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EXPERIMENTAL TRAWLING FOR HIGH-SEAS SALMON

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ABSTRACT

A large trawl, known as the "Cobb" Pelagic Trawl-Mark II, was tested near Adak, Alaska. Two Bureau of Commercial Fisheries research vessels were used in this experiment. One vessel fished the trawl to determine its capability to capture salmon on the high seas, and the other vessel fished gill nets to determine the availability of salmon.

Trawl catches were not large enough for research purposes, but further modification of the trawl may improve its efficiency.

The trawl catch consisted predominantly of small immature sockeye salmon. The gill nets, on the other hand, captured both small and large immature sockeye and chum salmon, but the catch consisted predominantly of large immature chums. When catches of small immature sockeye from both the trawl and gill nets were reduced to units-of-effort, the same trend in abundance was indicated by both types of gear.

Tows made at night and tows made in an easterly direction caught greater numbers of fish.

CONTENTS

INTRODUCTION

A large midwater trawl, referred to as the "Cobb" Pelagic Trawl-Mark II (McNeely 1963), is being developed by the U. S. Bureau of Commercial Fisheries.[1/] The trawl is designed to sample all types of pelagic fish, and if successful in taking large quantities it will be used commercially. Some success has been achieved with this trawl in fishing for hake (Merluccius productus) off the coast of California, and large hauls of jack mackerel (Trachurus symmetricus) and dogfish (Squalus acanthias) have also been taken close to the Washington coast (McNeely 1963). A few salmon have been taken in test trials prior to this study, but the trawl had not been tested in an area, and at a time, when an abundance of salmon was known to be available.

During the past 8 years, floating gill nets and purse seines have been standard sampling gear used in capturing salmon on the high seas. Samples have been used for studying the distribution and abundance of salmon in the North Pacific Ocean and the Bering Sea. More recently long-lining has been used by the Canadians to capture salmon for tagging experiments (Neave, Manzer, Godfrey, LeBrasseur 1962). All three types of gear have been effective sampling tools, but a trawl should have advantages in certain situations for improving the sampling program. These would include (1) more rapid recovery of gear during adverse weather, (2) reduced cost of gear, and (3) greater flexibility in depth of fishing.

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1/The "Cobb" Pelagic Trawl is under development by the Exploratory Fishing and Gear Research Base, Seattle, Wash. The Biological Laboratory, and the Exploratory Fishing and Gear Research Base, Seattle, Wash., cooperated in conducting the tests of the trawl reported here.

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To evaluate the effectiveness of a midwater trawl for capturing salmon on the high seas, the "Cobb" pelagic trawl was tested during the month of August 1963 in an area south of Adak, Alaska. The area shown in figure 1 was chosen for the study because of the concentration of salmon known to be located along the southern side of the Aleutian Islands during the month

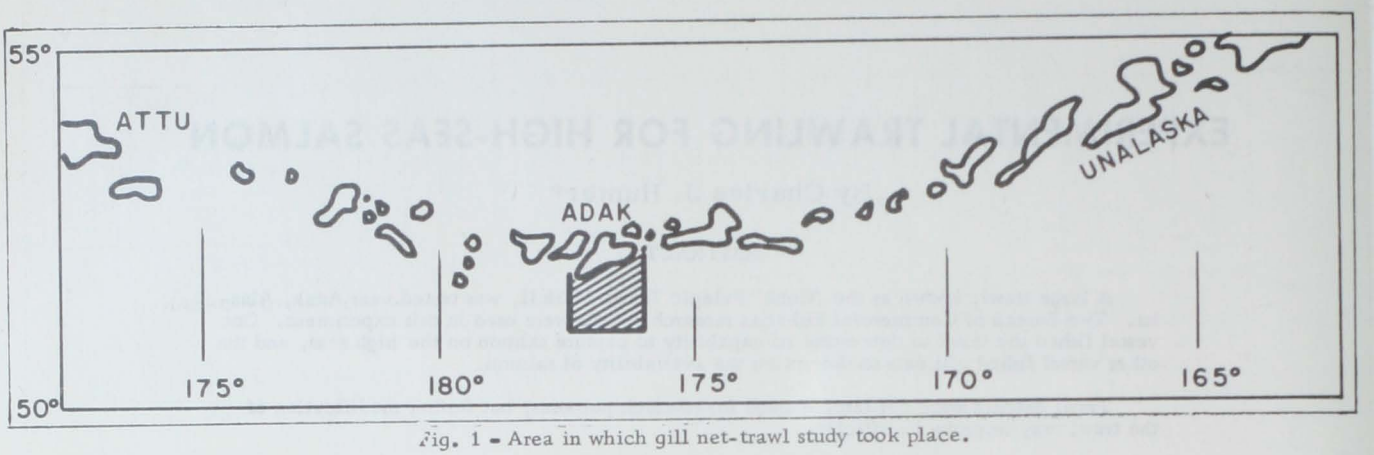

Fig. 1 - Area in which gill net-trawl study took place.

of August. By fishing in proximity to gill nets, it was possible to determine, to some extent, the availability of salmon to the trawl and to compare the fishing capabilities of the two types of gear. Other tests were conducted to study the relationship of direction of tow to catch, and the effects of daylight and darkness on the catch.

