574

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SPECIAL SCIENTIFIC REPORT–FISHERIES No. 574

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

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United States Fish and Wildlife Service
Special Scientific Report--Fisheries No. 574

Washington, D. C.
September 1968

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ABSTRACTS

An analysis of detailed operating records of two Hawaiian skipjack tuna vessels during 1952 and 1953 indicated consistent patterns of time utilization and activities that probably were representative for the Hawaiian skipjack tuna fleet during these 2 years. Availability of skipjack tuna appears to be lowest during the winter; hence, the vessels are drydocked and repaired then. The pattern of fishing was marked by a period of bait collection lasting a day or more, followed by a period of fishing that lasted from 1 to 5 days, but generally was 3 days or less. Baitfish mortality rates were so high that it was difficult to maintain a large quantity of live bait, or to fish successfully for more than 3 days. The design of the skipjack tuna vessels and their operating procedure reflected these constraints in the use of bait. Long-range vessels with refrigeration, possibly able to fish more efficiently during the winter, would be impractical without the development of methods to reduce baitfish mortalities. A fishery for live bait, independent of the tuna fishing vessels, would require the same techniques to be successful.

Much of the time at sea was spent in searching for fish rather than in fishing. A reduction in time spent searching would reduce the loss of baitfishes in the baitwells and increase the catch of skipjack tuna for baitfish used. Hence, knowledge of areas where skipjack tuna are concentrated would be of substantial value to the fishery.

INTRODUCTION

The skipjack tuna (Katsuwonus pelamis), which appears to be the major underutilized fishery resource of the central Pacific, has been estimated to offer minimum potential yields of 140,000 to 225,000 metric tons per year (Rothschild, 1966; Silliman, 1966). Hawaii, which now has a modest fishery for this species, may well become the optimum base for an expanded fishery. The present study examines the Hawaiian skipjack tuna fishery and some of the limitations whose removal, wholly or in part, could lead to the development of a major fishery. We recognize that to reconstruct the present fishery is not necessarily the best way to develop a major fishery in Hawaii. New fishing techniques may be developed, or techniques used elsewhere for taking tuna may be adapted for the Hawaiian fishery. Furthermore, several methods of fishing may be required to ensure optimum use of the skipjack tuna resource.

HAWAIIAN SKIPJACK TUNA FISHERY

The fishery for skipjack tuna (or aku, as it is called in Hawaiian) has been described by June (1951), who gave a short popular account, by Yamashita (1958) in his analysis of the skipjack tuna and bait catch statistics, and more recently by Uchida (1966) in his study of the catch and effort statistics collected in the Hawaiian skipjack tuna fishery. This pole-and-line, live-bait fishery is conducted from 17 sampan-type vessels which range between 17.8 and 23.3 m. in registered length. A supply of live bait, usually the anchovy or nehu, Stolephorus purpureus, must be caught and loaded into the baitwells before the vessel departs for the offshore fishing grounds. Some bait is captured at night, but most of it is taken during the day. The delicate nehu does not survive long in the baitwells, so a fishing trip is usually limited to a day or at most a few days. Lacking mechanical refrigeration systems, the fishing vessels usually carry ice to preserve the day's catch.

The fishery is highly seasonal. As estimated by weight of landings, the availability of fish is highest in the period from June through August, lowest in November through March, and intermediate in the remaining months. On the average, monthly catches in June-August are more than six times those in November-March.

The fishing sequence for a boat begins with a period of baiting.[1/] Fishermen usually catch baitfishes during the day by surrounding a school with a seine; the fish are then transferred to the baitwells. Fishermen are careful to avoid injuring the baitfishes, for mortalities may be heavy. If the amount of bait caught during the day is not sufficient for the trip to sea, the vessel may wait until dark and then attempt to fish for bait at night. At night, baitfishes which are attracted to a submerged light are seined and transferred to the vessel. Several days or nights of work may be required to catch enough baitfish to justify the start of fishing.

