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HERRING SPAWNING SURVEYS IN SOUTHEASTERN ALASKA

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United States Department of the Interior, Fred A. Seaton, Secretary
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HERRING SPAWNING SURVEYS IN SOUTHEASTERN ALASKA

by

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Figure 1.--Aerial views of herring milt clouds at Fish Egg Island near Craig, Alaska.

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ABSTRACT

Aerial surveys to observe milt clouds produced by spawning herring in Southeastern Alaska waters hold promise as a method for assessing the extent of spawn deposition. Flights are conducted at altitudes of 500 to 700 feet and at cruising speeds of 120 knots. The mileage of beach utilized for spawning is recorded on reduced prints of navigation charts. The surveys have resulted in the discovery of 80 previously unreported spawning beaches. Observations during these preliminary flights have also added valuable information on the time of spawning and the physical characteristics of the beaches.

INTRODUCTION

Biological studies of Pacific herring, *Clupea harengus pallasi*, in Alaska have provided valuable information regarding the life history and behavior of this species (Rounsefell, 1930), but violent fluctuations in catches have not been adequately explained. Catch statistics suggest that changes in abundance are responsible for the fluctuations, but other evidence suggests that availability of herring to the fishing gear may vary considerably.

To resolve this difference, abundance estimates based on other than catch-effort data were considered. Canadian biologists had developed one such method by appraising egg deposition at time of spawning. Ground surveys measuring egg density and length and width of areas utilized for spawning afford a measure of total mileage of deposition, which is used as a comparative index of abundance (Taylor, 1955). In Southeastern Alaska spawning areas are so widespread that intensive ground surveys to assess spawn deposition are not feasible. Therefore, a method of aerial assessment was developed through the collaboration of L. N. Kolloen [1/], G. W. Hilsinger, and C. H. Elling of the Bureau of Commercial Fisheries, and J. C. Stevenson of the Fisheries Research Board of Canada. In the spring of 1953 a systematic aerial survey was made in British Columbia and Southeastern Alaska. The success of this initial survey encouraged further investigation, and somewhat more refined surveys have continued in Southeastern Alaska.

The prime objective of aerial surveys is to determine the mileage of beach used for spawning in a given area. The extent of spawn deposition is assumed to indicate size of spawning population. In addition to comparison of annual changes in actual mileage utilized, changes in areas used for spawning can be studied and may help to determine environmental requirements for

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1/ The author especially wishes to acknowledge the late L. N. Kolloen who initiated this research and who unfortunately died in a plane crash while on official business in Southeastern Alaska on September 1, 1954.

spawning. Aerial surveys also afford a means of studying timing of spawning activities.

The purpose of this report is (1) to describe the procedures of the aerial survey and (2) to record preliminary information gained from surveys of the past three years.

METHODS OF AERIAL SURVEY

The Pacific herring spawns in intertidal areas, and during spawning activity clouds of milt appear in the water along the shoreline. These milt clouds may be readily observed from the air (fig. 1); they have been spotted from as high as 6,500 feet, and are most certainly visible from greater heights. Most aerial surveys are conducted at altitudes between 500 and 700 feet. In clear weather, milt clouds have been seen at three miles from these heights. The exact coloration of the milt varies with lighting conditions. During bright, cloudless days the milt appears milky white, but during overcast periods it may vary from pale yellow to yellowish green. The density of the milt also produces variations in color.

The rate at which milt disperses and is no longer visible depends on tidal action, wind, and density of deposition. The schooling behavior of Pacific herring is such that spawning is usually intense and continuous, and dispersion of milt from an area is rarely completed in a day's time. After the milt has disappeared, the beach utilized for spawning may be detected by the presence of sea gulls actively feeding on eggs. Gulls line the spawning beach in countless thousands and distinctly outline the areas of egg deposition. Observations are classified as (1) active spawn when milt is visible and (2) old spawn when gulls are the only evidence of spawning.

Aerial surveys require an observer familiar with the territory and characteristics of spawning beaches. Aircraft used thus far for surveys (Grumman Goose and Super Widgeon) cruise at speeds of 120 knots, and though a trained observer would have little difficulty locating specific landmarks, the novice might easily be confused. When necessary, two or three passes are made over the same grounds to ensure accurate mileage determinations. During flight the observer plots the entire route of the survey on reduced prints of navigation charts and marks beach areas used for spawning. After each flight the observer measures the spawning beach marked on the chart and determines the mileage observed.

Time of spawning varies in each area, and to provide coverage of all major spawning areas, surveys are made from mid-March to mid-May. Spawning in any location may continue for as long as five weeks and repeated flights are necessary to adequately assess egg deposition. Results of all flights in a given area are compiled on a single master chart. This provides a composite picture of the spawning beach utilized during the season. The 1955 master chart of one of the major spawning areas is presented in figure 2.

Attempts to standardize survey methods have met with several obstacles of which weather conditions are most important and govern the days selected for survey either because flying is impossible, or visibility is so poor that surveys are not practical. Yearly variations in time of spawning possible negate the necessity of flying on a given day. Rather, coverage or number of days and hours flown would appear to be of greater importance, so that standardization of flying time would provide a useful comparative index, whereas surveys on given days could well distort such an index.

Availability of aircraft has also been a factor in standardizing methods. Available flight time has limited the extent of surveys, which of necessity have been centered in areas of concentrated spawning activity. Thorough and complete coverage has been attained in these area, but in areas of very light spawning there has been no standardized coverage.

The goal of future survey work is to develop a standardized method of survey from which the size of spawning populations can be estimated. Route and area of coverage, time lapse between flights, and numbers of surveys per area have yet to be established.