FISHING GEAR AND METHODS

The John N. Cobb (fig. 2), a 93-foot purse seine-type vessel (Ellson 1950), fished the pelagic trawl, and the George B. Kelez (fig. 3), a converted Navy light cargo vessel (French 1963), fished the gill nets.

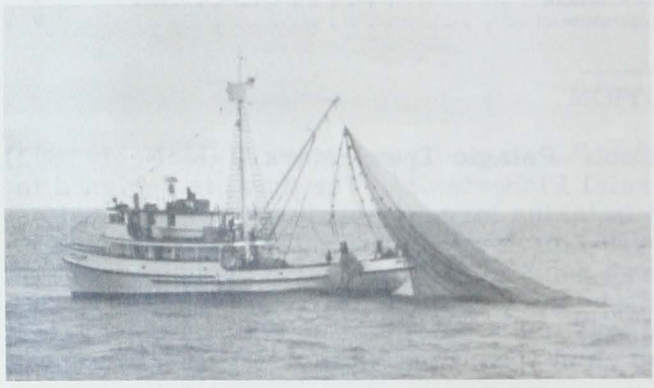

Fig. 2 - The U. S. Bureau of Commercial Fisheries research vessel John N. Cobb hauling the pelagic trawl.

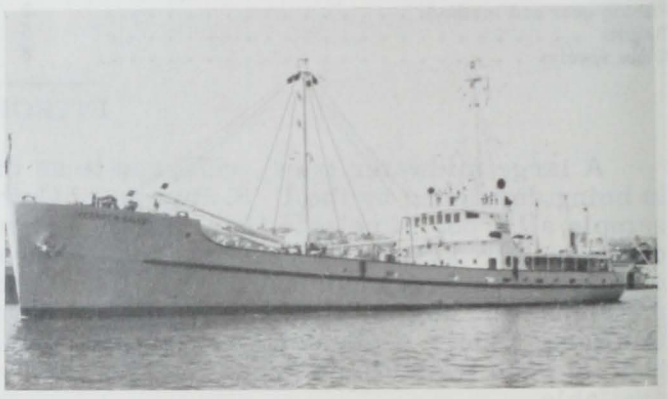

Fig. 3 - The U. S. Bureau of Commercial Fisheries research vessel George B. Kelez.

The gill net string (Larkins 1963a) was made up of 50-fathom shackles, 4 fathoms deep, and consisted of four mesh sizes of multifilament net: $5\frac{1}{4}$-inch; $4\frac{1}{2}$-inch; $3\frac{1}{4}$-inch; and $2\frac{1}{2}$-inch (fig. 4). In addition four experimental monofilament nets ($3\frac{1}{4}$-inch and $4\frac{1}{2}$-inch) were used but were not considered a part of this study. Usually, 18 shackles (fig. 4) of gill net were used, but when catches became inadequate 32 shackles were used to increase the sample size.

The length of the trawl (McNeely 1963) was 240 feet. The opening was estimated to be 75 feet wide and 90 feet high. It was constructed of 6-inch mesh in the wings, 3-inch mesh in the main body, and $3\frac{1}{4}$-inch mesh in the cod-end (fig. 5). A $\frac{1}{2}$-inch mesh liner (35 feet long) was used during the first 26 tows to retain the smaller marine animals. This liner was removed during the remaining tows to reduce clogging by jelly fish. During the first 26 tows, 51 Phillips trawl floats were used on the headline, but during the remaining 17 tows, 81 floats were used to increase the flotation of the headline.

