	2	5	6
Total recoveries	3		15		4		15		37	
Percent recoveries	0.9		2.4		0.8		1.5		1.5	
SUMNER STRAIT.—AREA 5										
Affleck Canal			1	7					1	7
Total recoveries			1						1	
Percent recoveries			0.2						0.1	
WEST COAST PRINCE OF WALES ISLAND.—AREA 6										
Nichols Bay					4	?	1	3	5	3
Brownson Bay	3	16	9	11	5	12	15	5	32	8
Hunter Bay			1	32			13	6	14	8
Point Webster							1	8	1	8
Klakas Inlet							5	5	5	5
Natkwa Inlet							1	7	1	7
Cordova Bay	1	36					4	3	5	9
Cape Muzon			4	6					4	6
Total recoveries	4		14		9		40		67	
Percent recoveries	1.2		2.2		1.8		4.1		2.7	
OUTLYING AREAS										
Kingsmill Point	1	10	3	7	1	0			5	6
Total recoveries	1		3		1				5	
Percent recoveries	0.3		0.5		0.2				0.2	
Summary of all recoveries	137		261		176		424		998	
Percent of all recoveries	40.4		41.8		35.7		43.1		40.9	

The percentage of recoveries in area 1, from the weekly taggings at McLean Point, tended to be highest in the early part of the season and lowest in the latter part, thus indicating a seasonal decrease in the portion of the run passing McLean Point that was bound for area 1. In reviewing the number of tagged salmon recovered in area 1 (see tables 4 and 5), it was found that very few were captured in the localities east of Cape Fox and in the south arm of Behm Canal. Considerable numbers were captured in Revillagigedo Channel and the north arm of Behm Canal. The largest numbers, however, were recovered consistently along the west shores of Annette and Gravina Islands.

The percentage of recoveries in area 2 from the weekly taggings tended to be lowest in the early part of the season and highest in the latter part. This is just the reverse of the seasonal trends in area 1. In other words, there was a very definite seasonal increase in the percentages of the pink salmon tagged at McLean Point that were recovered in area 2. The localities in which these recoveries were made were scattered along the east shore of Prince of Wales Island from Kendrick Bay to Kasaan Bay. During the first part of the season a large proportion of the salmon were recaptured just north of the point of tagging but, as the season progressed, more and more were reported from localities in the vicinity of Kasaan Bay.

The percentage of recoveries in area 3 from the weekly taggings was much smaller than those in areas 1 and 2. No doubt many of the tagged salmon bound for this area were intercepted in the latter regions. Nevertheless, there were sufficient recoveries in area 3 to give some indication of the time when these salmon migrated through Clarence Strait. Although the seasonal trends in area 3 are not very marked, there is indication that more of the recoveries were made in the early part of the season than in the latter part. In other words, more pink salmon bound for area 3, and the areas above it, migrate through Clarence Strait in the early part of the season than in the latter part.

The percentage of recoveries in areas 4 and 5 were so small that no definite trends occur in them. Many of the salmon bound for these areas were, no doubt, intercepted in areas 1, 2, and 3.

The percentage of recoveries in area 6 for the 1935 series of experiments was too small to indicate a definite seasonal trend. However, the percentage recovered from the 1936 series of experiments, although only slightly greater, indicates a possible upward trend in the latter part of the season. Since, in 1935, there was a misunderstanding on the part of the cannerymen in this area as to the method of reporting recoveries of tagged salmon, there is reason to believe the 1935 data are incomplete. This tendency toward an increase in the percentage of recoveries as the season progresses is in accord with the results from the experiments carried on near Cape Chacon during the second and third weeks of August in 1925 and 1926. In fact the whole distribution of the salmon tagged during the second and third weeks of August in the 1935 and 1936 experiments is in accord with the distribution of the salmon tagged in the 1925 and 1926 experiments.

In discussing the distribution of the recoveries from the early tagging experiments in Clarence Strait, evidence was pointed out which indicated that many of the pink salmon migrating along the west shores of Gravina and Annette Islands during the latter part of the season were bound for localities along the east shore of Prince of Wales Island in area 2. Further evidence in regard to this peculiar migration of the pink salmon in Clarence Strait may be found in the distribution of the recoveries from the 1935 and 1936 experiments.