The Hawaiian skipjack tuna fishermen depend on birds to locate fish. On a fishing trip, the fishermen search for bird flocks, which are usually associated with schools of fish. Several skipjack tuna schools commonly are encountered and fished during a fishing trip. Other species of fish are sometimes taken, principally small yellowfin tuna or ahi, Thunnus albacares; dolphin or mahimahi, Coryphaena hippurus; and little tuna or kawakawa, Euthynnus affinis.

Fishermen abandon a tuna school when the fish stop biting. Immediately after fishing, the catch from each school of tuna is placed in the baitwells that have been emptied of the bait in the course of fishing. Scouting ends when (1) the supply of baitfishes is exhausted by fishing or death in the baitwells, (2) the catch of skipjack tuna must be taken to port before it spoils or when the vessel is loaded, or (3) darkness approaches.

On arrival back in port and unloading of the catch, the vessel may or may not attempt night baiting, depending on whether a sufficient supply of bait remains in the wells or on the phase of the moon. (Night baiting is rarely attempted on bright, moonlight nights because the nehu fail to congregate around the submerged light.) The vessel departs for the tuna or baiting grounds early the next morning.

A period of baiting followed by a period of fishing may last from 1 to 7 days. Several days may be required to accumulate a load of bait, and in turn several days' fishing may follow. These episodes may be separated by a day or two of rest. This sequence appears to be characteristic of the fishery. In addition to fishing for bait and tuna, fishermen spend time unloading the catch, loading ice, repairing and maintaining the vessel, and traveling in the vessel from port to the bait and fishing grounds.

DISTRIBUTION OF TIME SPENT IN SKIPJACK TUNA FISHING

To study the efficiency of operation among the vessels of the Hawaiian skipjack tuna fleet, we examined the detailed logbooks that captains of two vessels had kept in 1952 and 1953. If

[1/] "Bait" and "baiting" are colloquial terms (used here for convenience) by which tuna fishermen refer to the catching of bait.

their use of time is characteristic of the fleet in general and if the pattern of their activities for the years 1952 and 1953 is characteristic of other years, we may analyze their records to obtain an idea of the operation for the fishery.

Table 1 gives the percentage breakdown of all time available to the two vessels during the 2 years. The first four categories cover periods during which the vessels are not active, but are tied up to the dock or are out of the water entirely. This time in port is more than half of all time available, averaging 61.3 percent for the two vessels in 1952-53. (However, the "nonworking" time of the average laborer on a "land" job for 8 hours a day, 5 days a week, plus miscellaneous holidays is something over 78 percent of the year. The fishermen on the two vessels averaged more than 65 hours a week at sea.) The major part of this time in port is spent in "rest and unloading," and the time required for unloading is doubtless a minor portion of this. A larger portion of this time is spent with the vessel anchored or tied up at the dock waiting to leave for the fishing grounds. In addition, time that the crew spends ashore for rest or with their families may account for a substantial portion of this time. The time spent traveling is that required to go to and from port to the bait and fishing grounds.

Certain activities listed in table 1 can be carried on by day or night, but others are restricted to daylight or to darkness. The most important activity during the day is scouting and fishing, which can be done effectively only during the day. Fishing for bait is another important daylight activity.

Since scouting and fishing and day baiting require daylight, whereas essentially all other activities (except night baiting) can be done at

Table 1.--Percentage of time spent in various activities and success of bait fishing by Hawaiian skipjack tuna Vessel A and Vessel B, 1952-53 (based on a 24-hour day, 7 days a week) and success of bait fishing