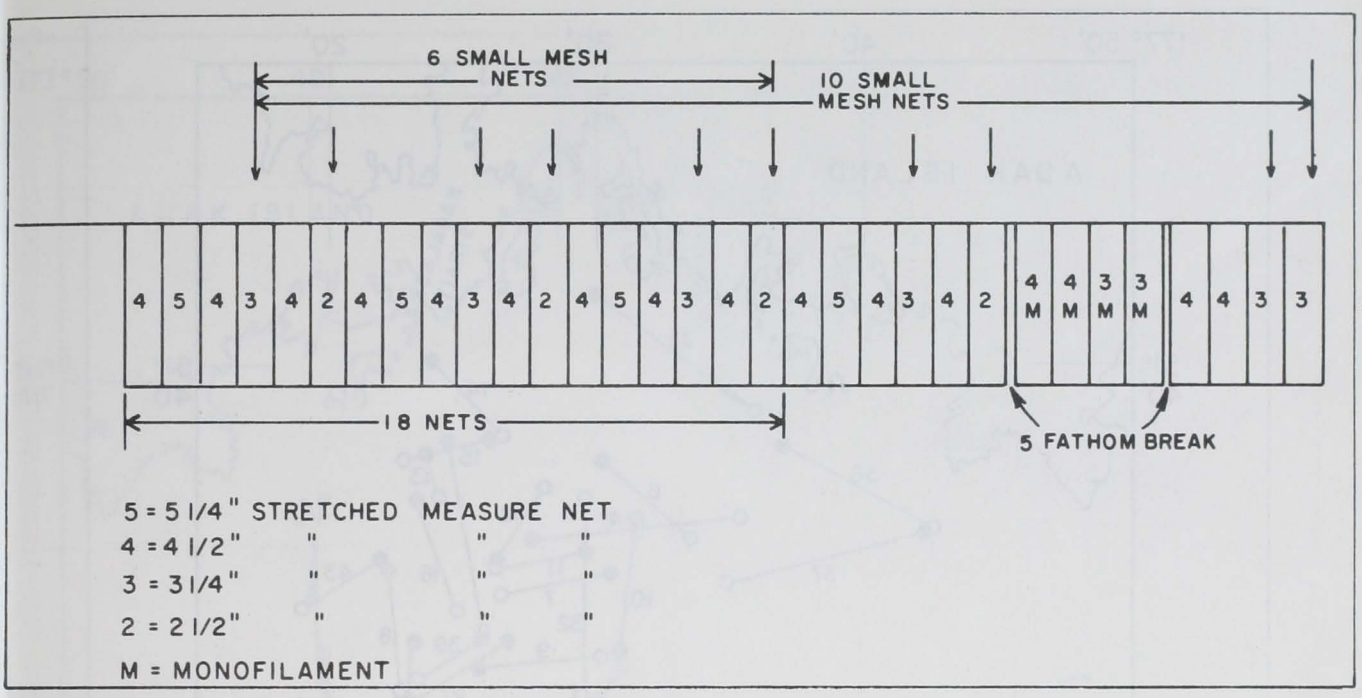

Fig. 4 - Gill net make-up for gill net-trawl study during the summer of 1963.

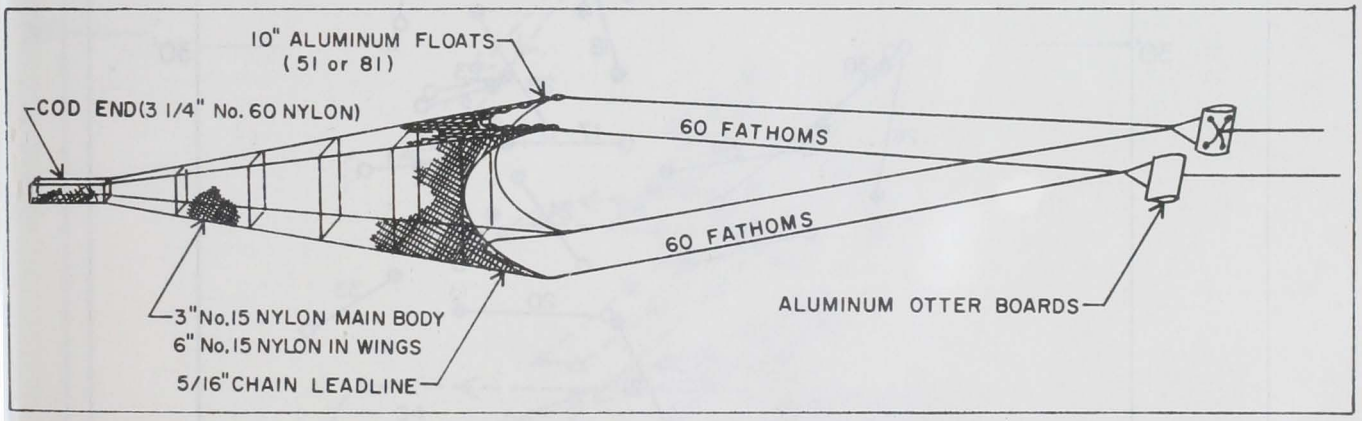

Fig. 5 - "Cobb" Pelagic Trawl-Mark II, showing method of rigging.

