U.S. AND JAPAN CONDUCT SUCCESSFUL SALMON RESEARCH CRUISE

By Robert R. French and Richard Bakkala

In a Commercial Fisheries Review article, May 1968, BCF's Seattle (Wash.), Biological Laboratory announced plans for cooperative research by the U.S. and Japan to study the distribution of salmon on the high seas. The two nations and Canada, as treaty members of the International North Pacific Fisheries Commission (INPFC), conduct research on fishery resources of common interest for effective utilization and conservation.

In the INPFC treaty of 1953, Japan agreed to abstain from salmon fishing on the high seas east of long. 175° W. Since then, however, we have found that sockeye salmon from Bristol Bay migrate westward past the abstention line in varying proportions.

One objective of the cruise was to investigate the possibility of forecasting the percentage of the run available to the Japanese fishery each year. We also wished to test the hypothesis that the distribution and migration of sockeye salmon from Bristol Bay are related to specific water masses in the North Pacific Ocean.

This report gives preliminary data on the catches, and the location of these catches in relation to water masses, in April, May, and June. We also report results of predation studies by the BCF vessel.

Vessels and Fishing Gear

The participating vessels were the Seattle Biological Laboratory's R/V "George B. Kelez" (550 tons) and the Japanese research vessels "Wakashio-Maru" (150 tons) and "Hokko-Maru" (220 tons), all shown in figure 1. The three vessels fished with gill nets of various mesh sizes; the Japanese also used longlines for capturing salmon to be tagged. The tagging data are not reported here. The U.S. vessel fished a basic net string of 32 shackles (1.8 miles or 2.9 km. long) with five mesh sizes ($2\frac{1}{2}$, $3\frac{1}{4}$, $3\frac{7}{8}$, $4\frac{1}{2}$, and $5\frac{1}{4}$ inches--63, 83, 98, 115, and 113 mm.), stretched

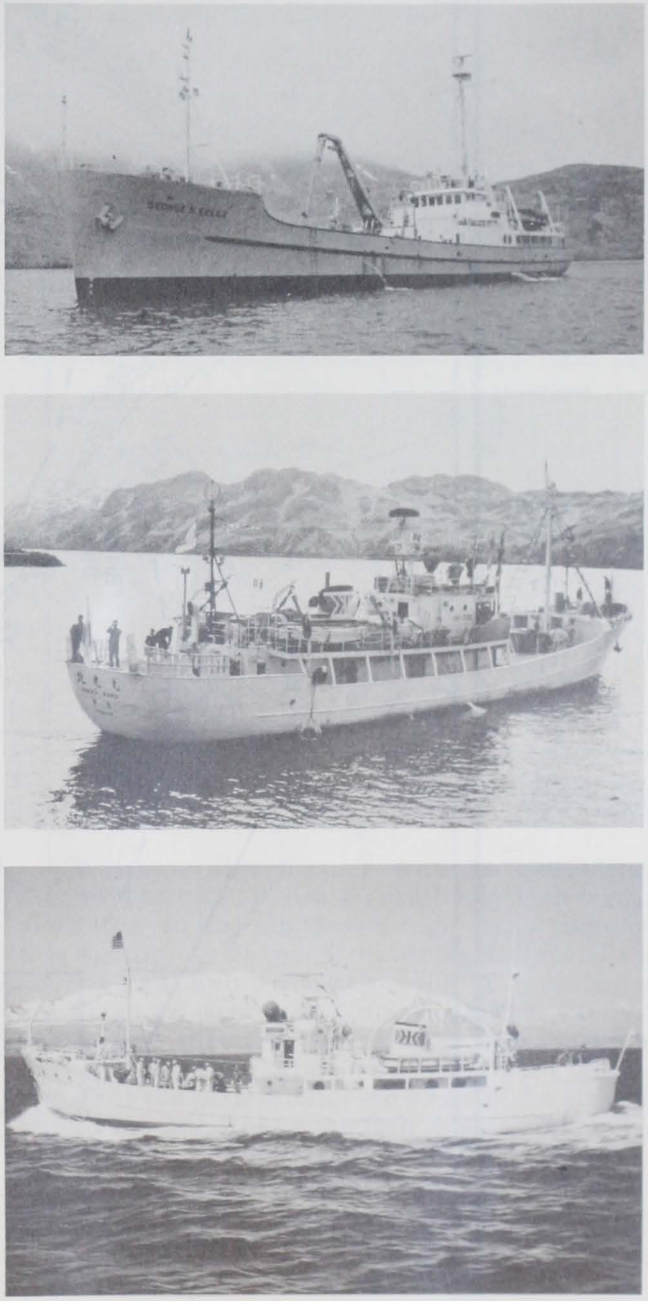

Fig. 1 - Cooperating research vessels--George B. Kelez (U.S.), Hokko-Maru and Wakashio-Maru (Japan).