SPAWNING LOCALITIES

Rounsefell (1930) lists the reported spawning areas of herring from California to the Bering Sea. Aerial surveys have

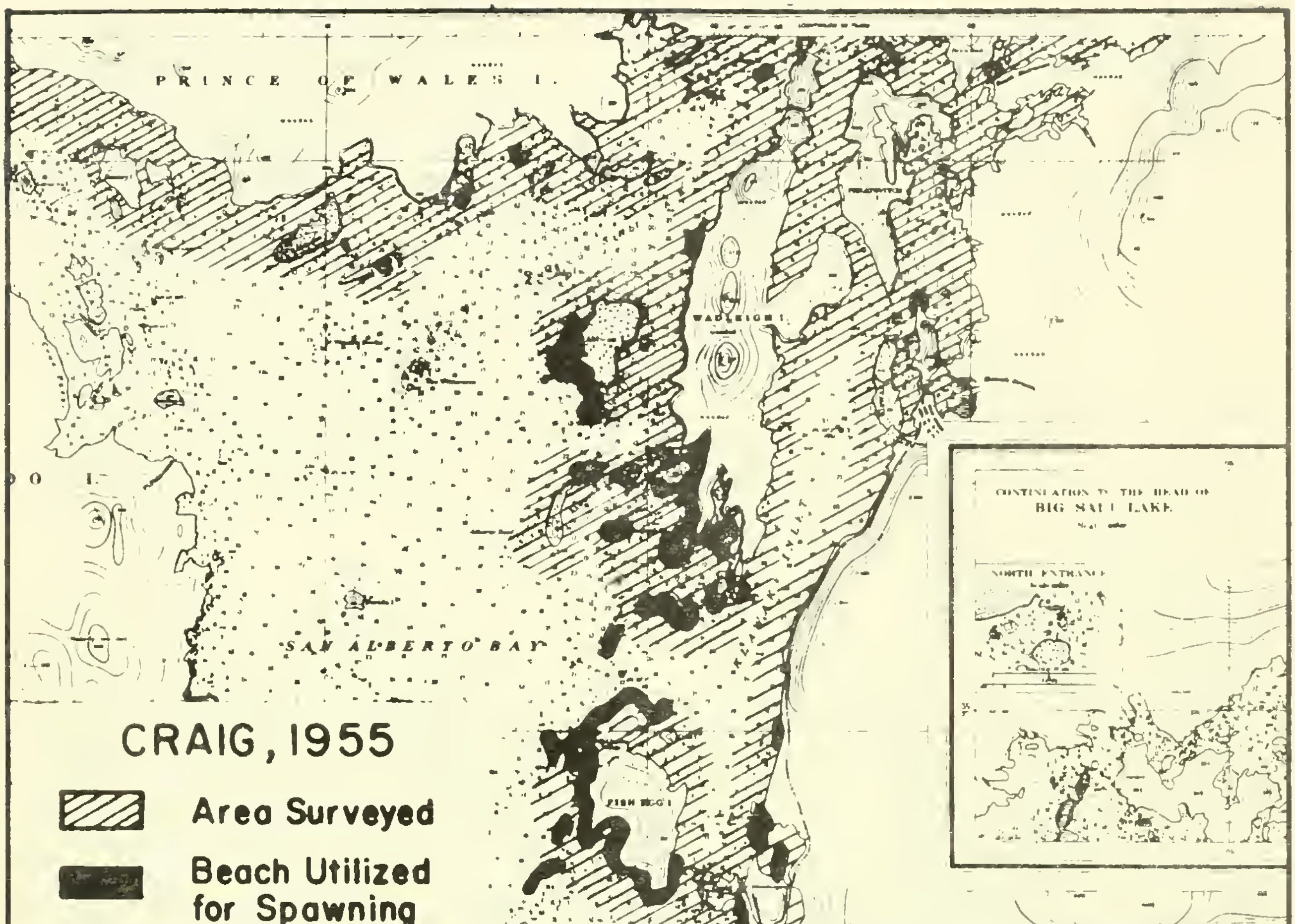

Figure 2.--Master chart of a major spawning area.

substantiated many areas in Rounsefell's listing for Southeastern Alaska and also have located additional spawning areas. Aerial surveys also have shown that areas utilized for spawning may differ from year to year. Some areas listed by Rounsefell have not been utilized in recent years. Tables 1 to 5 and figures 3 to 8 list spawning areas in Southeastern Alaska discovered by the aerial survey method and compare them with Rounsefell's listing.

The points listed represent definitive landmarks nearest actual spawning beaches and carry no significance as to extent of spawning. Some locations encompass far more ground than was utilized for spawning and others only a fraction of the total spawning area. For example, Pybus Bay (No. 16 on fig. 6) spawning includes but a very small portion of the bay; on the other hand, spawning at Fish Egg Island (No. 14 on fig. 5) occurs around the entire island. Spawning has been observed by air on 20 of the 57 spawning beaches listed by Rounsefell, and 82 new beaches have been located since 1953. Extensive aerial surveys, rather than an increase in beaches actually used for spawning, probably explain the large number of new spawnings discovered. There are three possible explanations why the 37 beaches listed by Rounsefell were not detected by aerial survey: (1) Changes may have taken place in spawning locales since 1930; (2) timing of aerial surveys may not have been synchronized with time of spawning in some areas; and (3) spawning beaches included those reported by local residents.

TIME OF SPAWNING

In some areas the same spawning beaches are utilized annually, whereas in others there is a definite change in location of spawning beaches from year to year. Observations during the past three years indicate that time of spawning varies less in areas where the same beaches are utilized year after year. For example, the first spawning of the Craig population in 1953 was reported on March 23, in 1954 on March 23, and in 1955 on March 28. This initial spawning was always on the west shore of Fish Egg Island. In the Behm Canal area, on the other hand, the first spawning was reported on April 6 at Helm Bay in 1953, on April 26 at Indian Point in 1954, and on April 19 at Caamano Point in 1955.