Four 1-hour tows in each 24-hour period were usually considered a day's fishing effort. Longer tows up to 4 hours were also made, but 1-hour tows appeared to produce about the same measure of success. Depending on the weather conditions, the number of tows-per-day ranged from 0 to 6. Although it was planned that at least one tow would be made toward east, south, west, and north each day, it was evident early in the cruise that this could not be accomplished because of adverse weather conditions. In general, tows were made as close as practicable to the gill-net positions (usually within 5 miles) with allowance for maneuverability of the vessel (figs. 6 and 7).

The experiment was programmed to use a minimum of 20 fishing days, but weather conditions permitted trawling on only 14 days. Four or more tows were possible during only 7 of the 14 days. This seriously limited the amount of information obtained.

Trawl and gill-net catches were analyzed by reducing each catch to a unit-of-effort. The catches were computed in numbers of fish caught per hour. Six small mesh nets (fig. 4) were used as the basis for determining unit-of-effort for gill-netting, since this was the number fished during most of the study.

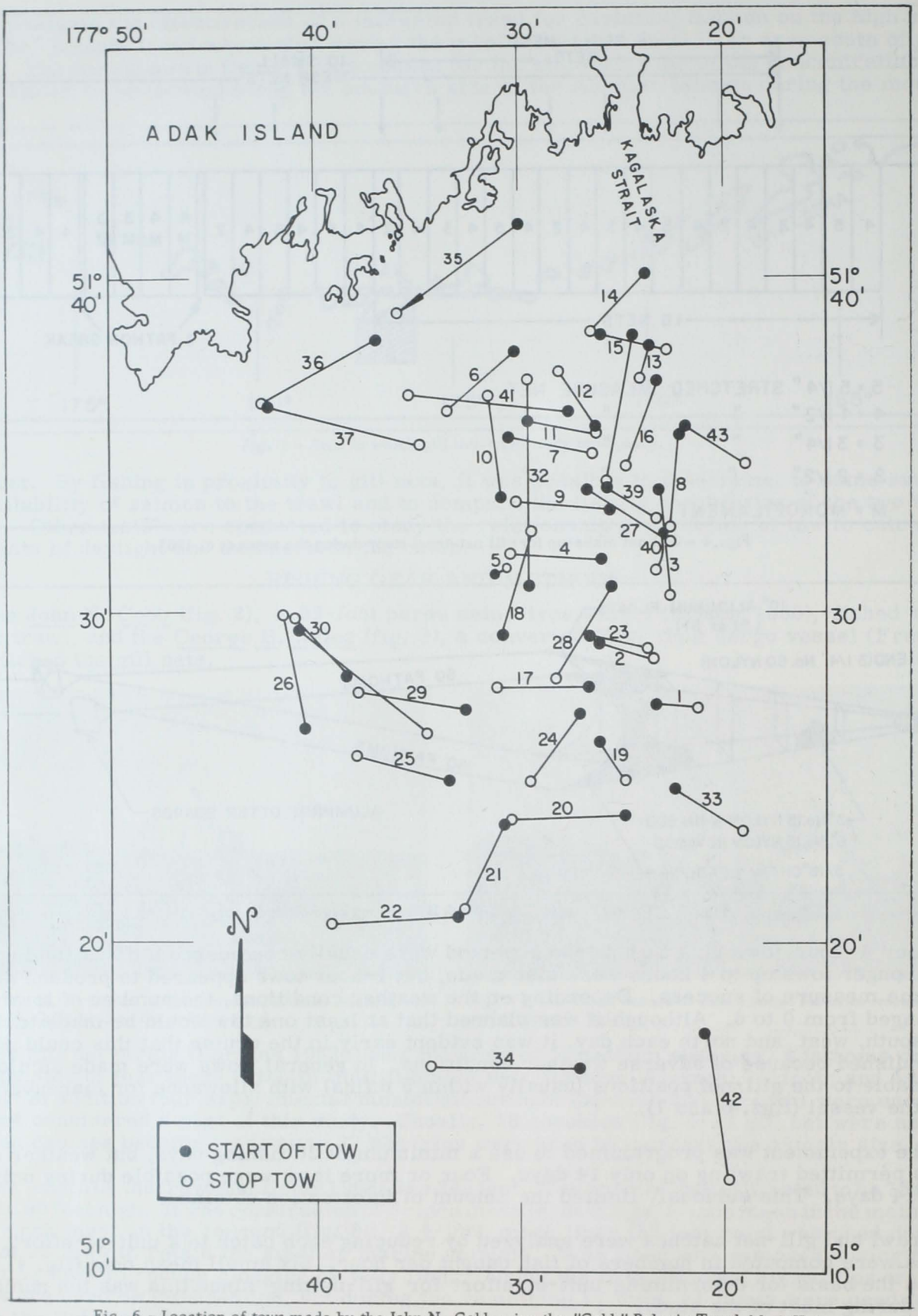

Fig. 6 - Location of tows made by the John N. Cobb using the "Cobb" Pelagic Trawl-Mark II during gill net-trawl study.

