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NINTH REGIONAL TECHNICAL MEETING ON FISHERIES

(Noumea, New Caledonia, 24 - 28 January 1977)

THE FISHING, HANDLING AND MARKETING OF 'SASHIMI' TUNA

by

William Travis
Principal Fisheries Officer
Government of Fiji

SUMMARY

The purpose of this paper is to provide Pacific Island fishermen and Fisheries Extension personnel with a complete 'do-it-yourself-kit' whereby they can exploit the lucrative 'sashimi tuna' market.

Providing that your territory possesses these few logistic requirements set out on page and your waters harbour even quite small stocks of Yellowfin or Big Eye Tuna, there is no reason why such a fishery cannot be established.

Understand that this is not an experimental fishery but an established, demanding one, into which you must fit yourselves. The market is always there, though seasonal prices may fluctuate over wide range. (Note: Seasonal 'high' November and December, seasonal 'low' - August).

Extension staff of government fisheries can play a vital role in setting-up the logistical requirements (making sure the necessary fishing gear is available; establishing contacts with box-manufacturers and overseas 'sashimi' buyers, etc.).

Co-operative authorities can also usefully perform such preparatory work. Such co-operation allows the active fisherman to get-on with his job - which is to catch the fish.

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Historic Preamble:

To most of us the phrase "a tuna fishery" conjures up mental images of large, complex vessels such as Purse-Seiners or Long-liners together with extensive shore-installations in the form of canneries, refiners, boat-yards, bulk stores and their attendant advanced technological back-up facilities - all of which require advanced industrial societies and heavy capital investments in order to flourish.

It is the intention of this paper to explore and promulgate existing market situations wherein tuna - far from being a bulk commodity requiring a certain large produce-volume/capital-involvement in order to be a viable economic success - can be successfully exploited by the individual or family fishermen with minimum of capital investment and who deals, do ni thousands of tonnes of produce, but in individual fish.

To many the idea that a fisherman can obtain a reasonable living from say, five fish a month will appear ludicrous - yet the established facts tell us otherwise. The key to this apparent paradox is contained in the combination of high-priced de luxe market outlets and low-cost capital investment. In a nutshell if a fisherman can expect two hundred dollars 'on the dock, for each of his five fish, for a total operational outlay of, say, twenty dollars per fish, then he has a viable undertaking. In fact, in investment return he has a little gold-mine! But there is yet another favourable point to consider with regard to such an operation and that is the ecological one.

To continually harvest a given oceanic locality of thousands or tens of thousands of tonnes of prime pelagic fish so that they may be reduced into a uniformly relatively-unappetising canned condition (having first been hard frozen) is not only detrimental to the nutritional value of the product but, in the long term, largely disastrous to the stock itself. A glance at any of the established world's tuna fishing grounds and their decline in yield over the past twenty years provides ample evidence in support of this statement.

But to 'cream-off' a fractional percentage of this stock and to preserve it in a near-perfect fresh state until it is consumed, makes not only sound nutritional sense (through admittedly catering to only a tiny percentage of the total consumer's market), but is also good business sense since the product price-value can thereby be boosted by as much as one thousand percent.

To establish such a Small-Units Fishery based on such a concept, each of the following facets of the total operation must be available and all must dovetail neatly together.

There must exist:

1. The fish.
2. The markets
3. The fishing method.
4. The correct fish-preservation and handling techniques.
5. The necessary transportation modes and methods

To ascertain whether or not your particular Pacific Island Territory has the potential for such a fishery, it is only necessary to answer affirmatively the following simple questions.

- (a) Do your local near off-shore *waters contain - either seasonally or permanently - even small stocks of medium to large size Yellow Fin tuna and/or Big-Eye Tuna? (or are your waters suspected of containing them?).
- (b) Have you a local tradition of ocean-fishing canoeism, or is there any way in which a proportion of your local populace can be trained as efficient small-boat fishermen?
- (c) Do you have available or can you make available, small quantities of good quality (i.e. clean, low-temperature) crushed ice and an associated small volume chill-room? (Not a blast freezer or low-temperature store).
- (d) Does your territory boast a modern airport with air-freight links to the major Pacific air centres such as Honolulu, Nadi, Guam, or Papete?