Rounsefell (1930) described a northerly and westerly progression in spawning time along the Pacific coast from California to the Bering Sea. Although some spawning areas in Southeastern Alaska follow this same progression, other areas do not. The earliest spawning occurs in the Craig area during the last two weeks of March, followed by the Kah Shakes and Sitka areas in late March and early April, and the Auke Bay area in late April and early May. The Behm Canal, Etolin Island, and areas in the vicinity of Frederick Sound are somewhat erratic in time of spawning. Spawning has been reported in early April and in June. At present no explanation for variance in spawning progression is apparent. Differences in environmental requirements of different races could, of course, influence time of spawning.

CHARACTERISTICS OF SPAWNING BEACHES

In conjunction with aerial surveys, a few ground surveys have been undertaken. Considerable variation of physical characteristics exists among the beaches examined. Spawning beaches at Fish Egg Island (fig. 5) are for the most part, gently sloping gravel beaches with patches of eelgrass (Zostera), rockweed (Fucus), and vine kelp (Macrocystis). In contrast, spawning beaches in Pearl Harbor (fig. 7) are steep, rocky shores covered with rockweed in the intertidal zone and beds of bladder kelp (Nereocystis) in deeper water. Eggs were attached to all vegetation but predominantly to eelgrass and rockweed. Unidentified vegetation was utilized to a much lesser degree.

SUMMARY

A method of aerial survey, pioneered by L. N. Kolloen, has been developed to observe spawning activities of herring in Alaska. Surveys are conducted at altitudes of 500 to 700 feet. Reduced prints of navigation charts are used to plot survey routes and locations of beach areas used for spawning. Observations of spawning are recorded as "active spawn" when milt is present and "old spawn" when the only evidence of spawn is birds in the area.

A comparison of Southeastern Alaska spawning beaches located by air and those

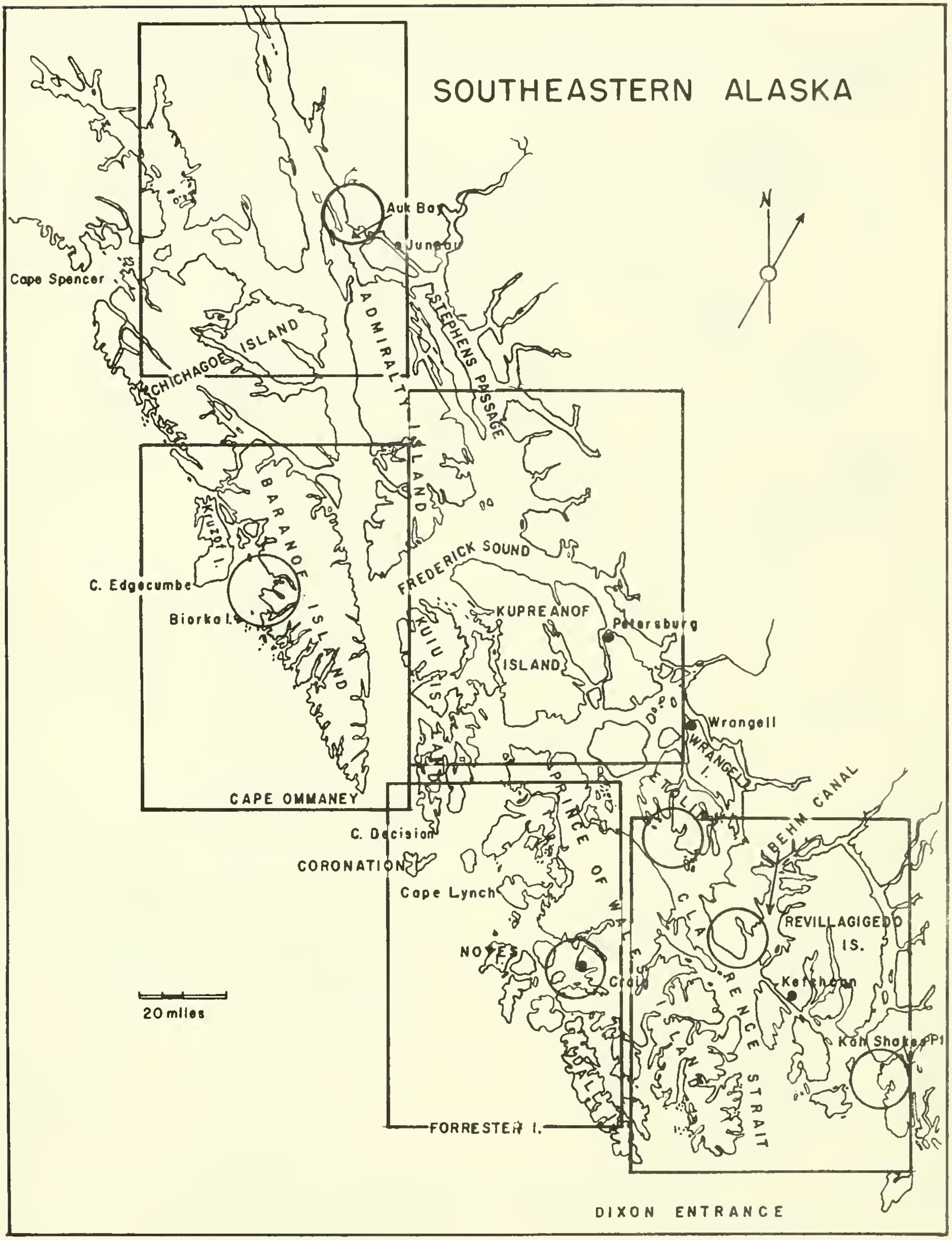

Figure 3.--Map of Southeastern Alaska showing the six main spawning areas (circled) and the boundaries of subsequent figures used to locate specific spawning beaches.