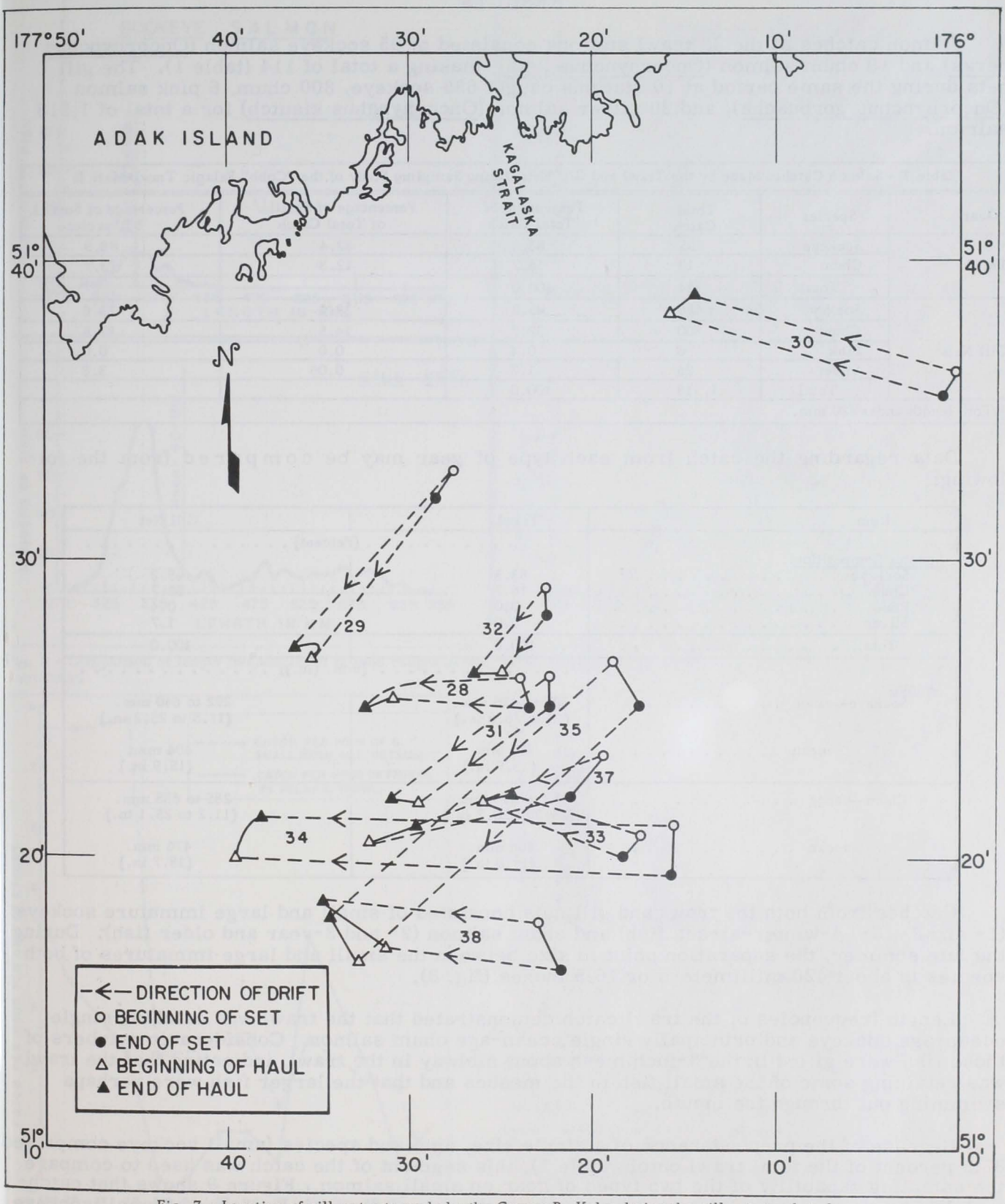

Fig. 7 - Location of gill-net sets made by the George B. Kelez during the gill net-trawl study.

RESULTS

Salmon catches at the 38 trawl stations consisted of 95 sockeye salmon (Oncorhynchus nerka) and 19 chum salmon (Oncorhynchus keta), making a total of 114 (table 1). The gill nets during the same period at 10 stations caught 686 sockeye, 800 chum, 6 pink salmon (Oncorhynchus gorbuscha), and 26 silver salmon (Oncorhynchus kisutch) for a total of 1,518 salmon.