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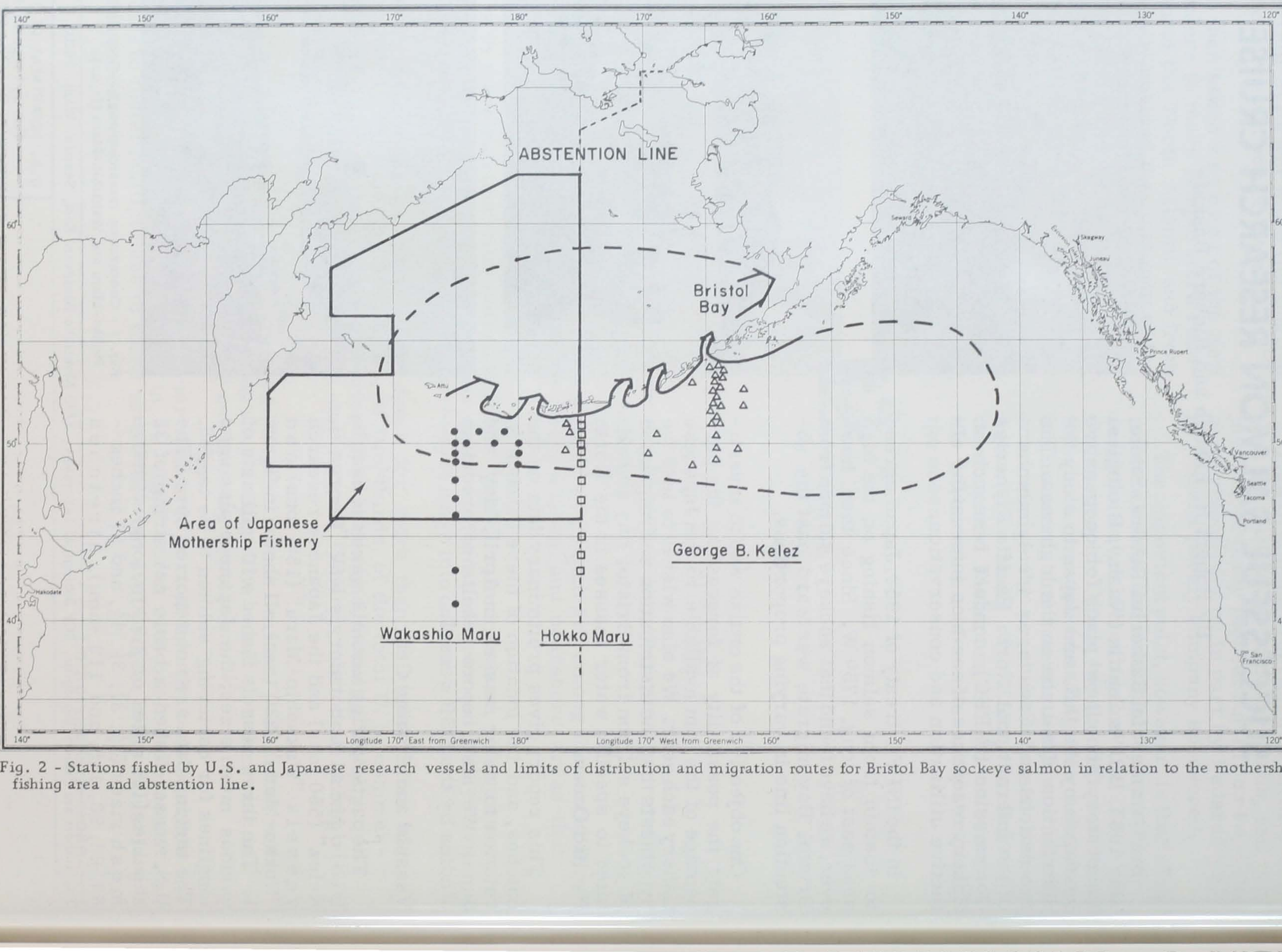

Fig. 2 - Stations fished by U.S. and Japanese research vessels and limits of distribution and migration routes for Bristol Bay sockeye salmon in relation to the mothership fishing area and abstention line.

measure. The Japanese vessels fished a basic string of 50 tans (2.5 km.) and 75 tans (3.75 km.), consisting of five mesh sizes (2.1, 2.8, 3.6, 4.8, and 6.1 inches--55, 72, 93, 121, and 157 mm.).