In discussing the localities in area 1 in which the tagged salmon were recovered (see tables 4 and 5), it was pointed out that the majority were recovered from the west shores of Gravina and Annette Islands. The total numbers, by weekly taggings, recovered in area 1 in the localities east of Cape Fox, Revillagigedo Channel, and Behm Canal, as a group, and the recoveries from the west shores of Gravina and Annette and Duke Islands, as a group, are given in table 6.

TABLE 6.—*Pink salmon recovered in area 1 from tagging experiments at McLean Point in 1935 and 1936*

Date of tagging experiment	Recoveries in 1935						Recoveries in 1936					
	East of Cape Fox, Revillagigedo Channel, and Behm Canal		West shores of Gravina, Annette, and Duke Islands		Total		East of Cape Fox, Revillagigedo Channel, and Behm Canal		West shores of Gravina, Annette, and Duke Islands		Total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
July 18							51	43	67	57	118	100
July 22	29	48	32	52	61	100						
July 25							52	35	96	65	148	100
July 27	51	54	44	46	95	100						
Aug. 1							38	37	68	63	106	100
Aug. 3	20	45	24	55	44	100						
Aug. 12	14	38	23	62	37	100						
Aug. 15							35	26	98	74	133	100
Aug. 17	8	25	24	75	32	100						

The relation between these recoveries and the total recoveries in area 1, expressed in percentage, is also given in table 6. It will be noted that the weekly percentage of recoveries in area 1, from the localities east of Cape Fox, Revillagigedo Channel, and Behm Canal, are highest in the beginning of the season and lowest toward the end. The weekly percentage of recoveries along the west shores of Gravina, Annette, and Duke Islands is, on the other hand, lowest at the first part of the season and highest toward the last. In other words, there is a seasonal increase in the percentage of tagged salmon caught in area 1 along the west shores of Gravina and Annette Islands, whereas there is a seasonal decrease in the percentage of the tagged salmon caught in other localities of the area.

Since there are very few streams along the west shores of Annette and Gravina Islands in which salmon can spawn, most of the tagged salmon caught in this region were evidently bound either for other localities in area 1, or in one of the other areas. During the first part of the season considerable numbers of tagged salmon were recovered in the north arm of Behm Canal and in area 3. No doubt many of those recovered from the west shores of Gravina and Annette Islands during the first part of the season were bound for those regions. In the latter part of the season, however, very few were recovered from the north arm of Behm Canal and area 3, but there were still large recoveries from the west shores of Gravina and Annette Islands. Where were these tagged salmon going at this time of the season?

In discussing the percentage of recoveries of tagged salmon in area 2 from the weekly taggings it was pointed out that there was a seasonal increase in these recoveries and that larger numbers were reported from the localities in the vicinity of Kasaan in the last part of the season than in the first part. Hence, it is not at all improbable that many of the tagged salmon recovered from the west shores of Gravina and Annette Islands during the latter part of the season were bound for the localities in area 2 in the vicinity of Kasaan Bay and southward. These salmon no doubt migrated across Clarence Strait to the west shores of Gravina and Annette Islands and then turned back to the localities on the east shore of Prince of Wales Island in area 2. Whether or not the salmon make this journey may depend to some extent upon the prevailing winds. If a southeast wind is blowing there seems to be a greater tendency for the salmon to migrate northward along the east shore of Prince of Wales Island rather than to cross over to the west shores of Gravina and Annette Islands. If a southwest wind is blowing the opposite course is more apt to be taken. No definite conclusions may be drawn because of the lack of sufficient information, at the present time, concerning the influence of wind direction on migration.

SUMMARY OF CAPE CHACON EXPERIMENTS

1. The results from the tagging experiments in Clarence Strait, both past and present, indicate that the pink salmon migrating into the strait at different times of the season follow rather definite migratory routes to the localities for which they are bound.

2. Most of the first pink salmon to appear each season are bound for localities in Revillagigedo Channel, the north arm of Behm Canal, Ernest Sound, or the northernmost regions in Clarence Strait. These salmon enter Clarence Strait by way of Cape Chacon and, after migrating for a short distance northward along the east shore of Prince of Wales Island, leave this shore and either follow directly up the middle of the strait or turn eastward until they reach the west shores of Annette and Gravina Islands. From here they either continue northward into the north

arm of Behm Canal and the northern regions of Clarence Strait, including Ernest Sound, or they continue eastward and southward into Revillagigedo Channel.