Notice that in the above list the question of markets does not arise for the very simple reason that these already exist and are common to all Pacific territories, being namely Japan, the west coast of the United States and - to a lesser extent - Honolulu (Hawaii), Agana (Guam) and Okinawa (Ryukus)

Pre-supposing that your territory can meet these simple requirements, we can progress to a detailed examination of the fishery.

* By 'near off-shore' is meant your 'beyond the reef' area to a distance of say twenty miles and with depths attaining at least 500 fathoms, preferably 1500.

SECTION ONE: THE FISH

Dealing with these in the order of their likely predominant populations we have:

(1) Yellow-fin Tuna (Thunnus Albacore)

The market requirement for this species is limited to those fish extending from the near-adult phase to the fully-grown and sexually mature. That is, from a round weight of some 60/70 lb. (27-32 Kgs) at the lower end of the scale to the "gorillas", as they are known in the trade, of 240/280 lb. (109/127 Kgs).

Suitable sizes of fish within this range can be obtained by "selective fishing" (See Section 3 Fishing Methods).

As a rough guide any fish with a fork-length of less than 33 ins (84 cms) is probably too small. (Over the 42 ins mark considerable difference in weights between individual fish of similar lengths will begin to be noticeable).

Having determined the required sizes of the fish we must now take a detailed look at their habits, though it should be understood that these may differ in detail from area to area according to specific differences within the local environment.

Habits:

Yellowfin Tuna may be considered primarily as daylight predators who rely upon their keen sight plus an acoustic sense for the location of their prey. Their sense of 'smell or taste' seems limited and can only be considered a factor at very close prey/bait range. The fact that they are usually taken by sports-fisherman on optically stimulating moving lures is in general conformity with this statement.

"Trolling" techniques does not play a great part in this particular fishery under discussion for the following reasons.

- (a) It is usually economically unrealistic (see Section 3 Fishing Methods)
- (b) It often affects the quality of the fish's flesh - which factor is of considerable importance and requires amplification.

Yellowfin tuna that has been subjected to considerable 'flight' prior to boating often display, when butchered, a condition known as "burning", and which appears as tonal discoloration throughout the flesh usually extending outwards from the vertebra and in the valuable "shoulder" meat situated behind the head. Though this situation can be brought about by bad butchery immediately after death or through lack of good icing-down technique, its usual cause is due to a reaction within the fish itself prior to death and brought about by intense activity. Briefly, the Yellowfin's physical design allows it to be one of the fastest and certainly the quickest

accelerating fish in the ocean for its body

weight ratio. This powered 'take-off' demands that large quantities of arterial blood are supplied to its muscular tissues in order to activate such a response. To obtain such an 'instant energy injection' the Yellowfin makes use of a remarkable system of small arteries (scientifically referred to with good reason as the 'rette mirabile' (wonderful net), which pumps blood laterally through its muscles on demand. Normally, after a brief period of intense activity the diffused blood slowly works its way back to the main arterial system and normal circulation is resumed. If the fish is killed during a period of hyper-activity however, the blood-charged muscles retain the hot blood tunas are among the warmest-blooded of all fishes, a typical yellowfin's blood temperature being $1^{\circ} - 5^{\circ}\text{C}$ in excess of that of the surrounding sea. This activates certain chemical break-downs within the tissues and results in discoloration and deterioration in taste of the flesh.

Thus any form of fishing which allows the fish such hyper activity must be avoided. Normal trolling allows large Yellowfin ample opportunity for frenzied activity prior to boating and thus cannot be considered as being the most satisfactory method of fishing for this specific market which requires prime undamaged fish.