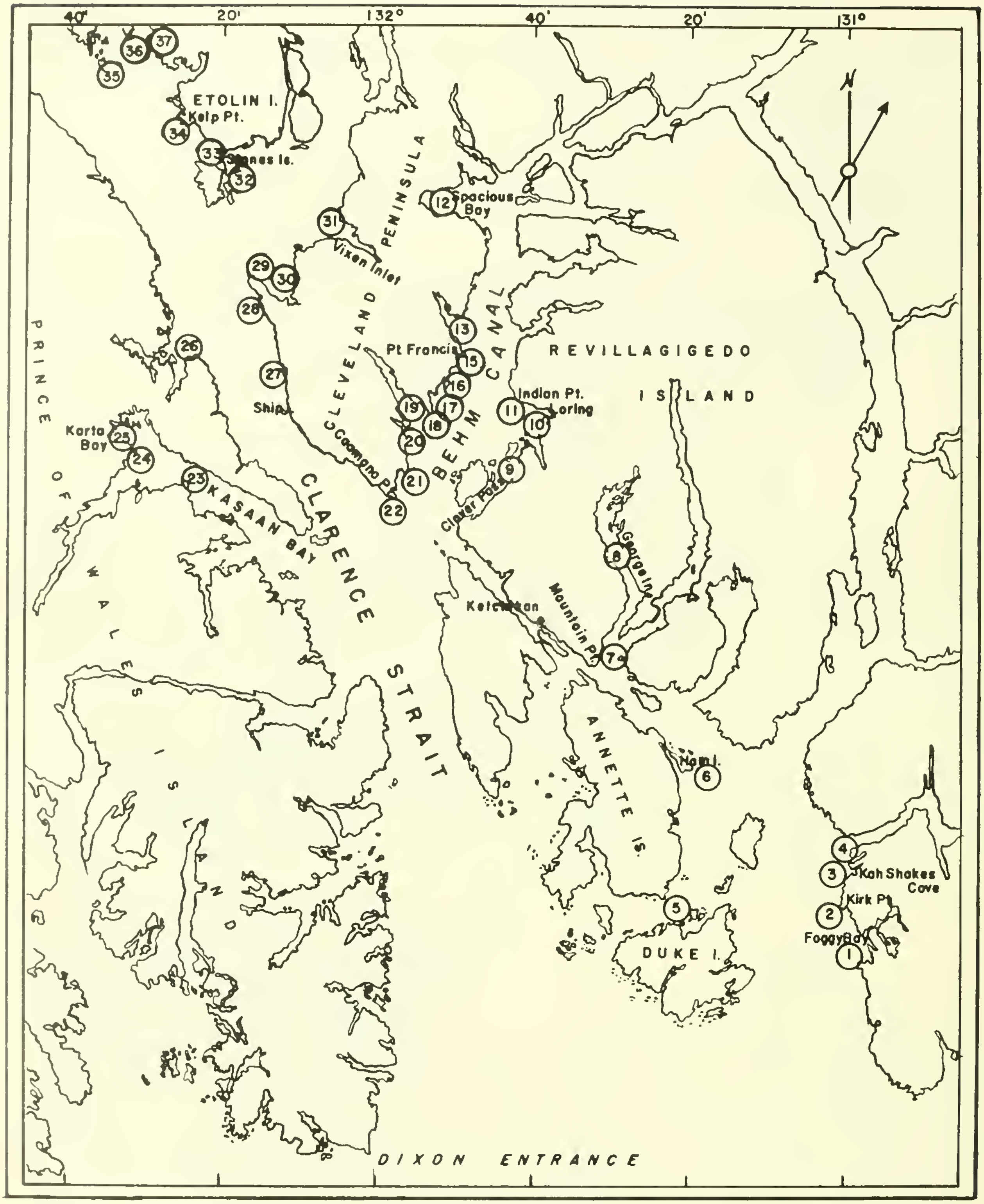

Figure 4.--Chart of spawning beaches in the vicinity of Ketchikan.

Table 1.--Spawning beaches in the vicinity of Ketchikan (x = spawning observed; o = no spawning observed; - = not surveyed)

Number	Locality	Rounsefell	Aerial survey 1953	Aerial survey 1954	Aerial survey 1955
1	Foggy Bay		x	x	x
2	Kirk Point		x	x	x
3	Kah Shakes Cove		o	x	x
4	Kah Shakes Point		o	o	x
5	Annette Point		o	x	o
6	Ham Island		o	x	x
7	Mountain Point		o	x	o
8	George Inlet		-	x	o
9	Clover Pass		x	x	o
10	Loring	x	o	o	o
11	Indian Point		o	x	o
12	Spacious Bay	x	o	o	o
13	Port Steward	x	o	o	o
14	Morgan's Cove[1/]	x			
15	Point Francis		x	x	x
16	Raymond Cove		x	x	x
17	Wadding Cove		o	x	o
18	Trunk Island	x	o	x	o
19	Helm Bay		x	x	o
20	Smuggler's Cove		o	x	o
21	Bond Bay		x	o	x
22	Caamano Point	x	o	o	x
23	Kasaan Village		x	o	o
24	Sandy Point		o	o	x
25	Karta Bay		x	o	o
26	Tolstoi Bay		x	o	o
27	N. E. of Ship Island		o	o	x
28	Meyer's Chuck	x	o	o	o
29	Lemesurier Point		x	x	x
30	Union Bay	x	o	o	o
31	Vixen Inlet	x	o	o	o
32	Stones Island		x	o	o
33	Etolin Island		x	o	x
34	Kelp Point		o	-	x
35	Stanhope Island		o	-	x
36	Marble Point		o	-	x
37	Burnett Inlet		o	-	x

1/ Local name, exact location unknown.