3. This peculiar migration of the salmon along the west shores of Annette and Gravina Islands results in many of the salmon, bound for the north arm of Behm Canal and the northern regions of Clarence Strait, being intercepted by the traps and purse seines operated along these shores.

4. As the season progresses, more and more of the pink salmon entering Clarence Strait by way of Cape Chacon are destined for the localities along the east shore of Prince of Wales Island below Approach Point. Most of these salmon continue northward along the east shore of Prince of Wales Island instead of crossing the strait to the west shores of Annette and Gravina Islands. Many of those that do cross the strait turn back from the shores of these islands to the localities on the east shore of Prince of Wales Island.

5. At the very close of the season many of the salmon migrating into Clarence Strait are bound for localities in Cordova Bay on the extreme southwest shore of Prince of Wales Island.

The migration of the pink salmon along the west shores of Annette and Gravina Islands, especially the latter, makes these shores one of the most productive fishing areas in Clarence Strait. The fishing gear operated in this area intercepts the runs of pink salmon that are bound for practically all of the localities in Clarence Strait and its adjacent waters to the east. It is for this reason that so many of the pink salmon tagged in Clarence Strait were recovered along the west shores of these islands.

PINK-SALMON TAGGING EXPERIMENTS IN SUMNER STRAIT, 1924–36

It has long been known that the run of pink salmon in Sumner Strait appears earlier in the summer than the run in Clarence Strait. The time the salmon appeared in the commercial catches and the location of these catches in the strait indicated that most of these early migrants were bound for localities in the extreme eastern section and the adjoining waters of Zimovia Strait, Eastern Passage, Blake Channel, and Bradfield Canal. However, the extent to which this run penetrated the waters of Clarence Strait and other adjoining channels was not known. In order to determine more completely the distribution of the localities in which these pink salmon spawned, the Bureau laid plans for a number of tagging experiments to be carried on in various parts of Sumner Strait. This work began in 1924, was continued each year through 1927, and taken up again in 1935 and 1936. Since only one experiment was carried on in each of the latter seasons, their results will be discussed with those from the early experiments.

The locations where the salmon were tagged in Sumner Strait from 1924 to 1936 are shown in figure 1. The dots indicate the locations of early taggings and the triangle is that of the later ones. The early tagging was done at Cape Decision, Ruins Point, and Point Colpoys, and during 1935 and 1936 only at Point Colpoys. Although none of these experiments continued throughout the entire season of any year, they varied sufficiently in point of time so that, taken together, they give a picture of the movements of fish in this region over an entire season. Thus, experiments were carried on at Cape Decision and Ruins Point in 1924, 1925, and 1927, between July 12 and August 3; those at Point Colpoys on July 10, 1926, July 26 to 30, 1927, August 13, 1935, and August 16, 1936. A summary by geographic areas of the results from all experiments from 1924 to 1936 is given in table 7. The individual localities in the geographic areas, in which the tagged salmon were recovered

from the 1935 and 1936 experiments at Point Colpoys, are given in table 8. The taggings at Point Colpoys were made from the trap operated at this location by the Pacific American Fisheries, Inc., and the Bureau of Fisheries wishes to express its appreciation for the cooperation of this company in furnishing these facilities, and the salmon that were tagged.

TABLE 7.—*Pink salmon tagged in Sumner Strait, 1924–36, and number recovered* [1]

[Column headings indicate locality and date of tagging]