Item	1952			1953			Average 1952-53
	Vessel A	Vessel B	Average	Vessel A	Vessel B	Average	
				Percent			
In port:							
Drydocking	7.1	5.7	6.4	6.6	14.3	10.5	8.4
Repairs	13.3	1.2	7.3	3.1	3.8	3.5	5.4
Unable to operate because of bad weather	0.8	1.9	1.4	1.1	3.2	2.1	1.8
Rest--unloading	42.6	56.6	49.6	46.1	37.3	41.7	45.7
Subtotal	63.8	65.4	64.7	56.9	58.6	57.8	61.3
At sea:							
Traveling	8.2	6.2	7.2	10.7	8.2	9.4	8.3
Drifting	2.5	--	1.3	1.1	--	0.6	0.9
Baiting							
Day	8.4	5.7	7.1	8.1	7.0	7.5	7.3
Night	3.5	7.6	5.6	3.3	7.7	5.5	5.5
Scouting and fishing							
Skipjack tuna	13.2	15.1	14.1	19.2	18.5	18.9	16.5
Other fish	0.4	--	0.2	0.7	--	0.3	0.3
Subtotal	36.2	34.6	35.5	43.1	41.4	42.2	38.8
Day baiting (catch per hour in buckets)	2.05	2.49	2.27	3.23	3.75	3.49	2.88
Night baiting (catch per hour in buckets)	0.55	0.03	0.29	0.82	0.39	0.61	0.45

any time, the use of time for scouting and fishing and day baiting should be considered in relation to the daylight hours available. On the basis of 12 hours of daylight, the percentage of time used in scouting and fishing and day baiting can be obtained by simply doubling the percentages given in table 1 for these activities (table 2).

It appears from table 2 that on an annual basis, a little less than one-half of the daylight hours are spent in scouting and fishing or in day baiting. This situation is considered in more detail later.

Table 2.--Percentage of daylight hours spent in scouting and fishing and day baiting by Hawaiian skipjack tuna Vessel A and Vessel B, 1952-53

Activities	1952	1953	Average
		Percent	
Vessel A			
Scouting and fishing	26.4	38.4	32.4
Day baiting	16.8	16.2	16.5
Total	43.2	54.6	48.9
Vessel B			
Scouting and fishing	30.2	37.0	33.6
Day baiting	11.4	14.0	12.7
Total	41.6	51.0	46.3

FACTORS AFFECTING THE CATCH OF SKIPJACK TUNA

Factors affecting the catch of skipjack tuna may be considered in three major categories, although this scheme is somewhat of a simplification, considering the interaction among the factors. These categories are (1) the availability of skipjack tuna, (2) the availability of live bait, and (3) the availability of the crews and fishing vessels for fishing.

Availability of Skipjack Tuna

As mentioned earlier, the availability of skipjack tuna follows a marked seasonal pattern. Table 3 gives the skipjack tuna catch, baitfish catch, and quantity of skipjack tuna landed per pound of bait as a monthly average for the summer (June-August), the spring and fall (April-May and September-October), and the winter (November-March) for Vessel A and Vessel B during 1952-53, years combined. The skipjack tuna catch per month and per hour of scouting and fishing, and per pound of live bait used shows a decided seasonal trend. Catches were highest in summer and lowest in winter. The trend is less obvious for baiting, except for a peak in the night baiting returns during the spring and fall. The data for bait catches during daylight indicate a reversal in the seasonal trend for Vessel B as compared with Vessel A. Night baiting was highly productive in spring and fall; catches in these periods averaged 71 percent of the total catch of bait at night for Vessel A and Vessel B. The data for the two vessels were pooled for 1953, but the night-baiting record for Vessel B was obviously incomplete for 1952 and was not included.

The rate of encounter between fishing vessels and fish schools varied with the season. Although the number of schools sighted is not routinely logged by the commercial fishing fleet, data collected on research vessel cruises show that fewer schools are seen in winter than in other seasons (Royce and Otsu, 1955).

