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DEEP HAND-LINING FOR YELLOW-FIN TUNA AT
FUNAFUTI, ELLICE ISLANDS

by

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1. FOREWORD

1.1 Tuna-resource surveys in the Gilbert and Ellice Islands

The Fisheries Survey Unit, with headquarters in Tarawa (Gilbert Islands), is directed by a Chief Fisheries Development Officer, who is responsible additionally for assignments supervised by three Fisheries Development Officers, one operates from headquarters and the other two are in charge of Fisheries Survey Units in the Line (Christmas Is.) and Ellice Islands (Funafuti atoll). The principal task of the Unit is to survey the tuna resource and establish export fisheries if feasible. In the Gilbert Islands a joint survey programme operated by Government in partnership with private enterprise is investigating the possibilities of establishing a pole and live-bait fishery. Results of this survey are hopefully promising and a final evaluation is anticipated towards the end of this year.

At Funafuti, in the Ellice Islands, surveys carried out by the Unit have confirmed the presence of surface schooling yellow-fin and skip-jack throughout the year. Time has not permitted studies of annual or seasonal fluctuations in respect to a quantitative resource but preliminary assessments of the natural live-bait population gives rise to some concern as to the methods locally suitable for developing an export fishery.

1.2 The potential of a small-craft tuna fishery at Funafuti

The three principal local methods of tuna fishing at Funafuti are by trolling, pole and lure, and by deep hand-lining. Normally, but not invariably, these three activities are conducted at separate times of the day and interests are presently focussed on small-craft using two or more of these techniques to obtain maximum daily catch-rates. Trolling results, despite inadequate craft, are considered to be highly promising: pole and lure fishing has been observed to be profitable under specific conditions but little is known about the traditional deep hand-lining for yellow-fin, dog-tooth, skip-jack and other tuna.¹ This short paper attempts to describe the deep hand-lining technique and to present the results of thirteen days' fishing in June 1972. These investigations will be continued for at least six months and a final report and summary will be made available then.

2. MATERIALS AND METHODS

2.1 Fishing vessels

The Fisheries Survey Unit's vessel is an 8 m. diesel craft capable of about 10 knots. The slowness and other features of this vessel serve to emphasise optimum specifications for craft suitable for this three-method type of fishing and it is thought that Oregon dories powered by 130 h.p. inboard-outboards would be ideal in every respect and projects submitted for approval and overseas funding include three craft of this type. In the meantime the deep hand-lining survey is being carried on from the Unit's 8 m. fishing vessel. On arrival at the selected fishing area, on the atolls leeward side, the vessel is either anchored so that it lies over depths of 150 m to 200 m or is allowed to drift in localities of similar depths. (Vide para. 4, sec. 1.)

2.2 Hand-lining gear

The gear is simple and cheap and is described in detail hereunder. During the current survey programme, four lines are used by four crew members but it has been found that one man can control two lines under certain circumstances (Vide para. 4, sec. 3.).

2.2.1 Lines

Several different types of line have been tried but best results have been obtained from coloured nylon monofilament, in lengths of 500 m., with a breaking strain of 80 kg to 100 kg.

¹ A list of fish referred to in this paper appears as Appendix "A".

2.2.2 Swivels

Swivels, the type and their use, continues to present problems. Some cheap barrel swivels occasionally snag, pinch and break the line, brass swivels may attract sharp teathed "wahoo" resulting in further line losses, other swivels will not take the strain of powerfully fighting dog-tooth tuna and swivels placed too close to the hook appear to scare the yellow-fin.

Optimum positioning of a swivel appears to be from 10 m to 20 m from the hook, and the only satisfactory type is a stainless steel pattern manufactured in the United States of America for game-fishing.

2.2.3 Trace wire

Plastic-coated braided wire has been used successfully - 20 cm. to 30 cm. is adequate. A well known bronze coloured braided trace used by game fishermen might be useful but has not been available: long-line wire, piano wire and several cheaper articles have been used and rejected as catch rates are much lower when these used in comparison to results obtained from using no trace (highest rate) or plastic-covered wire. Connecting the hook directly to the nylon gives the highest catch rates of yellow-fin but miscellaneous catches of dog-tooth tuna, wahoo, occasional bill-fish and other species are much reduced.

2.2.4 Hooks

Several different patterns and sizes have been used and the most successful is the Japanese tuna-hook measuring 17 mm. from barb to shank, - a very small hook in comparison to the fish it catches.