Table 1 - Salmon Catches Made by the Trawl and Gill Nets During Sampling Study of the "Cobb" Pelagic Trawl-Mark II

Gear	Species	Total Catch	Percentage of Total Catch	Percentage of Small[1]/ of Total Catch	Percentage of Small[1]/ by Species
Trawl	Sockeye	95	83.3	82.4	98.9
	Chum	19	16.7	12.3	73.7
	Total	114	100.0		
Gill Nets	Sockeye	686	45.2	33.3	73.6
	Chum	800	52.7	14.5	27.6
	Pink	6	0.4	0.0	0.0
	Silver	26	1.7	0.06	3.8
	Total	1,518	100.0		

1/Fork length under 420 mm.

Data regarding the catch from each type of gear may be compared from the following:

Item	Trawl	Gill Net
	(Percent)	
Species Composition:		
Sockeye	83.3	45.2
Chum	16.7	52.7
Pink	0.0	0.4
Silver	0.0	1.7
Total	100.0	100.0
	(mm. (in.))	
Length:		
Sockeye--range	305 to 426 mm. (12 to 16.8 in.)	292 to 640 mm. (11.5 to 25.2 in.)
" mean	354 mm. (13.9 in.)	404 mm. (15.9 in.)
Chum--range	350 to 513 mm. (13.8 to 20.2 in.)	285 to 638 mm. (11.2 to 25.1 in.)
" mean	406 mm. (16.0 in.)	476 mm. (18.7 in.)

Catches from both the trawl and gill nets consisted of small and large immature sockeye (1- and 2-, 3-, 4-winter-at-sea fish) and chum salmon (2- and 3-year and older fish). During the late summer, the separation point in size between the small and large immatures of both species is about 420 millimeters or 16.5 inches (fig. 8).

Length frequencies of the trawl catch demonstrated that the trawl was catching single ocean-age sockeye and principally single ocean-age chum salmon. Considerable numbers of those fish were gilled in the 3-inch mesh about midway in the trawl, indicating that the trawl was retaining some of the small fish in the meshes and that the larger fish were perhaps swimming out through the mouth.

Because of the preponderance of a single size, age, and species (small sockeye comprised 83.3 percent of the total trawl catch, table 1), this segment of the catch was used to compare the sampling capability of the two types of gear on small salmon. Figure 9 shows that catches taken by the two types of gear indicate about the same trend in abundance of small sockeye salmon in the area fished. Large sockeye were practically absent from the trawl catches, but they were well represented in the gill-net catches (fig. 8).