Since yellowfin tuna are primarily visually-stimulated day-feeders that part of the fishery which concerns itself with them becomes a day-time operation. However, the full-moon period can also result in good catches if other factors are present (see Section III, 'Fishing Methods').

(b) Swim-paths: In their pelagic journeyings, besides being 'oceanic rangers' Yellowfin also often become what may be termed "island-skirting" fish. Nearly every Pacific Island has a specific locality traditionally accepted as the 'hole' or 'rood' of the Yellowfin. Usually these places are in the entrance channels to large lagoons; tucked behind the 'horns' of an overlapping reef-systems; in the lee-eddy of some cape, cliff or reef-spur; or around the periphery of some off-shore submerged bank or shoal. Such areas seem to form necessary 'navigational check-points' for these fish and do not necessarily represent feeding-grounds but rather submarine markers along their oceanic water-ways. At such points the Yellow-fin

usually 'check-in' at specific depths (often, but not always, governed by specific water temperatures), with the larger fish travelling at a deeper level - and sometimes therefore further off-shore. Rather than a continuous stream of fish, these fish travel in 'pods' whose size, in numbers, is universally proportional to the size of the individual fish comprising it. A 'pod' of sixty-pound Y/F may number one hundred or more individual; of one hundred-and-eighty pounders, maybe ten; while the 'gorillas' usually travel in twos or three's or even singly.

Gaps between separate pods may vary, according to seasonal densities, from ten minutes to several hours - with an average intervening span of about forty-five minutes. Under good conditions such 'gaps' may seem almost non-existent, due to successive pods of fish being induced to remain in the vicinity through 'chumming' or other enticements. (see Section III 'Fishing Method').

However, since the fish are not normally feeding, they swim at a set level. If an appetising bait is literally dangled in front of their nose they will take it; if it is plainly in view but a mere 3 fathom above/below their passage-route level it will be ignored. Hence the key to the operation is the establishment of the precise swimming level of the successive waves of fish.

The table below represents typical Yellowfin swim-paths on island-skirting water-ways. Considerable seasonal or localised differences may occur and the list is meant as a illustration rather than a specific actuality.

<u>Size of Fish</u>	<u>Daytime Cruise-depth range</u>
40 - 70 lb.	18 - 40 fathoms (27 - 25°C)
70 - 140 lb.	30 - 70 (26 - 23°C)
140 - 200 lb.	50 - 100 (24 - 22°C)
200 plus	90 fathom + (22°C)

Note: The temperatures given are also of an illustrative nature only and do not necessarily represent exact depth correlations).

(c) Preferred baits:

Whilst the smaller sized Yellowfin may be induced to take cut or strip bait, whole bait is always preferable. Obviously the bait-fish size utilised will depend on the size of tuna being sought - chiefly due to the degree of hook concealment which varying sizes of bait provide varying sizes of hook. Wherever possible live baits should be offered. (see Section III 3: The Fishing Method).

(d) Behaviour when hooked:

Cruising Yellowfin tunas, other than the 150 lbs. plus sizes, usually take the bait gently and tentatively - thus they must be allowed to run freely at first. Once the hook is felt or the line-pull noticed Yellowfin will move off at an accelerating rate, diagonally downward towards a deeper level. When this movement has been arrested (see Section III: Fishing Method), the fish will first try to descend vertically and a characteristic "thump-thump", caused by tail-lash or pressure-wave will be transmitted up the line. On being hauled to the surface the fish will normally swim in slow circles, angled-downwards, so that a steady pull is felt on the line at all times. Usually, when raised above the level at which the fish was swimming when hooked, it will make a second major escape-bid diagonally downwards. When this has been arrested the fish will resume its circles which become slower - though of the same radius - for the remainder of the ascent. On reaching the surface and conscious of the proximity of the boat, the fish will become frightened and 'flurry'. This should be curtailed as quickly as possible and the fish brought to gaff without further hyper-activity. It is very important that a hooked fish is never allowed to escape. Once off the hook, the frightened fish will dive rapidly from whatever depth he is at the time of his escape, alarming all other fish over a wide area, and taking with him all members of his 'pod'.