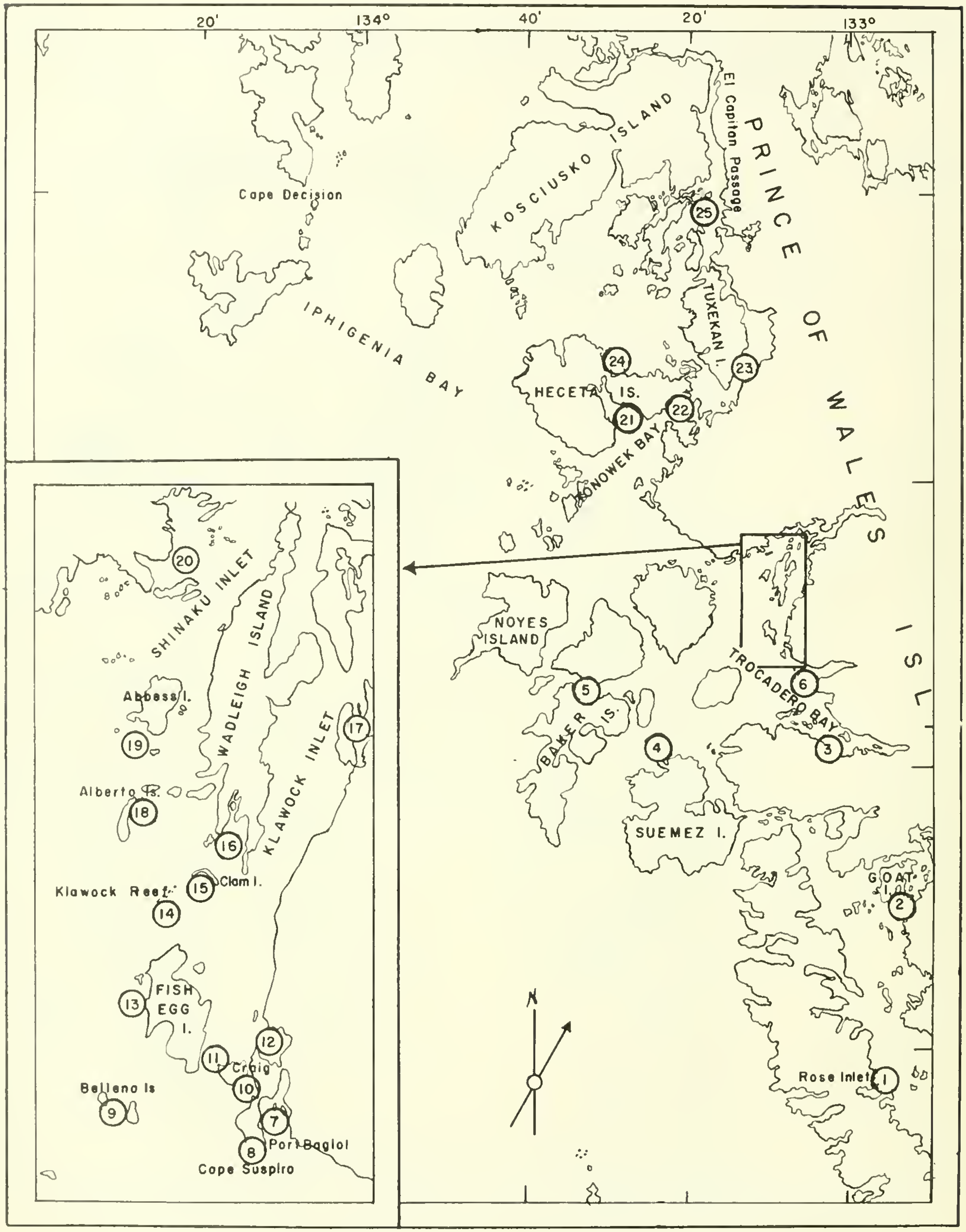

Figure 5.--Chart of spawning beaches in the vicinity of Craig.

Table 2.--Spawning beaches in the vicinity of Craig (x = spawning observed; o = no spawning observed; - = not surveyed)

Number	Locality	Rounsefell	Aerial survey 1953	1954	1955
1	Rose Inlet	x	o	-	-
2	Goat Island		o	-	x
3	Trocadero Bay	x	o	o	o
4	Suemez Island		x	o	o
5	Baker Island		x	o	o
6	Coronados Islands		o	o	x
7	Port Bagial		x	o	x
8	Cape Suspiro		x	x	x
9	Bellana Islands		x	o	o
10	Craig small boat harbor		x	x	x
11	Crab Bay		x	x	x
12	Craig	x	o	o	o
13	Fish Egg Island	x	x	x	x
14	Klawock Reef		x	o	x
15	Clam Island	x	x	o	x
16	Wadleigh Island		x	x	x
17	Klawock Inlet		o	x	x
18	Alberto Islands		o	x	x
19	Abbess Island		x	x	x
20	Shinaku Inlet		x	x	x
21	Warmchuck Inlet	x	o	o	o
22	Tonowek Narrows	x	o	o	-
23	Tuxekan Passage	x	o	o	-
24	Sierra Sound	x	o	o	-
25	Shakan Pass (El Capitan Pass)	x	o	o	-