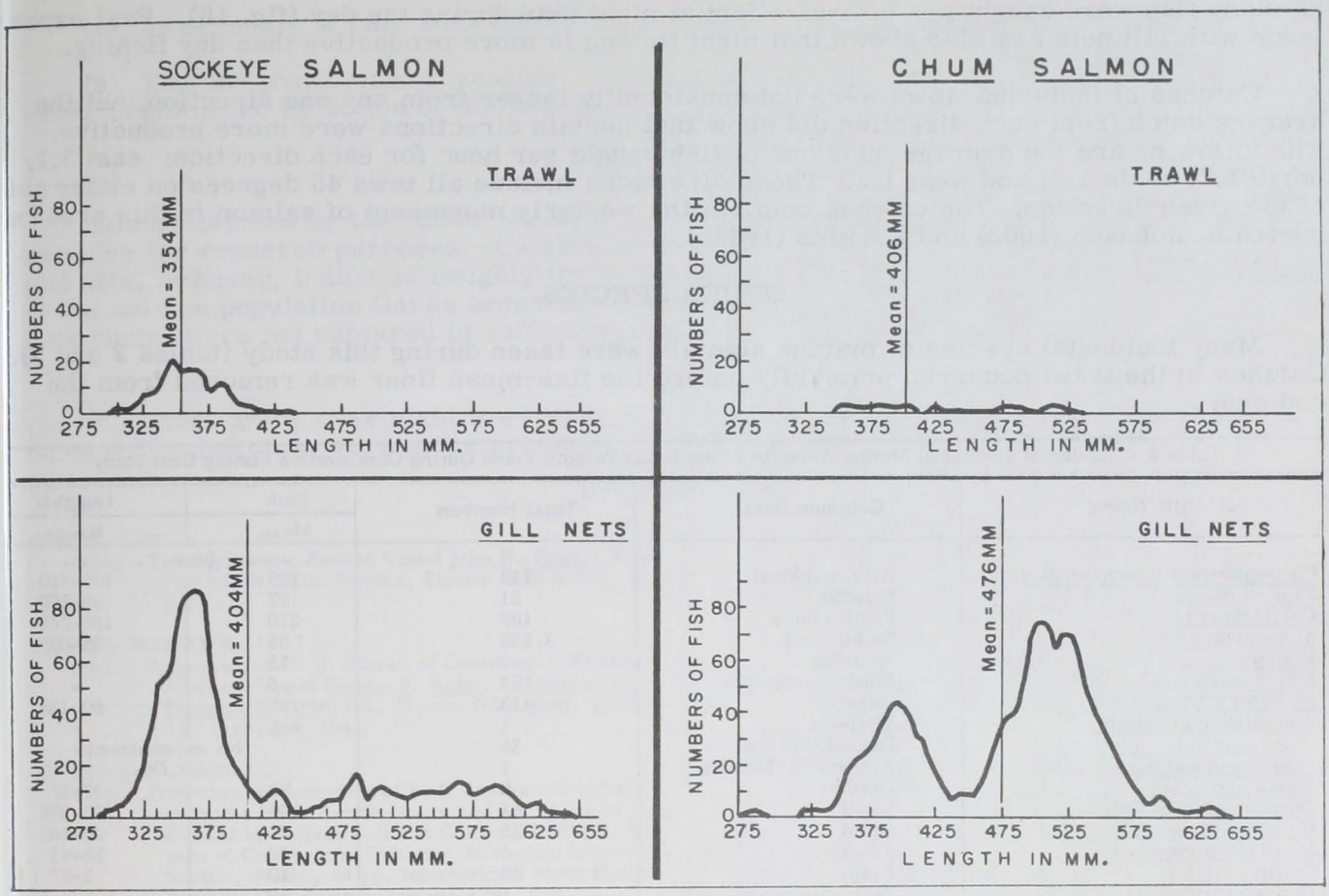

Fig. 8 - Comparison of length frequencies of salmon caught in the "Cobb" Pelagic Trawl-Mark II and gill nets during trawl and gill-net study.

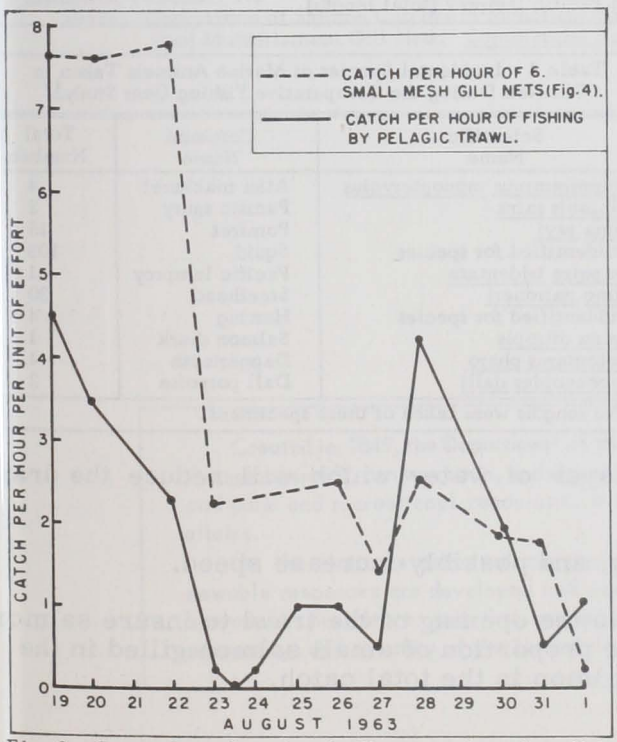

Fig. 9 - Comparison of trawl and gill-net catches of small immature sockeye salmon.

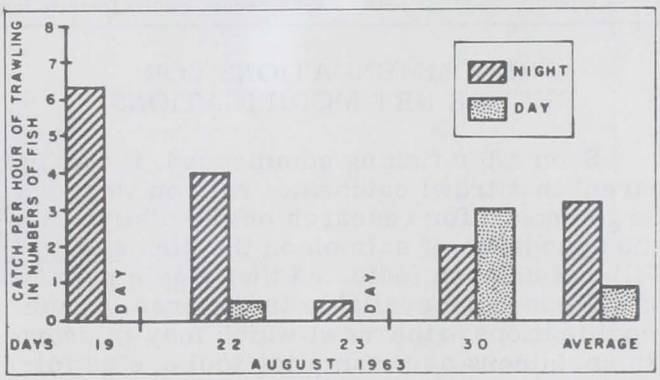

Fig. 10 - Comparison of trawl catches taken during hours of daylight and darkness. (Catches were compared when tows were made during both day and night.)