	Point Colpoys, July 10, 1926	Point Colpoys, July 26–30, 1927	Point Colpoys, Aug. 13, 1935	Point Colpoys, Aug. 16, 1936	Total, Point Colpoys	Ruins Point, July 18–25, 1925	Ruins Point, July 12–Aug. 3, 1924	Cape Decision, July 30, 1927	Total, Ruins Point and Cape Decision
Number tagged	259	569	386	498	1,712	1,217	250	162	1,629
LOCALITY OF RECOVERY									
SUMNER STRAIT (ALL POINTS).—AREA 5									
Total recovered	2	6	9	9	26	295	20	8	323
Percent recovered	0.8	1.1	2.3	1.8	1.5	24.2	8.0	4.9	19.8
UPPER CLARENCE STRAIT.—AREA 4									
Point Colpoys						32	6	5	43
Snow Passage and Stikine Strait	3	13	19	84	119	36		2	38
Narrow Point, Ernest Point to Point Harrington, and East Island	8	34	47	66	155	30	3	2	35
Total recovered	11	47	66	150	274	98	9	9	116
Percent recovered	4.2	8.3	17.1	30.1	16.0	8.2	3.6	5.6	7.1
MIDDLE CLARENCE STRAIT.—AREA 3									
Ernest Sound	28	88	3	6	125	29	2	2	33
Approach Point, Caamano Point to Narrow Point and Ernest Point	11	39	20	7	77	15	2	2	19
Total recovered	39	127	23	13	202	44	4	4	52
Percent recovered	15.1	22.2	6.0	2.6	11.8	3.6	1.6	2.5	3.2
LOWER CLARENCE STRAIT.—AREA 2									
East shore of Prince of Wales Island from Approach Point to Brownson Bay:									
Total recovered	1	4	2	6	13	6	3		9
Percent recovered	0.4	0.7	0.5	1.2	0.8	0.5	1.2	0.0	0.6
LOWER CLARENCE STRAIT.—AREA 1									
West shores of Gravina, Annette, and Duke Islands	2	21	4	9	36	13	1		14
Behm Canal, *north arm*	4	6		2	12				1
Behm Canal, south arm		1			1	1			9
Tongass Narrows and Revillagigedo Channel	1	8	2	3	14	7	2		4
East of Cape Fox	1				1	4			2
British Columbia		2			2	1		1	
Total recovered	8	38	6	14	66	26	3	1	30
Percent recovered	3.1	6.7	1.6	2.8	3.8	2.1	1.2	0.6	1.8
OUTLYING AREAS									
Northwest coast Prince of Wales Island (all points)						27	7		34
Chatham Strait and Frederick Sound (all points)	2	1			3	7	3	16	26
Total recovered	2	1			3	34	10	16	60
Percent recovered	0.8	0.2	0.0	0.0	0.2	2.8	4.0	9.9	3.7
SUMMARY:									
Total recovered	63	223	106	192	584	503	49	38	590
Percent recovered	24.3	39.2	27.5	38.5	34.1	41.3	19.6	23.5	36.2

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647. The original records of the tagging experiments from 1924 to 1927 are given in the reports of Rich 1926, Rich and Suomela 1927, and Rich and Morton 1929.

TAGGING EXPERIMENTS AT RUINS POINT AND CAPE DECISION

Ruins Point is located on the east side and Cape Decision on the west side of the entrance to Sumner Strait. Point Colpoys is located in the central part of the strait where, through Snow Passage, Sumner Strait connects with the northern part of

Clarence Strait. Because of the rather wide geographic separation of these points, separate summaries were made of the Ruins Point-Cape Decision experiments and the Point Colpoys experiments.

TABLE 8.—*Pink salmon tagged at Point Colpoys in 1935 and 1936* [1]