Communications

The language difference prevented voice communication, but vessel activity was coordinated by use of the International Code. This method of communication proved satisfactory; it allowed daily radio schedules in which data were exchanged on vessel position, catch by species, number of gill nets fished, and water temperatures at various depths. The Kelez also communicated daily with the Seattle Laboratory via single side band radio. It sent catch results and oceanographic data; in return, the vessel received the positions of the various water masses to guide scientists in planning fishing stations.

Fishing Results

Fishing stations of the three vessels in relation to migration routes of maturing Bristol Bay sockeye salmon--and the area of the Japanese mothership fishery--are shown in figure 2. The Kelez fished in April, May, and June, primarily south of the eastern Aleutian Islands; the two Japanese vessels fished in May south of the central and western Aleutian Islands.

Sockeye salmon were widely distributed in April and May. The maturing and immature fish showed differences in distribution (fig. 3). Maturing sockeye salmon (to spawn in 1968) were in the Ridge, Oyashio Extension, and Subarctic Current Areas of the Subarctic Region, but not in the Transition Area. The one set in the Alaskan Stream also took no maturing fish. Immature fish (those that will remain at sea at least 1 more year) were primarily in the southern water masses--the Oyashio Extension, Subarctic Current, and Transition Areas--but were not taken south of lat. 46° N. By early June, maturing fish were relatively abundant in the northern part of the sampling areas in the western Gulf of Alaska (fig. 4). These salmon were en route to Bristol Bay; the main group migrated through this area from June 1 to 10. By the middle of June, the relative abundance of maturing sockeye salmon had decreased, and immature fish had appeared throughout the Ridge Area.

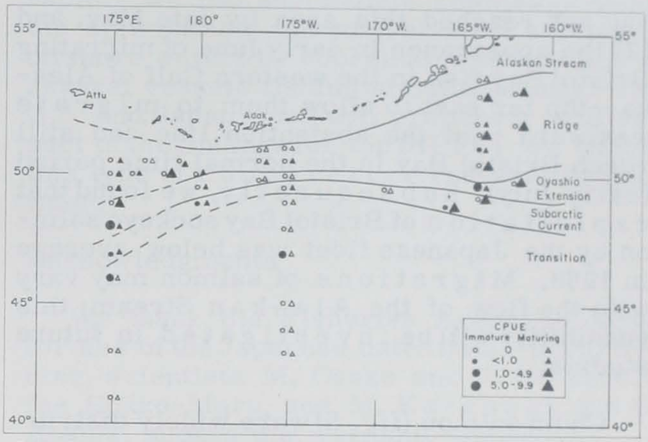

Fig. 3 - Relative abundance of immature and maturing sockeye salmon in April and May and location of water masses in the Subarctic Region of the North Pacific Ocean.

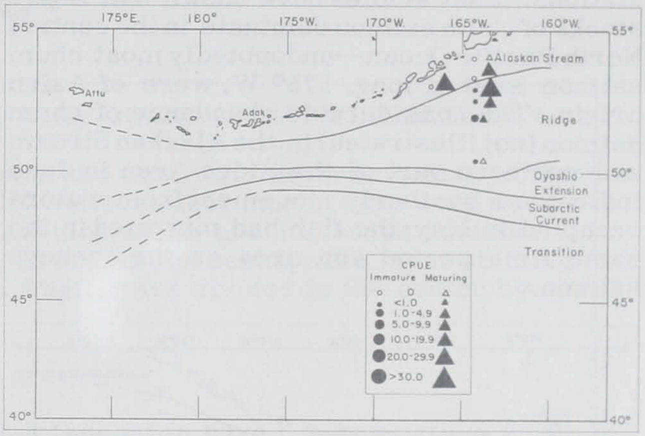

Fig. 4 - Relative abundance of immature and maturing sockeye salmon in June and location of water masses in the Subarctic Region of the North Pacific Ocean.