2.2.5 Sinkers

Oval to round, smooth beach-stones weighing about 1 kg to $1\frac{1}{2}$ kg are used. As the sinkers are released when the line attains the desired depth, a large number of stones are required: on average days a fisherman will need 8 to 10 sinkers per hour.

2.3 Method

The method requires considerable skill but the principles are simple. The hook is baited and with a parcel of attractant is attached to the sinker which is then cast over the side and line paid out until the required depth is reached. The sinker is then released which in turn causes the attractant and hook to be released. After 8 to 10 minutes, if no fish is hooked, the line is hauled and the process repeated. Higher catches are obtained by frequent rebaiting.

2.3.1 Choice of bait and attractant

Results have indicated that highest catch-rates of yellow-fin are made when using yellow-fin, skip-jack, or black skip-jack as the bait and attractant. Other firm fleshed fish give rather lower returns and soft flesh baits are normally useless.

2.3.2 Obtaining bait and chumming material

During the survey, sufficient skip-jack are obtained by trolling from Funafuti to the fishing area. If a damaged (by shark) yellow-fin is caught, the residue is then used for bait. In the event of a trolling, pole and lure cum hand-lining fishery being developed, the bait would be obtained by one of the first fishing methods.

2.3.3 Preparing bait and attractant

A badly prepared bait does not catch fish. The skip-jack or yellow-fin is cut up into thin fillets, skinned and free from bone. The fillets are made into cubes of 20 m. and tapering slices measuring 10 mm x 10 mm x 100 mm. Two cubes are used to cover the shank, the tapered-slice is thence arranged to hang from the base of the hook and remaining parts are covered by impaling one or two more cubes.

The attractant is made by masticating or mincing up several fillets, a cupful of attractant is used at each rebaiting.

The baited hook and attractant are carefully laid in the middle of a large leaf (breadfruit is suitable) which is then folded to form a neat parcel: the latter is then placed beside the selected sinker-stone and held in place by eight to ten turns of the line secured by passing a bight two to three times under and over the turns. It is necessary to test that a jerk on the line will release the turns from the sinker and parcel. The prepared sinker is cast overboard and at 200 metres several strong jerks are made to release the sinker which results in the leaf floating away leaving an undamaged bait surrounded by a cloud of attractant.

2.3.4 Hauling and boating the catch

Hauling should be done as quickly as possible taking care that the line is thrown to the deck in such a manner as to run out freely if required. Slow hauling may invite the attention of sharks, but hauling merely to renew baits may be done in spasms to attract any wahoo which may be present. Boating large tuna gives rise to difficulties and a stout landing net has been found more satisfactory than a blood-letting gaff.

2.4 Changing the fishing-station

If, after an hour or so without catching a yellow-fin or if several demersal fish are hooked, the survey vessel is moved to a new station within the general locality, moves seldom exceed 1 km.

3. RESULTS

The results referred to are related to 13 fishing-days during June 1972. The survey was confined to an area marked on Admiralty Chart No 2983, Funafuti Atoll, as Te Afua Sari which lies to the immediate north-west of Tepuka Island.

3.1 General data

3.1.1 Tide

The survey period covered all aspects of the tidal range.

3.1.2 Weather and sea conditions

Winds were easterly varying from 0 to 30 knots: rain squalls were frequent on five days. Seas varied from calm, through slight and moderate to rough.

3.1.3 Steaming hours to and from fishing grounds

Total steaming time was 35 hours.

3.1.4 Fishing time, drifting or at anchor

Fishing-hours totalled 55.

3.1.5 Hook-hours

Total hook-hours from using four and rarely five lines was 225.

3.2 Fish caught

3.2.1 Yellow-fin catch

Day Number	Number of yellow-fin caught	Weight of yellow-fin in pounds
1	7	340
2	5	270
3	2	90
4	3	170
5	17	1,060
6	6	310
7	3	140
8	4	240
9	6	340
10	6	300
11	12	710
12	2	110
13	8	390

Thirteen fishing days 81 yellow-fin weighing 4,470 lbs. (approx.)

Weights approximate.

3.2.2 Other-tuna catch

Day Number	Number and Species of Tuna	Approximate weight
8	1 Dog-tooth tuna	80 lbs.
10	1 Dog-tooth tuna	60 "
11	1 Skip-jack	14 "
	3 "Other" tunas Weighing	154 lbs.

The yellow-fin catch tabled in 3.2.1 above includes two fish which are locally recognised as a variety of the common yellow-fin and are referred to by a different vernacular. This form is striking, the length to weight ratio is exceptionally high and pectoral fins are noticeably longer.