Locality of recovery	Salmon recovered and average time enroute					
	Aug. 13, 1935, 386		Aug. 16, 1936, 498		Total, 884	
	Number	*Days*	*Number*	*Days*	*Number*	*Days*
SUMNER STRAIT.—AREA 5						
Kah Sheets Bay			2	5	2	5
Red Bay	2	1			2	1
Point Baker	1	?			1	?
Rocky Pass	2	7			2	7
Port Beauclerc	1	8	7	5	8	5
Calder Bay	1	3			1	3
Warren Channel	2	9			2	9
Total recoveries	9		9		18	
Percent recoveries	2.3		1.8		2.0	
UPPER CLARENCE STRAIT.—AREA 4						
Snow Passage and Stikine Strait:						
Snow Passage	19	2	65	2	84	2
Steamer Point			19	3	19	3
Point Harrington, East Island to Ernest Point, and Narrow Point:						
Steamer Rock			2	3	2	3
East Island	3	6			3	6
Whale Passage	7	6	9	12	16	9
Marsh Island			11	3	11	3
Screen Islands	3	13			3	13
Lincoln Rock			26	6	26	6
Lake Bay	3	7			3	7
Eagle Creek	29	5	12	9	41	6
Ratz Harbor	2	3	2	9	4	6
Olson Cove			4	7	4	7
Total recoveries	66		150		216	
Percent recoveries	17.1		30.1		24.4	
MIDDLE CLARENCE STRAIT.—AREA 3						
Ernest Sound:						
Ernest Point			4	5	4	5
Union Point and Watkins Point			1	8	1	8
Emerald Bay			1	6	1	6
Point Ward	3	6			3	6
Narrow Point, Ernest Point to Approach Point, and Caamano Point:						
Meyers Chuck	12	5	5	7	17	6
Wolf Creek	2	7			2	7
Ship Island	3	7			3	7
Niblack Point			2	7	2	7
Grindall Island	3	9			3	9
Total recoveries	23		13		36	
Percent recoveries	6.0		2.6		4.1	
LOWER CLARENCE STRAIT.—AREA 2						
East shore Prince of Wales Island from Approach Point to Brownson Bay:						
Chasina Point			3	5	3	5
Moria Sound	1	4			1	4
Ripp and Scott Points			2	7	2	7
Cape Chacon	1	4			1	4
Brownson Bay			1	7	1	7
Total recoveries	2		6		8	
Percent recoveries	0.5		1.2		0.9	
LOWER CLARENCE STRAIT.—AREA 1						
West shores of Gravina, Annette, and Duke Islands:						
West Shore of Gravina Island	3	7	6	6	9	6
West Shore of Annette Island			3	4	3	4
Seal Cove	1	7			1	7
Behm Canal and Revillagigedo Channel:						
Cape Caamano			2	6	2	6
Point Sykes			2	5	2	5
Foggy Bay	2	8	1	2	3	6
Total recoveries	6		14		20	
Percent recoveries	1.6		2.8		2.3	
Summary of all recoveries	106		192		298	
Percent of all recoveries	27.5		38.5		33.7	

[1] These data do not include recoveries reported from the point of tagging nor those doubtful as to location of capture. See text, p. 647.

Seven tagging experiments were carried on at Ruins Point in 1924 and 1925, and one at Cape Decision in 1927. Since these experiments were carried on at different times in the season, from July 12 to August 3, their results should indicate the destinations of the pink salmon that migrate through Sumner Strait at all times of the season. A total of 1,629 pink salmon were tagged, of which 590, or 36.2 percent, were recovered. Of these, 393, or 19.8 percent, were captured in Sumner Strait, area 5; 116, or 7.1 percent, in upper Clarence Strait, area 3; 9, or 0.6 percent, in lower Clarence Strait, area 2; 30, or 1.8 percent, in lower Clarence Strait, area 1; and 60, or 3.7 percent, along the northwest shore of Prince of Wales Island, Chatham Strait, and Frederick Sound. Hence it may be assumed that most of the pink salmon migrating into Sumner Strait are bound for localities in the strait and the northern regions of Clarence Strait, with only a small percentage migrating to localities in the lower regions of Clarence Strait. It is also important to note that of the 52 tagged salmon recovered in middle Clarence Strait, area 3, 33 were captured in Ernest Sound, indicating that many of the Sumner Strait pink salmon use the northern region of Clarence Strait only as a means of reaching Ernest Sound and its adjoining channels.

TAGGING EXPERIMENTS AT POINT COLPOYS

Further and more exact proof of this distribution of the Sumner Strait pink salmon in Clarence Strait and Ernest Sound may be found in an analysis of the results from the Point Colpoys taggings. A total of five tagging experiments were carried on at Point Colpoys; one on July 10, 1926, one each on July 26 and 30, 1927, one on August 13, 1935, and one on August 16, 1936. Thus, these experiments cover a period from July 10 to August 16 and represent both the odd- and even-year runs in equal proportion. The results were compiled in a manner similar to the procedure followed with the Clarence Strait data. In other words, they were used to show the seasonal differences in the distribution of the pink salmon to the spawning localities in the eastern section of Sumner Strait and its adjoining channels, and in Clarence Strait and Ernest Sound.

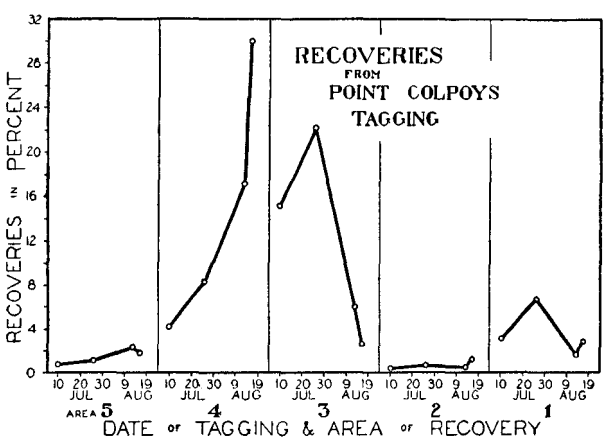

FIGURE 5.—Trends in the percentage recoveries of tagged pink salmon from the 1926, 1927, 1935, and 1936 tagging experiments at Point Colpoys.