(e) Relation with other tunas: Idealised Diurnal Movements.

As a general rule, Yellowfin congregate on the lee sides of the reefs or islands when engaged in their "island-skirting" activities. In such areas they may remain for hours or weeks at a time, depending upon such factors as their bodily condition, the presence or absence of adequate food, the proximity of their next 'stage', etc. In such lee-areas they are often found in close proximity to other tunas such as Skipjack and, to a lesser degree, Dog-Tooth. Smaller Yellowfin may mix with the Skipjack, with their larger brethren either at deeper levels directly below the Skipjack or, on shelving slope, further off-shore and again at deeper levels.

Idealised cruising-level patterns for Yellowfin Tuna and their relationship to smaller tunas are shown in Figures I and II.

2. Big-Eyed Tuna (Thunnus obesus)

The market requirement for this species is as for Yellowfin, with the exception that, due to their being considered a more valuable and sought-after fish, the lower weight limit may extend downward to 45-50 lbs. (20/23 Kg).

(a) Habits:

Big-Eyed Tunas are primarily night-feeding animals, highly sensitive to light, and which occupy in consequence deeper oceanic levels than Yellowfin Tuna during the day. Although they can be taken on a hook in the day-time it is difficult to induce these fish into a feeding pattern whilst the sun is up and also their deep cruise-levels (<150 fathoms) makes their location and the actual fishing for them relatively difficult. At night time, however, particularly during dark-of-the-moon periods or under overcast conditions, they rise to feed in the upper levels and will readily take a prepared bait. From an operational standpoint then, the fishing for Yellowfin may be taken as a day-time occupation and for Big Eye a night-time one.

(b) Physical Characteristics:

Rapid death releases less lactic acid into the bloodstream than in the case of Yellowfin, thus "burning" is less of a problem with hooked Big-Eyed. However, since the flesh is softer, greater care has to be exercised in handling the fish to preserve prime quality (see Section IV 'Markets'). The presence of a large air-bladder in Big-Eyed Tuna results in:

- (a) A better Sonar/Echo-Sounder target
- (b) A deeper, more egg-shaped body
- (c) "Blowing-up" (and stomach-up attitude) of the fish when forced near the surface
- (d) A slower cruise-speed (1-2 knots only).

(c) General Characteristics:

Big-Eyed Tuna live within the 13-25°C temperature band and will usually only feed when in water of 18°C - 23°C (optimum 21°C). Their spawning grounds are in the Center Equatorial Current (up to 11° N and S). Life span is 6 to 7 years and their food is mainly squid, mid-water prawns (really euphausiids) and young fish (carangoids). Their preferred bait is Opelu (Round herring), (Flying Fish), or Atule (Scad Mackerel).

(d) Feeding Time:

90% of the time these tunas will only feed at LW \pm 1 hour or HW-1 hour (i.e. not on the full ebb or flow and preferably at slack-water low tide). This characteristic persists even if the total rise/fall of tide is a mere 4 inches. As a general rule, large fish (over 120 lbs.) will feed on the low water slack, and small fish (less than 90lbs) will feed just before the top of the tide.

(e) Behaviour when Hooked:

On feeding the restriction imposed by any hook/line combination Big-Eyed Tuna sound vertically downwards, which habit distinguishes them from Yellowfin. When brought to a halt, like Yellowfin, they will emit a dull "thud-thud" tail or pressure-wave blow which can be readily felt. On being hauled in they are more sluggish than Yellowfin and their efforts to escape less determined. When within 5-10 fathoms of the surface their air-bladder is usually so inflated as to cause them to rise on their backs involuntarily to the surface.

SECTION TWO: THE MARKETS

The markets to which this particular fishery addresses itself is the Oriental Fresh-Raw-Fish market.