Size composition of the skipjack tuna catch also varies seasonally. Schools of "season" fish, in which individuals weigh from 6.8 to 11.3 kg., usually migrate into Hawaiian waters during the summer but are largely absent during other seasons. The abundance of large fish in the summer fishery explains in part the apparent seasonal change in the skipjack tuna catch per unit quantity of live bait used in fishing. Although small tuna can be hooked and landed more rapidly than large ones, the weight of the landings probably increases with the size of fish landed, but not in direct proportion. Since extremely large fish must be gaffed, the weight landed per unit time declines.

The size of the fish caught, therefore, is an important factor affecting the catch of skipjack tuna per unit quantity of bait used; size is not, however, the only source of variability in this index. The quantity of live bait available is the amount caught by the fishermen less the amount of subsequent mortalities in the baitwells; the bait used for fishing can be overestimated if losses of bait are high. Variations in the size of vessel crews also affect the efficiency of

Table 3.--Catch rates of bait and skipjack tuna in Hawaii, 1952-53

Season	Day baiting catch	Night baiting catch	Skipjack tuna catch	Skipjack tuna catch	Skipjack tuna catch
	Kg./hour	Kg./hour	Kg./month	Kg./hour of scouting and fishing	Kg./kg. of bait
Vessel A					
Summer	12.8	1.8	32,941	207.8	34.7
Spring and fall	8.9	3.3	19,237	121.7	24.7
Winter	7.2	1.2	7,786	83.8	16.3
Vessel B					
Summer	10.2	0.6	58,792	340.7	67.0
Spring and fall	12.2	2.1	23,168	155.6	33.4
Winter	12.4	0.9	13,108	96.4	25.0

fishing and hence the catch of tuna per unit quantity of bait used.

Catches made within 1 or 2 days after baiting were usually larger than those made after bait was held for a longer period. Data for Vessel A for 1952-53 and for Vessel B for 1953 (the night bait catch for Vessel B appeared to be only partially recorded in 1952) showed that the longer the bait was held aboard, the smaller were the average catches of tuna. Exceptions were the catches made during the same day on which bait was taken and the catches made the day after night bait was captured (fig. 1 and table 4). After 3 days it is likely that the quantity of bait still aboard may be insufficient to provide a major catch, although occasionally enough bait may be left to tempt the fisherman to go fishing again. About 10 percent of the total number of fishing trips occurred after 3 or more days since the last catch of bait.

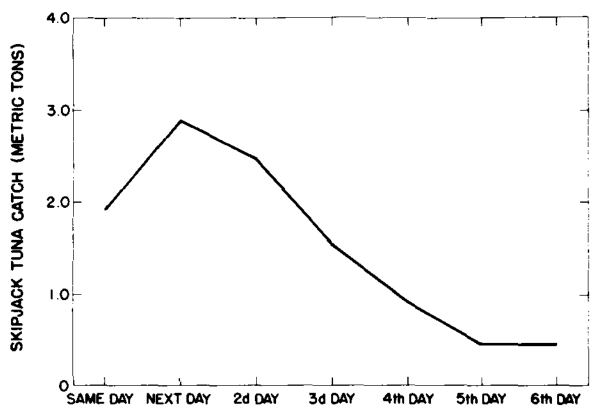

Figure 1.--Hawaiian skipjack tuna catch in metric tons according to number of days since bait catch was made.

The catch of skipjack tuna per trip per kilogram of live bait expended was highly variable; for Vessel A during 1952-53 it ranged from 0 to more than 113 kg. The higher value is undoubtedly not a maximum because the data were not adjusted for baitfish mortalities. As might be expected, the distribution of this ratio was highly skewed. Average seasonal values were given in table 3 for Vessel A and Vessel B.