Of major significance was the indication that relatively few Bristol Bay fish were available to the Japanese high-seas fishery this spring. In the past, maturing Bristol Bay sockeye salmon were observed migrating westward from the Gulf of Alaska, thence northward through the eastern and western Aleutian passes. This route took part of the run past the provisional abstention line at long. 175° W., where the fish were vulnerable to the Japanese mothership fishery. The proportion of the Bristol Bay sockeye salmon available to the mothership fishery varies from year to year for reasons not yet understood.

Evidently no major migration of maturing Bristol Bay fish passed the abstention line in 1968. This was indicated by: (1) the low abundance of sockeye salmon along long. 175° W., which shows that Bristol Bay fish had not reached this area by late May, and (2) the appearance in early June of migrating Bristol Bay fish in the western Gulf of Alaska--too far east to allow them to migrate westward past the abstention line and still reach Bristol Bay in the normal time period (early July). Subsequently, we found that exploitation of Bristol Bay sockeye salmon by the Japanese fleet was below average in 1968. Migrations of salmon may vary with the flow of the Alaskan Stream; this possibility will be investigated in future studies.

Chum salmon (fig. 5) were widely distributed in more southern waters on the two western cruise tracks, but they were farther north in the areas fished by the Kelez at the eastern stations. Past studies have shown that Asian stocks of chum salmon dominate in the central North Pacific Ocean--undoubtedly most chum salmon west of long. 175° W. were of Asian origin. The considerable abundance of chum salmon (not illustrated) in the Alaskan Stream and northern part of the Ridge Area in June indicates a northerly movement from waters occupied in May; the fish had migrated in the same time period and area as the sockeye salmon.

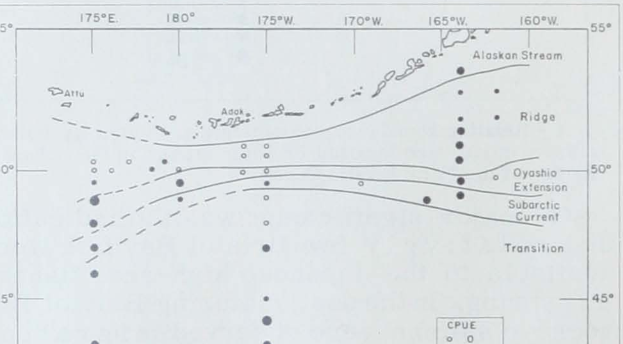

Fig. 5 - Relative abundance of chum salmon in April and May and location of water masses in the Subarctic Region of the North Pacific Ocean.

The distribution of pink salmon was similar to that of chum salmon (fig. 6). In the western part of the sampling area, they appeared in the southern water masses and were not generally abundant in the Ridge Area. In the eastern section, in May, they were most abundant in the southern part of the Ridge and Oyashio Extension Areas. By June, they were abundant in the northern part of the Ridge Area and Alaskan Stream (not illustrated).

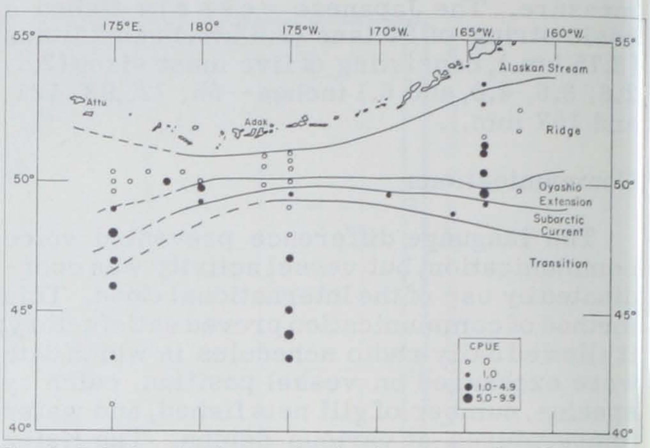

Fig. 6 - Relative abundance of pink salmon in April and May and location of water masses in the Subarctic Region of the North Pacific Ocean.

Predation

The George B. Kelez also conducted experiments on predation of salmon caught in gill nets. It has long been known that sea lions, fur seals, birds, and sharks feed on salmon in gill nets. The effect of the predation on catch rate, however, has not been determined. The method used was to attach freshly frozen salmon from the previous night's catch to the gill nets at time of setting; the numbers remaining were tallied when nets were hauled in the morning.