This is generally referred to as 'The Sashimi Trade' from the Japanese word for that product. Ideally, 'sashimi' consists of wafer-thin slices of fresh tuna meat taken from the following species:

- (a) Bluefin Tuna
- (b) Big-Eyed Tuna (sometime referred to as 'Tropical Blue-fin')
- (c) Yellowfin Tuna.

The 'top' (in quality and price) markets are within Japan itself, with lesser (but significant) demands and usually lower prices in the following localities.

- (a) Okinawa
- (b) Saipan/Guam
- (c) Honolulu
- (d) California

Sashimi is basically 'gourmet' food and, as such, the standards applied are extremely high. Unless this fact is borne in mind and the stringent demands of the buyers exactly met, then the fishery cannot be a success.

For a first-grade, carefully handled sashimi tuna extremely high prices are available at all times. These prices (as of late 1976) may alternate between a low U.S.\$3.75 per pound C.I.F. up to a 'high' of US\$11.00 to 12.00 per lb.

However, a second grade, casually handled sashimi tuna will often be sold for what are literally 'cannery prices', i.e. 30 cts per lb.

Always remember that, in the Sashimi trade, each fish is individually examined and individually auctioned. There are no 'lots', 'tonnes', 'skips' or 'baskets' of fish in this trade. Every fish which a fisherman or group of fishermen submit is considered to be representative of the individuals concerned, and every fisherman must be expected to stand by his fish.

If at any time you are a little bit doubtful as to the high quality of a sashimi fish, do not submit it for sale. Eat it, sell it to a cannery or give it to friends, but never market it. If it does turn out to be a 'Grade II Fish' your reputation (and therefore the price you command in the market) will suffer in future consignments.

Market Grading: The Sashimi market grades its products as follows:

1. The size and general appearance of each fish.
2. The colour of the meat and its uniformity
3. The 'fattiness' of the meat
4. The taste.

As a fisherman you are directly responsible for items (1) and (2) above. Item (3), the 'fattiness' of the fishes' flesh, is beyond your control however, being a product of tuna species, the characteristics (mainly thermal) of the waters in which it was caught, and the food on which it fed during its recent past life. Notice that item (4) the taste, comes at the end of the market requirements. This is due to the reason that, according to Japanese methodology, if items (1), (2) and (3) are top quality then the 'taste' must inevitably be so as well. In fact, at the judging prior to each auction, no 'taste test' is ever performed.

1. Categorisation of 'Sashimi tuna'

The desired characteristics of the fish are

1. Size: To give the maximum poundage of red meat as compared with overall weight. Note: sashimi tuna are submitted to the market whole round (i.e. with head and tail, but gutted and gilled).

Preferential sizes:

Big-Eyed Tuna: 140 lbs. plus

Yellowfin Tuna: 180 " "

2. Appearance: Absolutely NO gaff or knife wounds in body. Eyes intact. Head intact. Mouth not torn. Body unbruised, not discoloured or flattened on either side. No sub-cutaneous blood clots. Fins un-frayed. Uniform colour, (preferably leaden hued). Gills cut away cleanly. Cut open, with single straight cut from anus to pectoral junction. No intestinal residue remaining in gut cavity. No blood clots adhering to stomach walls or exposed vertebrae. No yellowish (bile) staining to abdominal cavity. Body straight, not distorted and with firm unwrinkled flesh. Body temperature approximately -2 to $+1^{\circ}\text{C}$.

The only allowable wounds or body cuts are:-

- (a) A small 'ice-pick' wound in top of skull caused by skewer or small-calibre bullet.
- (b) Small 'armpit' stab wound under either pectoral whereby fish has been bled. (See Section 4, Fish Handling and Preservation.)
- (c) Knife cut to provide blood drain and to expose tail-meat on either side of trunk between 4th and 5th finlet. (See Figure 3). In some cases, particular markets may require the tail to be completely severed at this point. If this is requested, always include the severed tail within the freight-package, as payment (at a similar rate to rest of fish) is made for this appendage.