As a working hypothesis, we assume that fish bite better if they are hungry. Biting response presumably changes with time, as the skipjack tuna passes through periods of satiety and hunger. A thorough understanding of the feeding behavior and what may affect it could substantially increase the efficiency of fishing. If the fish pass through cycles of satiety and hunger, then it would be of tremendous value to the fishermen to be aware of this periodicity and to be able to detect the stages from the behavior of the fish. If feeding follows a daily rhythm, the fishermen could take advantage of this fact by concentrating fishing effort in the "best" periods. Data concerning skipjack tuna catches and time of day, however, gave no evidence of an optimum time for fishing; early mornings and late afternoons were poor and catches appeared to decline slightly at midday. It is not clear whether this midday slump is due to poorer fishing or to a slack in scouting intensity while the crew is eating lunch.[2/]

[2/] These data were from records of interviews with fishermen.

Table 4.--Size and number of landings according to the time since the last catch of live bait, Hawaiian skipjack tuna Vessel A and Vessel B, 1952-53[1]

Size of skipjack tuna catch	Landings						
	Same day as bait catch	Next day	2d day	3d day	4th day	5th day	6th day
Metric tons	No.	No.	No.	No.	No.	No.	No.
< 0.9	29	38	18	13	5	1	1
0.9-1.8	16	37	23	5	-	-	-
1.8-2.7	10	18	8	4	-	-	-
2.7-3.6	9	17	6	3	1	-	-
3.6-4.5	3	8	2	-	-	-	-
4.5-5.4	6	10	6	-	-	-	-
5.4-6.3	-	6	5	-	-	-	-
6.3-7.2	1	5	-	-	-	-	-
7.2-8.2	1	3	1	-	-	-	-
8.2-9.1	-	3	1	1	-	-	-
9.1-10.1	-	-	-	-	-	-	-
10.0-10.9	-	-	-	-	-	-	-
10.9-11.8	-	1	1	-	-	-	-
11.8-12.7	-	-	-	-	-	-	-
12.7-13.6	-	2	-	-	-	-	-
13.6-14.5	-	1	-	-	-	-	-
14.5-15.4	-	-	-	-	-	-	-
15.4-16.3	-	-	-	-	-	-	-
16.3-17.2	-	1	-	-	-	-	-

[1]There may be unrecorded catches of night bait, a factor which would extend length of fishing period.

Availability of Live Bait

Essentially, any small fish will serve as bait, some more effectively than others. In general, however, Hawaiian skipjack tuna fishermen are firmly convinced that nehu is the best baitfish. Knowledge of the characteristics that make it an excellent baitfish would be most useful. Finding a supplemental baitfish with qualities similar to those of the nehu would be an important step toward removing some of the limitations of the fishery.

The availability of bait affects the operation of the skipjack tuna fleet importantly. The crew of a sampan may spend as much as half of their time fishing for bait (Yamashita, 1958), with the result that there is less time for tuna fishing. Tables 1 and 2 show the percentage of total time spent in catching bait and table 5 gives the percentage spent in day baiting by season during 1952-53 for Vessel A and Vessel B. In general, the time spent day baiting is a little less than half of the total daytime activity, except for winter baiting of Vessel A.

Table 5.--Percentage of time spent by two Hawaiian skipjack vessels in day baiting, by season, 1952-53

Season	Vessel A	Vessel B
	Percent	Percent
Summer	45.8	47.0
Spring and fall	45.7	34.2
Winter	67.3	29.7

Obviously, a reduction in hours spent taking bait by day provides more time for fishing; however, bait would have to be provided by other means. The yield from the greater fishing effort should increase in direct proportion to the time spent fishing. An increase in the efficiency of night baiting might provide more bait. Another approach would be to separate bait catching from fishing. The net value of the increased catch of skipjack tuna should exceed the costs of maintaining a separate bait fishery. Furthermore, if nehu is the bait species, mortalities due to catching, handling, and transfer to the vessels' baitwells must be minimized. Baitfish mortality was one of the important reasons for the rejection by the fishermen of an independent bait fishery in the past.

Hatchery rearing of a suitable baitfish has some attractive features, if it can be done economically, since the supply of bait could be regulated to the needs of the fleet. The vessels could depend less on the availability of bait on the baiting ground.