Local names, exact locations unknown:

Sugar Point	x
Eleven Mile	x
Hornbrooke Island	x

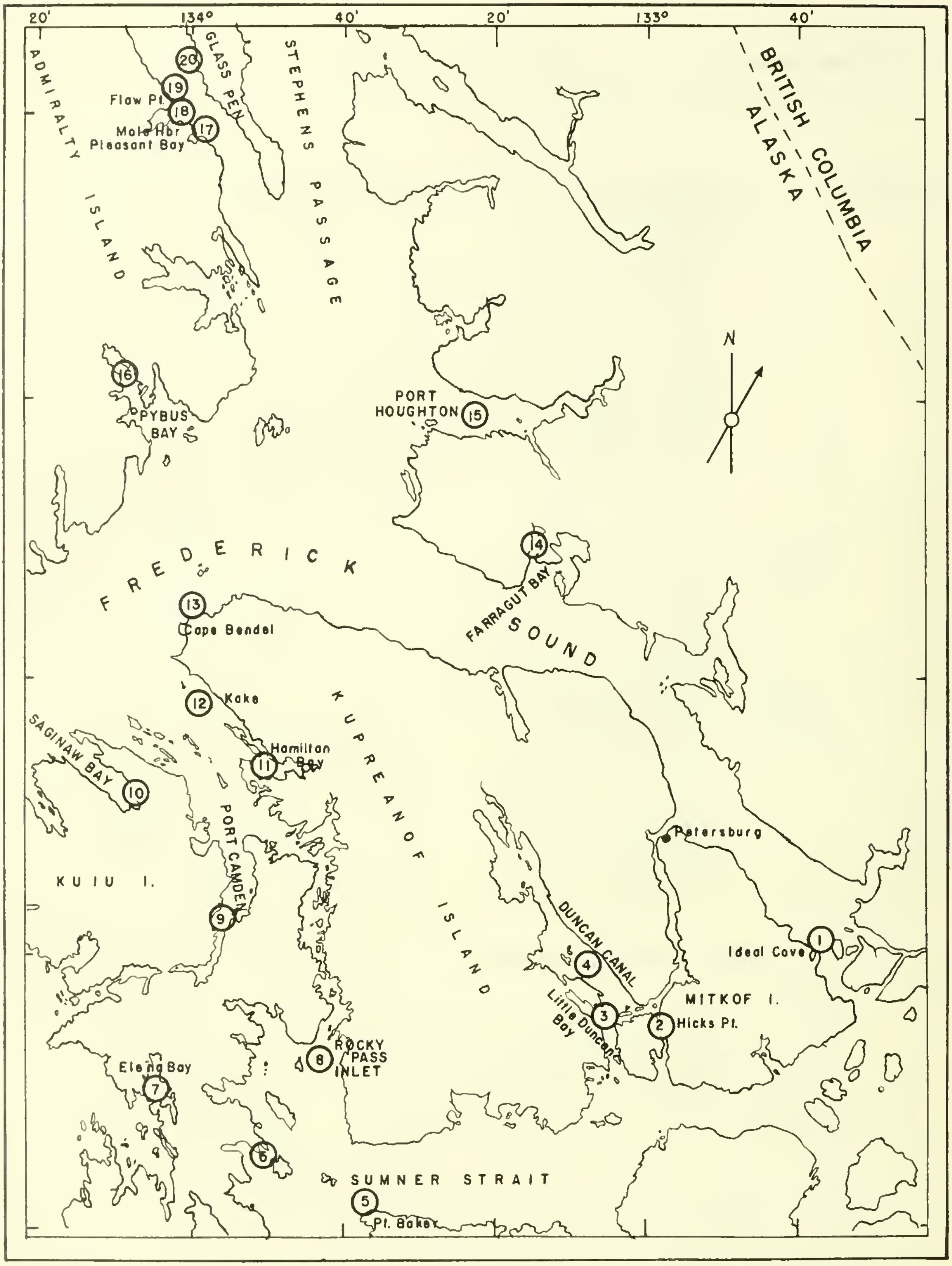

Figure 6.--Chart of spawning beaches in the vicinity of Frederick Sound.

Table 3.--Spawning beaches in the vicinity of Frederick Sound (x = spawning observed; o = no spawning observed; - = not surveyed)

Number	Locality	Rounsefell	Aerial survey 1953	1954	1955
1	Ideal Cove		-	o	x
2	Hicks Point		x	o	o
3	Little Duncan Bay		o	o	x
4	Duncan Canal	x	o	o	o
5	Point Baker		o	x	o
6	No Name Bay		o	x	x
7	Elena Bay		o	x	-
8	Rocky Pass Inlet	x	o	o	o
9	Port Camden		o	o	x
10	Saginaw Bay		x	o	-
11	Hamilton Bay	x	o	o	o
12	Kake	x	o	o	o
13	Cape Bendel		o	x	o
14	Farragut Bay		o	x	o
15	Port Houghton	x	o	o	o
16	Pybus Bay	x	o	x	o
17	Pleasant Bay	x	o	o	o
18	Mole Harbor	x	o	o	o
19	Flaw Point		o	x	o
20	Glass Peninsula west shore		x	x	o