2. Meat colour: Should be a uniform red, without local or centralised darkening. Uniformity of colour is obtained through correct bleeding and correct chilling. (See Section 4, Fish Handling and Preservation.)

3. Fattiness of Meat: This is usually ascertained by extracting scraps of the tail-stump meat between the fingers (see 1 (c) above) and establishing its oiliness and texture by rubbing these scraps between thumb and forefinger. A 'poor' fish will yield watery meat, easily shredded. A 'good fish' has solid meat which leaves an oily residue and characteristic 'tuna' smell upon the finger-tips. (An interesting point is that the 'right' to pick-up these 'test scraps' from the auction floor is subject to licence. The official licensee is permitted to sell these valuable 'test scraps' to restaurants. The practice says much for the cleanliness of Japanese 'sashimi auction' floors and the value of sashimi in general. A major auction may only yield a total of 5-10 lb. of shredded flesh-scrap per day).

General Market Consideration

1. A perfectly-presented iced - fish earned the highest price.
2. Due to incessant demands frozen fish (subsequently re-thawed) often nowadays from the bulk of sashimi auctions, but the iced fish always takes precedence in price.
3. Since the bulk freezing and re-thawing of sashimi fish is extremely expensive and exacting, it is not recommended as a Pacific Islands Method. Instead ice-brining of individual 'perfect' fish (destined for the top bracket of this selective market) should always be the goal.

Marketing Assistance:

Before dispatching 'sashimi' tuna to any of the described markets, it is necessary that preliminary contact be made with reliable dealers. Suggested initial Marketing 'contacts' include:

- (a) For the Japanese/Tokyo Fish Auctions:
Your nearest Japanese Trade Commissioner.
- (b) For Guam/Saipan markets:
The Chamber of Commerce at Agana and Saipan.
- (c) For the Honolulu market:
N.M.F.S. Honolulu or United Fishing Company at
Kewalo Basin Honolulu (attention Mr Frank Godo).

Preliminary enquiries should include the following information:

- (a) The species and weights of the tunas you wish to market.
- (b) The fact that these are for the 'Sashimi' trade.
- (c) Your method of preserving, handling and boxing the fish.
- (d) The frequency and volume of the proposed traffic in fish.
- (e) A request for specific handling or forwarding instructions from the dealer should his requirements differ from those you have outlined.
- (f) A request for a quotation and agreement on a trial-basis with 'freight costs forward' (i.e. payable at receivers' end).

If reputable dealers are approached in this fashion you will find they are most helpful and very efficient. They have to be, they are in a highly-competitive trade in which the available volume of produce never meets the demand.

Always follow their instructions precisely and, if these prove impossible to fulfil, explain why. Sashimi dealers are experts in fish-mongery and will go to great lengths to encourage and support embryonic suppliers, providing that these suppliers show themselves to be serious in their intentions.

NOTE ON MARKETS

Honolulu Often acts as a 'middle-man' forwarding agency for sashimi tunas - thus the prices offered may not be too attractive from this source unless Hawaii itself is in short supply. Bear this in mind if disappointing quotations are received from United Fishing Company.

SECTION THREE: THE FISHING METHOD

The gear and fishing methods described hereunder are the result of extensive commercial practice and success in this form of fishery. That is not to say that they cannot be improved upon, but that they work. Beginners in this fishery are strongly advised to go along with these recommendations and methods to begin with, until their own mounting experience under specific localised conditions results in natural improvements and modifications.