Certain apparent characteristics of the nehu strongly influence the operations of the skipjack tuna fishery. They include a low average rate of capture--about 11.3 kg. per hour during the summer season--and a high mortality thereafter. Baitfish mortality usually averaged about 25 percent a day after capture. Brock and Takata (1955) found an hourly average instantaneous mortality of 0.013 for nehu taken by lift net at night and held thereafter in running sea water for 36 hours. This estimate of mortality agrees approximately with the 25-percent estimate, if the latter is considered as applicable to the initial 24 hours after capture. Day baiting, however, requires additional handling of the baitfish in comparison with bait fishing at night with a lift net; therefore, it is likely that the average day-bait mortality for the initial 24 hours following capture is greater than 25 percent. Although no data are available on mortality for longer periods, the limited length of time that a catch of baitfish can be used for fishing suggests that the baitfish mortality does not decline greatly after the initial mortality following capture (table 4 and fig. 1).

The rate of capture of bait during daylight must be sufficiently high to provide enough bait for a day's fishing. Bait caught at a rate of 11.3 kg. per hour would in 1 day, on the average, provide an adequate supply for a day's tuna fishing. At this rate of capture, however, a vessel could have difficulty in accumulating enough bait if it preferred to fish at least a week. The problem of accumulating bait is further compounded by the high mortality; an hourly instantaneous rate of 0.013 is about equal to a weekly mortality rate of 0.889 or nearly 90 percent. The size of the baitwells, the tuna-carrying capacity, icing requirement, and useful cruising range of the vessels, therefore, are limited by the average rates of capture and mortality of baitfish. These characteristics of the vessels are responsible for the fishing pattern of a day or two of baiting followed by 1 to 5, but usually 1 or 2 days of fishing. Numerous short episodes of baiting and fishing increase the time spent traveling between baiting and fishing grounds, and make the development of a long-range fishery elsewhere in the central Pacific an impossibility if present practices in the use of this baitfish species are continued. A long-range fishery during the winter, however, may be the best means of increasing the production of skipjack tuna during the off-season months. Under present conditions, an "improved" vessel design for the fishery is difficult to visualize; the present vessels may represent nearly the optimum considering the low rate of capture and survival of the nehu.

The duration of the fishing trip was independent of the duration of the baiting period, which was not surprising. The time spent in the capture of bait showed a significant negative correlation with the time available for fishing ($r = -0.551$) but showed no correlation with the actual time spent fishing. The quantity of bait taken to sea, however, was positively correlated with the duration of the fishing trip ($r = 0.395$), but not significantly so with the skipjack tuna catch. Furthermore, the correlation between the time spent fishing per trip and the catch was not significant. Perhaps it should be pointed out that the significant correlations shown above do not account for a great deal of the above variation. These results suggest that baiting proceeds until an adequate supply of live bait is aboard, after which fishing proceeds until a load of fish is obtained or the bait supply is exhausted. If fishing is poor but a large quantity of bait is aboard, the period spent fishing will, on the average, be longer. If fishing is good, the bait supply will be used more rapidly, but because of high baitfish mortality, the resulting catch will not necessarily be large (except occasionally within a 2-day period following baiting) even though the preceding bait catch was large.

Availability of Vessels

The availability of the vessel for fishing is affected by maintenance and repair, traveling time between port and baiting grounds, delivery of fish or picking up ice, and time spent ashore for a wide variety of reasons. The "active" time, which included that spent in traveling, bait fishing, and scouting and fishing, for the two vessels and the 2 years was 37.9 percent of the entire period. On a seasonal basis, "active" time was 33 percent in winter, 45 percent in spring and fall, and 53 percent in summer. These statistics suggest, as was obvious from the logbook records, that repairs and maintenance of the vessels usually were performed during the winter and fishing effort was intensified during the summer.