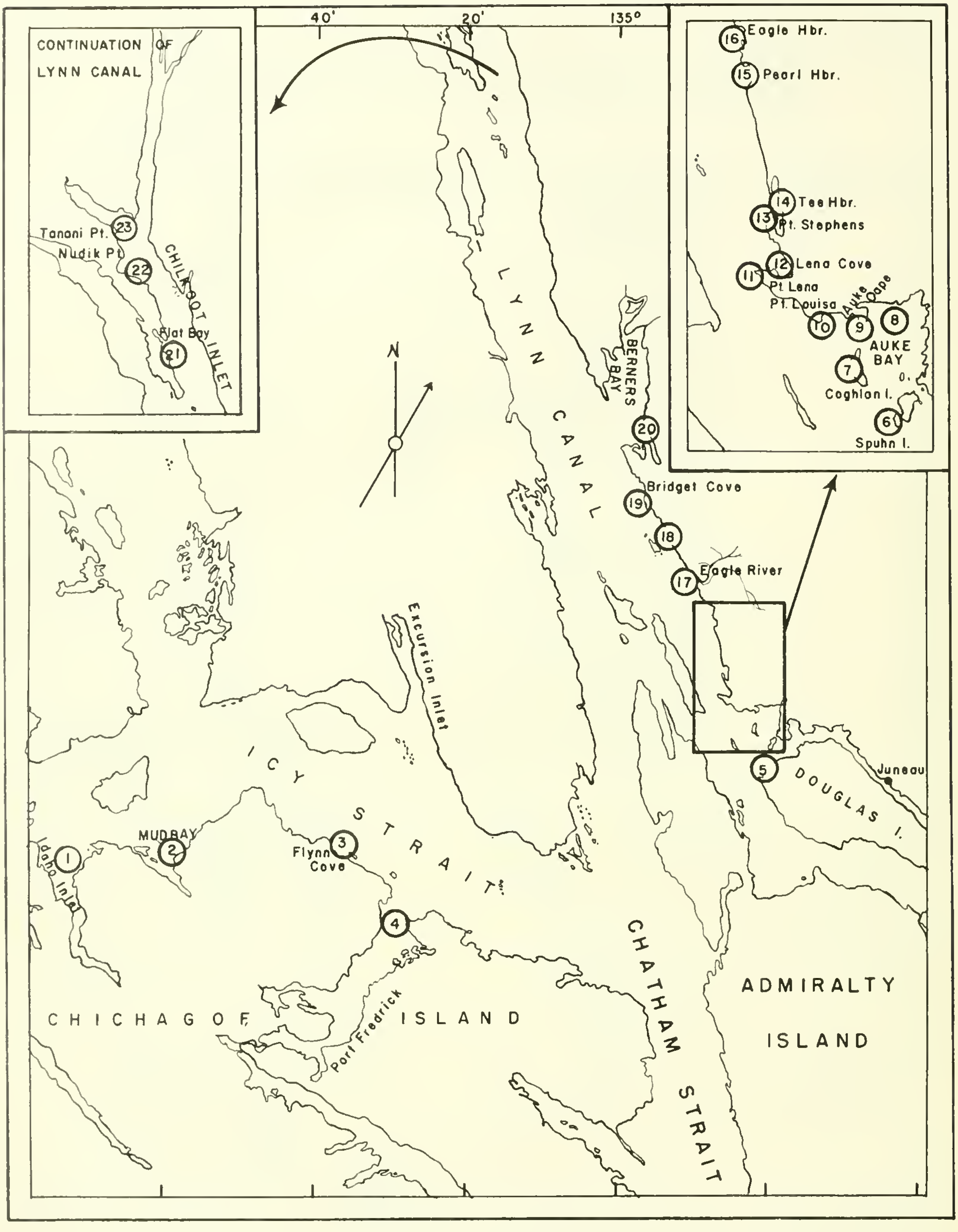

Figure 7.--Chart of spawning beaches in the vicinity of Auke Bay.

Table 4.--Spawning beaches in the vicinity of Auke Bay (x = spawning observed; o = no spawning observed; - = not surveyed)

Number	Locality	Rounsefell	Aerial survey 1953	Aerial survey 1954	Aerial survey 1955
1	Idaho Inlet	x	-	o	-
2	Mud Bay	x	-	o	-
3	Flynn Cove	x	-	o	-
4	Port Frederick	x	-	o	-
5	Douglas Island	x	x	o	o
6	Spuhn Island		x	o	o
7	Coghlan Island	x	x	o	x
8	Auke Bay	x	x	x	x
9	Auke Cape		x	x	x
10	Point Louisa	x	x	x	x
11	Point Lena	x	x	x	x
12	Lena Cove	x	o	x	x
13	Point Stephens	x	o	o	x
14	Tee Harbor	x	x	x	x
15	Pearl Harbor		x	x	x
16	Eagle Harbor		x	x	x
17	Eagle River		o	x	x
18	Mainland east of Benjamin Island		x	x	x
19	Bridget Cove		x	x	x
20	Berners Bay (Echo Cove)		o	x	o
21	Flat Bay		-	x	x
22	Nudik Point		-	x	x
23	Tanani Point		-	o	x