Total losses of "decoy" salmon amounted to about 29%. Loss was about 35% for fish attached to the corkline, and 21% for fish on the leadline (about 25 ft. or 7.6 m. below the surface). The greatest losses were at stations where we saw sea lions around the nets.

Losses of decoy fish decreased as distance from shore increased (fig. 7). Beyond 100 miles from shore, the loss was less than 20%, and in two of four sets no decoy fish were lost. Within 100 miles of shore, loss of decoys ranged from 22 to 90%.

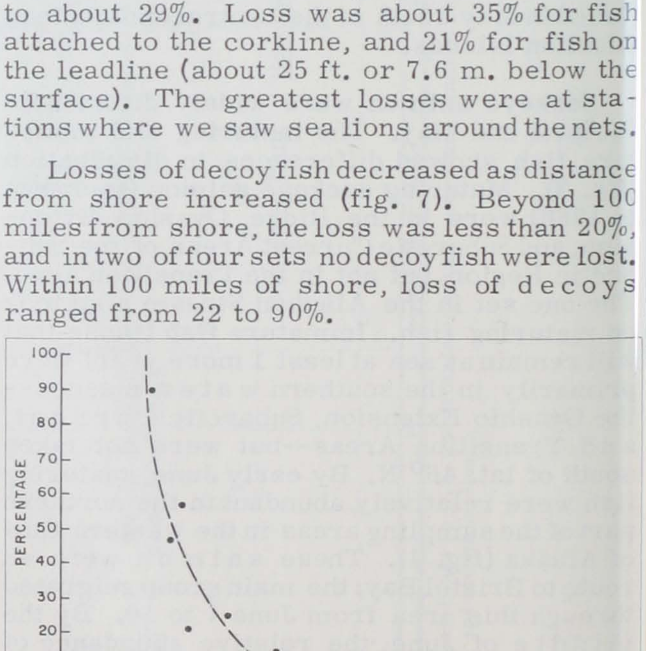

Fig. 7 - Loss of decoy salmon in relation to distance offshore (line fitted by inspection).

That salmon in gill nets are lost to predators is beyond question, but it is also necessary to evaluate the effect on catch rates in gill nets. A problem in present techniques is that live salmon may be taken by predators at any time during the night, whereas decoy fish are exposed to predators throughout the time the nets are in the water.

Effectiveness of Cooperative Cruise

This first cooperative cruise by researchers of the U.S. and Japan was successful. Despite language problems, effective communication between vessels was achieved. The results clearly demonstrate how much more rapidly we can accumulate knowledge about the distribution and migration of salmon in offshore waters by coordinated operations of several vessels fishing simultaneously. The U.S. and Japan soon will prepare a joint report of the findings for the INPFC. We expect this type of cooperative research to continue.

Acknowledgments

We thank the Fisheries Agency of Japan for use of the Japanese catch data--in particular, scientists M. Osako and J. Ito aboard the Hokko-Maru, and M. Katsuagi and G. Hoshiai aboard the Wakashio-Maru.

WHAT IS THE MOST IMPORTANT DISCOVERY MADE ABOUT THE OCEANS?

One of the most important discoveries about the oceans is the true nature of the sea floor. Not so long ago it was generally believed that much of the deep ocean floor was a featureless plain. We now know that there are numerous mountains under the sea, some of them higher than Mt. Everest. But perhaps the most striking discovery is that all oceans except the North Pacific are divided in the center by an almost continuous system of mountains.

Some of the other important discoveries are:

Discovery in 1938 of the coelacanth, a fish thought to have become extinct 50 to 70 million years ago, but which was found to be thriving off South Africa.

Discovery of a layer of living organisms spread over much of the oceans at a depth of several hundred fathoms (deep scattering layer).

Discovery of nodules of manganese, cobalt, iron, and nickel which can be dredged from the sea floor.

Discovery that the earth's crust is much thinner under the sea than under the land and that the bed of the ocean is underlain by basalt rather than by granite which makes up the continents.

Discovery of a deep sound channel that carries sounds for thousands of miles.

Discovery of life in the deepest parts of the oceans.

Perhaps the most important recent discovery is that man can live and work in the ocean for extended periods of time. Captain George F. Bond, a medical officer in the United States Navy, discovered that, once a diver's blood has become saturated with breathing gases at a given depth, decompression time is related only to the depth and not to the length of time the diver remains there. This led to the concept of underwater habitation by Cousteau and Link. ("Questions About The Oceans," U. S. Naval Oceanographic Office.)