The time spent traveling was nearly equivalent to that spent day baiting. Of course, much of the traveling usually is during darkness, for the vessel departs for the fishing grounds in the early morning hours and returns after dark. The operational pattern for a fishery such as the Hawaiian fishery, where the vessels have short periods for taking bait and for fishing and a limited carrying capacity for the catch, obviously shows a higher percentage of time spent traveling to baiting grounds, to fishing grounds, and to port than would be true if longer intervals could be spent fishing.

AREAS OF PROFITABLE RESEARCH

To make the skipjack tuna fishery more productive through the modifications of the methods of live-bait fishing, a number of obvious problems would need solutions. Some solutions would make the fishery more productive immediately, but others would become important later.

A solution to the problem of the live-bait supply would provide an immediate and major increase in the production of skipjack tuna. A means of quick access to live bait would eliminate the daylight time spent taking bait. A reduction in day-baiting time and traveling time could increase production a minimum of about 50 percent. Reduction in baitfish mortalities during and after capture would add substantially to the usable supply of bait. The increase in catch thus possible would be proportional to the additional bait available for fishing through reduction in mortalities and to the reduction in traveling time to the bait grounds. Although estimates place bait mortality before use at about 25 percent, this level is probably reached within 24 hours or less. Bait catch data from Vessel A and Vessel B suggest that mortalities approach 100 percent within 5 days or less and that useful quantities of baitfish seldom last beyond 2 or 3 days. It is possible that improved bait-handling, which permitted longer survival for the nehu, would increase skipjack tuna production by 50 percent with fishing vessels of the types presently used. Vessels designed to take advantage of survival of baitfish over a longer period could provide an even greater improvement in skipjack tuna production, since larger quantities of bait could be taken to sea. A vessel with refrigeration could remain almost continuously at sea fishing, returning to port only to discharge the catch and renew its bait supply. A successful fishing operation of this character would also require a rapid procedure for obtaining live bait. A lengthy period of baitfish survival at sea would permit the development of vessels that could fish at greater distances from port if distant tuna concentrations justified the longer trip. Such concentrations may occur in the zone of enrichment along the Equator.

Mention has been made of the importance of understanding the mechanism and releasers of the feeding frenzy in tuna. What is it about a baitfish species that makes one very effective and another only moderately so? What are the stimuli, and when and why are they most effective? Such information would be most useful in selecting and testing various other species as a possible baitfish for skipjack tuna fishing and may actually lead to improved baiting and fishing for the fleet.

Another problem for which a solution would be of value is where and when concentrations of tuna occur. If their distribution is governed by certain oceanographic characteristics or the processes resulting therefrom, the ability to predict oceanic conditions on the fishing ground would be of great value. It has been estimated that about one-tenth of the time spent scouting and fishing is actually spent in the capture of fish. A reduction in the scouting time, and use of the time saved for fishing, could produce major increases in production. To take full advantage of the reduction in scouting time, an increase in the supply of live bait would be most desirable. A solution to the problem of locating tuna, however, would give improved catches without improvements in the baitfish supply. Since a reduction in scouting time would in effect have the same consequence as an increase in the number of trips or vessels fishing, and since live-bait fishing requires baitfishes, the number of trips or size of the present fishing fleet is, to a degree, keyed to the available resource of baitfishes. We have mentioned that each scouting and fishing episode is limited by the survival of the baitfish; therefore a reduction in the scouting period would certainly result in a more effective use of the available bait as well as substantial increase in the catch.

Skipjack tuna concentrations occur in local waters at various places for periods of several days or weeks. Ability to predict the location of these concentrations would require knowledge of short-range changes in the ocean locally. In addition, if techniques could be developed to permit fishing vessels to remain at sea longer, the prediction of major distant concentrations at various times of the year and estimates of their regional abundance would be of great value. This latter kind of prediction is now being made for the Hawaii region; its general extension may be most useful in the future.

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MS#1783

Created in 1849 the Department of the Interior--a department of conservation--is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States--now and in the future.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
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