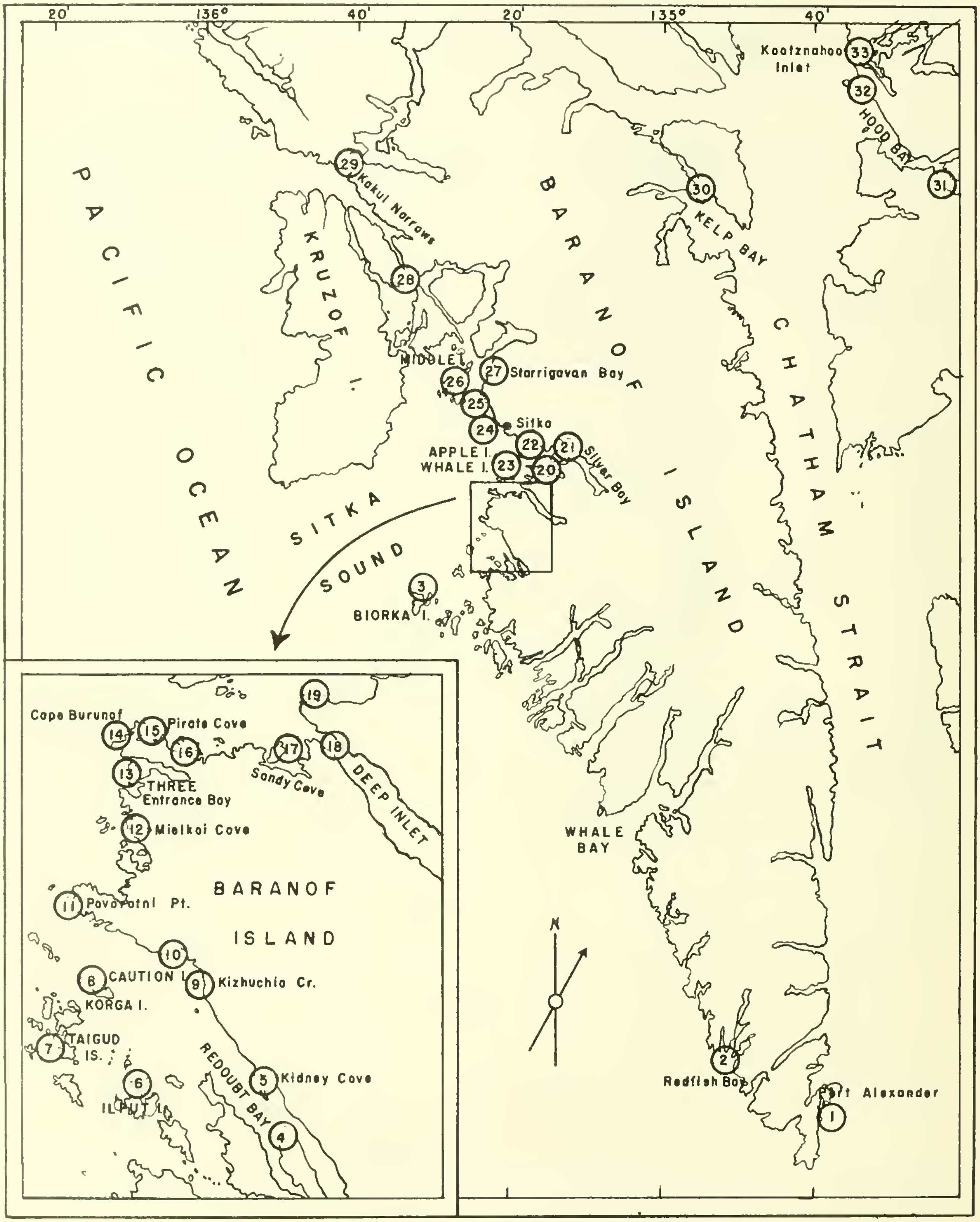

Figure 8.--Chart of spawning beaches in the vicinity of Sitka.

Table 5.--Spawning beaches in the vicinity of Sitka
(x = spawning observed; o = no spawning observed;
- = not surveyed)

Number	Locale	Rounsefell	Aerial survey 1953	1954	1955
1	Port Alexander	x	-	-	-
2	Redfish Bay	x	o	-	o
3	Biorka Island	x	o	o	o
4	Redoubt Bay		o	o	x
5	Kidney Cove		x	o	x
6	Ilput Island		o	o	x
7	Taigud Islands		x	x	x
8	Korga Island		x	x	x
9	Kizhuchia Creek		x	x	x
10	Caution Island		x	x	x
11	Povorotni Point		x	x	x
12	Mielkoi Cove		x	x	x
13	Three Entrance Bay		x	x	x
14	Cape Burunof		x	o	x
15	Pirate Cove		x	x	x
16	Samsing Cove		x	x	x
17	Sandy Cove		x	o	x
18	Deep Inlet		x	o	o
19	Aleutkina Bay		x	o	x
20	Leesoffskaia Bay		o	x	x
21	Silver Bay	x	o	o	o
22	Jamestown Bay 1/	x	o	x	o
23	Whale Island 1/	x	x	o	o
24	Apple Island 1/	x	o	x	x
25	Kasiana Island 1/	x	o	o	x
26	Middle Island 1/	x	o	o	x
27	Starrigavan Bay 1/	x	o	o	x
28	Whitestone Narrows	x	o	o	o
29	Kakul Narrows		o	x	o
30	Kelp Bay		o	x	-
31	Hood Bay	x	o	o	-
32	Killisnoo Lagoon	x	o	o	-
33	Kootznahoo Inlet	x	o	o	-
	Stretchers Cove 2/	x			

1/ Rounsefell reports spawning from Silver Bay to Whitestone Narrows. Presumably this was not continuous and therefore may or may not include the beaches utilized in recent years.

2/ Exact location unknown, presumably near Hood Bay.

listed by Rounsefell in 1930 show that 84 additional beaches have been located since 1953. However, spawning has not been observed on 37 beaches listed by Rounsefell. The large number of new spawnings discovered is accredited to make extensive coverage afforded by aerial surveys.

Each year the initial spawning in Southeastern Alaska occurs in the vicinity of Craig during late March. Kah Shakes, Sitka, and Auke Bay spawnings follow and are usually completed in early May. Spawning times in Behm Canal, Etolin Island, and Frederick Sound are variable and have been reported in late April, May, and early June. Some areas do not conform to the northerly and westerly progression in spawning time described by Rounsefell (1930).

Considerable variation was noted in physical characteristics of spawning beaches, but ground surveys indicated that most eggs were attached to eelgrass or rockweed.

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