3.2.3 Shark catch

Damage to tuna by sharks was variable: initially high it declined when a shark-set appropriately baited was drifted 50 metres astern. The baited-hook was set at 40 metres and the line was attached to a glass tuna-buoy. This gear served, in many cases, to divert the attraction of sharks from hauled-tuna.

Sharks in the area were observed to be small, the largest a little over 250 lbs but most averaged between 60 and 100 lbs.

The total shark catch in the 13 days was 17.

3.2.4 Bill-fish catch

The catch was "nil" although several were hooked and broke the tackle.

3.3.5 Miscellaneous fish caught

A number of pelagic and demersal fish were caught, the largest were "wahoo" of thirty to fifty pounds, the smallest were "schnappers" of five to ten pounds. The latter were caught as the vessel drifted off the fishing station into shallower water and the catching of demersals invariably resulted in starting the engines and moving back to deep water.

The total catch of miscellaneous fish was 167 weighing about 900 lbs.

4. DISCUSSION

The notes in previous sections refer to the initial period of a deep hand-lining survey and consequently it is now premature to draw conclusions or to raise questions for discussion. Methods are being modified and much will be learned during the next five months. Until the programme is completed, only a few matters warrant discussion.

4.1 Tuna distribution during the fishing period

On each of the 13 fishing-days, local trollers had variable catches of yellow-fin and skip-jack in the vicinity but at earlier times on each day. When deep swimming yellow-fin were hooked, surface schools of much more juvenile yellow-fin were sometimes observed, surface schooling black-skip-jack in large schools were frequently seen and a few schools of ordinary skip-jack were noted. On other occasions no surface-schools were seen in the area.

4.2 Albacore

None were caught but local fishermen report that this fish occurs in similar depths on the eastern side of the atoll - this will be investigated towards the end of the survey when winds change to a north or north-westerly direction.

4.3 Gear and losses attributed to inadequate equipment

It is difficult to estimate the number of large tuna (of at least two species) that were lost on account of gear failures. A rough estimate is that from 12% to 15% were lost in this manner but each lost-fish would have weighed much more than the average-weight of those successfully caught and it is likely that the loss of 12% or 15% by numbers would be equivalent to a weight loss of 25% to 30%. Because of this, the Unit is currently making up different types of gear for trial fishing but the immediate problem is to achieve this without reducing the satisfactory catch-rate obtained on the described gear. This activity is likely to prolong the survey period as each type of modified gear has to be carefully evaluated against the present.

4.4 Multiple set lines for deep-swimming tuna

As has been stressed, the purpose behind this study is to find the best manner to extend productive fishing-effort for small craft which have been out trolling for several hours. In addition to the deep hand-lining technique, trials have been done using ten separate lines, baited with flying-fish and set to lie at 140 metres depth: each line is buoyed and the string of buoys is connected to the fishing vessel in the same manner as the shark-set described. Results of this operation were very variable and ranged from totally negative to an occasion which produced two yellow-fin of 80 lbs., two more of about 50 lbs and two "wahoo" of about 40 lbs. This method has not been completely rejected but it was observed that positive results only occurred on the rare occasions when currents were absent or insignificant, that is to say, the baited hooks seldom fished at the required depths.

4.5 Summary

The results so far obtained from this method of deep hand-lining justify an in-depth study. If the catch-rate can be maintained or improved it would greatly increase the day-to-day total-catch of small-craft which operated as trollers prior to undertaking a period of deep hand-lining.

5. DETAILS OF FISH REFERRED TO IN THIS PAPER

<u>English vernacular</u>	<u>Local vernacular</u>	<u>Scientific name</u>
Black Tipped Shark	Mangor (blanket term)	<u>Eulamia maculipinnis</u> ?
Lesser Black Tipped	"	<u>E. limbatus</u> ?
White Tipped Shark	"	<u>E. longimanus</u> ?

<u>English vernacular</u>	<u>Local vernacular</u>	<u>Scientific name</u>
Yellow-fin tuna	Takua	<u>Neothunnus macropterus</u>
Dog-tooth tuna	Kaikaifua	<u>Gymnosarda nuda</u>
Skip-jack	Atu	<u>Katsuwonis pelamis</u>
Black Skip-jack	Atu alo	<u>Euthymus affinis</u> ?
Trevally	Tefaule	Carangidae
Trevally	Ulea	Carangidae
Wahoo	Pala	<u>A. solandri</u>
Schnappers	-	<u>Lutjanidae</u>

The spear-fishes (Istiophoridae) are locally represented by the sail-fish (usually 60 to 100 lbs), short-billed marlin, black marlin and sword-fish.