The percentages of the tagged pink salmon recovered in the various geographic areas from each of the experiments are given in figure 5. From an inspection of this figure it will be noticed that very few of the salmon tagged at Point Colpoys were recovered in area 5 (Sumner Strait). The seasonal trend in the percentages of the recoveries in this area was not very definite and cannot be considered as indicative of any seasonal change in the number of pink salmon bound for the area. The seasonal trends in the percentages of recoveries in areas 3 and 4, on the other hand, were very marked and are certainly indicative of a seasonal increase in the number of pink salmon bound for the localities in area 4, and a definite seasonal decrease in the numbers bound for the localities in area 3. The percentage of recoveries in area 2, like those in area 5,

was very small. The percentage of recoveries in area 1, although by no means as great as those in areas 3 and 4, did show some indication of a seasonal decrease. It is not improbable that the majority of the Sumner Strait pink salmon migrating as far south as area 1 in Clarence Strait come from the early, rather than the late, part of the run.

SUMMARY OF POINT COLPOYS EXPERIMENTS

In reviewing the distribution of the pink salmon tagged at Point Colpoys (see tables 7 and 8), it will be noted that the majority of the tagged salmon recovered during the early part of the season were captured in the Ernest Sound region of area 3. This region supports a large number of excellent spawning streams whose pink-salmon populations enter them during the early part of the season. The majority of the tagged salmon recovered during the latter part of the season, on the other hand, were captured in area 4. This region also supports a large number of excellent spawning streams whose pink-salmon populations are known to migrate into them during the latter part of the season. Hence it may be assumed that most of the pink salmon migrating through Sumner Strait as far as Point Colpoys are bound for the localities in Ernest Sound and its contiguous channels, and the localities in the northern region of Clarence Strait. Furthermore, the pink salmon destined for localities in Ernest Sound and its adjoining channels, which are the farthest from the sea, pass through Sumner Strait early in the season, whereas those bound for the localities in Snow Passage and the northern region of Clarence Strait, which are closer to the sea, migrate later in the season.

The results from both the Clarence and Sumner Straits experiments indicate that most of the pink salmon migrating through these channels in the early part of the season are bound for the inside localities farthest from the sea, and as the season progresses they tend more and more to migrate into the localities which are closer to the sea. In view of these results the authors do not feel that the contention of the salmon packers, that their catches of pink salmon in area 2 during the latter part of the season are made from the runs migrating through Sumner Strait, is well founded.

CONCLUSIONS

Cape Fox region.—The pink salmon migrating through Dixon Entrance to the shores near Cape Fox are either bound for localities east of the cape or those in Revillagigedo Channel and the south arm of Behm Canal.

Cape Chacon region.—Most of the pink salmon entering Clarence Strait by way of Cape Chacon, during the early part of the fishing season, are destined for localities in Revillagigedo Channel, the north arm of Behm Canal, and the more distant localities in the northern region of Clarence Strait. Most of those migrating by the same route later in the season are bound for localities on the east shore of Prince of Wales Island south of Approach Point. Thus, the early migrants are native to the streams farthest distant from the sea, whereas the later migrants are native to those in the more proximate localities.

Cape Muzon region.—The tagging experiments carried on near the entrance to Cordova Bay were all made during the latter part of the season. The results indicate that at this time the incoming pink salmon are bound for localities in Cordova Bay, with a small percentage continuing around Cape Chacon to the southeast shore of Prince of Wales Island.

Point Colpoys region.—Those pink salmon migrating through Sumner Strait which pass Point Colpoys early in the season are destined for localities in Ernest Sound and the central region of Clarence Strait with a few continuing as far south as Revillagigedo Channel. Those passing the point later in the season are destined almost exclusively for localities in Snow Passage and the northern region of Clarence Strait. Thus, again, we find a seasonal difference in distribution. The early migrants are destined for the localities remote from the sea, the later migrants for the more proximate localities.

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