The percentage of small chum taken by the trawl was much greater than the percentage in the gill-net catches (table 1). The trawl caught 73.7 percent small chum while the gill nets caught 27.6 percent small chum. This difference further indicates that the trawl was more selective for small immature salmon.

Night tows were more productive than day tows during 3 of the 4 days when comparisons were possible. Usually more than three times

as many fish were caught per unit-of-effort at night than during the day (fig. 10). Past experience with gill nets has also shown that night fishing is more productive than day fishing.

Catches of individual tows were not consistently larger from any one direction, but the average catch from each direction did show that certain directions were more productive. The following are the average numbers of fish caught per hour for each direction: east 3.1; north 1.7; south 1.6; and west 1.2. These directions include all tows 45 degrees on either side of the given direction. The catches confirm the westerly movement of salmon in this area reported by Johnson (1963) and Larkins (1963b).

OTHER SPECIES

Many incidental species of marine animals were taken during this study (tables 2 and 3). Catches in the trawl occurred primarily before the fine-mesh liner was removed from the cod end.

Table 2 - Incidental Species of Marine Animals Taken in the Pelagic Trawl During Comparative Fishing Gear Study

Scientific Name	Common Name	Total Numbers	Fork Length 1/	
			Mean	Range
			(mm.)	
Pleurogrammus monopterygius	Atka mackerel	219	125	100-160
Zaprora silenus	Prowfish	21	97	50-200
Cololabis saira	Pacific saury	187	210	185-260
Eleginus gracilis	Saffron cod	3,536	55	35-80
Liparis	Snailfish	1	55	-
Electrona arctica	Bigeye lanternfish	153	6	-
Mallotus villosus	Capelin	413	105	60-135
Anarrhichthys ocellatus	Wolf-eel	1	485	-
Chauliodus macouni	Fanged viperfish	35	No measurements	
Atheresthes stomias	Arrowtooth flounder	1	Do.	
Brama rayi	Pomfret	8	43	37-47
Onychoteuthis banksii	Squid	61	250	150-355
Gonatopsis borealis	Squid	228	70	20-180
Moroteuthis robusta	Squid	4	38	32-43
Gonatus fabricii	Squid	28	10	2-27
Lampetra tridentata	Pacific lamprey	1	38	-
Callorhinus ursinus	Fur seal	1	No measurements	

1/Fork length measurements except for squid species (mantle length) and Pacific lamprey (total length).

RECOMMENDATIONS FOR FUTURE NET MODIFICATIONS

Soon after fishing commenced, it was apparent that trawl catches of salmon were not large enough for research on the distribution and abundance of salmon on the high seas. Gill-net catches indicated that ample numbers of salmon were available in the area. Some modifications to the trawl which may improve its usefulness as a sampling tool are as follows.

Table 3 - Incidental Species of Marine Animals Taken in Gill Nets During the Comparative Fishing Gear Study 1/

Scientific Name	Common Name	Total Numbers
Pleurogrammus monopterygius	Atka mackerel	4
Cololabis saira	Pacific saury	2
Brama rayi	Pomfret	15
Not identified for species	Squid	103
Lampetra tridentata	Pacific lamprey	1
Salmo gairdneri	Steelhead	30
Not identified for species	Herring	4
Lamna ditropis	Salmon shark	1
Anotopterus pharo	Daggertooth	4
Phocoenoides dalli	Dall porpoise	2

1/No lengths were taken of these specimens.

(1) Compress the depth of the opening of the trawl so as to sample a narrow surface layer of water which will reduce the drag of the net and allow an increase in speed.

(2) Reduce the length of the net to reduce drag, and possibly increase speed.

(3) Incorporate an electrical shocking device in the opening of the trawl to insure salmon do not escape. This loss was indicated by the large proportion of small salmon gilled in the meshes of the net and the predominance of small salmon in the total catch.

(4) Incorporate a fyke into the trawl to hinder salmon from swimming out of the net.

(5) Tow the trawl with 2 vessels, one on each side, to allow the trawl to pass through water undisturbed by action of the vessel.

CONCLUSIONS

Salmon catches by the "Cobb" Pelagic Trawl were not of sufficient numbers to be used as samples for research purposes. Catches of small immature sockeye salmon by the trawl and gill nets, however, indicated roughly the same trends in relative abundance. Other segments of the salmon population (large immature sockeye; large immature chum, and small immature chum) were not captured in sufficient numbers by the trawl to compare with gill-net catches.

In almost every case night tows were more productive than day tows. Also, tows made in an easterly direction were more productive than tows made in other directions.

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