Basic Equipment Needed

(a) For the Yellowfin Day-Fishery

- (1) A boat Anywhere from 18-28 foot long. Should ride well to a sea anchor; be a stable fishing platform; have plenty of working space aft and space for a large fish box. (Note: providing they can accommodate the fish box, there is nothing to prevent a good outrigger canoe from being a satisfactory vessel for this work.)
- (2) The power Inboard or outboard. Petrol or diesel. Just as long as it takes the vessel 'there-and-back' with reliability.
- (3) Electronics Ideally, a high-powered (300-600 watt transceiver output). Fish-finder having a 28-50 khz transceiver emission and fitted with STC and variable pulse-length controls. Such a unit (e.g. JMF type 2001 or 1502, approximately \$800.00 ex Japan) may be beyond many fishermen for a start. It should be emphasised that such sophisticated equipment is NOT essential, particularly if there already exists local knowledge as to where the deep-swing tunas are to be found. However, the correct usage of a powerful Fish-Finder will certainly result in greatly increased catches and far less time spent on 'hit-and-miss' drops.
- (4) Fish box This should be a well-insulated, strongly constructed container at least 5'6" long, 2'6" wide and 2'6" high (or built to your own measurements) capable of holding 4 x 180 lb. (82 kgs) fish. Should have drain holes in the bottom or in the side-walls just above floor level. One inch high 'feet' or runners (to aid drainage) are advantageous. Lids should be insulated and made in sections to allow for partial opening. A knife rack fitted along either end or side is useful as are lashing-points. An hypothetical idealised Fish box is shown in Figure 4. Should the boats' design allow sampan-style 'beneath-the-deck' insulated fish boxes of adequate size, this is even better.

(5) Ancilliary deck-gear:

- (a) 2 Tail-ropes, eye splice in each end, of at least $\frac{1}{4}$ dia. synthetic rope. Overall length 6-8 feet.
 - (b) 2 'Meat Hooks' - see Figure 4
 - (c) 2 'Killer-Gaffs' -" " 4
 - (d) 1 Makeshift or Army-simples canvas folding-stretcher
 - (e) 1 Spinal Probe - see Figure
 - (f) 2 Long-bladed (8"), slim knives
 - (g) 2 Heavy-bladed (6") knives
 - (h) 1 Small Ice-bucket or Igloo-container for bait
 - (i) 1 Dip-net
- b) Adequate cleats, lashing rings or points, all around after-deck and positioned so as to leave capping-rails, side decks and transom surface completely clear.

c) For the Big Eye Tuna Night-Fishery:

As for Yellowfin, but additionally.

- 1. Battery to provide deck and overboard illumination.
- 2. 2 Hand Flashlight
- 3. Flashlights with adjustable spotlight on headband, belt-mounted battery, and switch. (approx. \$4.50 ex-Japan).

d) For Bait-Fishing for both methods:

- 1. 2 sets Squid Jigging Gear
- 2. 2 sets Akule/Opelu Gear (see Ron Powell "Akule Fishing in the Hawaiian Islands. SPC Fish. Bulletin").

Specific Tuna Fishing Rigs.

- a) 1 or 2 Bow lines - (see Fig. 5) each made up of:

100 fathoms black Nylon or Kuralon (mm) line
 1 x 6 lbs. Colombia River lead
 1 x 4 lb. " " "
 6 x Brass Heavy Duty 9 mm Swivels Type 5642

- 6 x Swordfish Snaps with 8/0 swivel to fit down-line.
- 6 x 3 fathom leader-lengths of 300 lb. monofilament.
- 6 x Size 3 Mustad Circle Hooks Model. (or 3 sizes 3, and 3 size 5)
- 18 x A14 Lead sleeves to swage leaders
- 20 fathoms Buoy line
- 2 x 1 gallons Plastic bottle-floats (chlora or similar) with 3 ft strop terminating in a swordfish snap.
- 1 x Plastic or Glass Longline float.

6. 4 or more Down Lines: (See Fig. 5)

each made up of:

- 60-100 fathoms black-dyed size 125C braided Nylon line.
- 30 fathoms (size 100) Super Toto handline.

- 1 x 2 lb. 'Banana Lead' (see Figure)
- 1 x 4 lb. " " " "
- 1 x 9 mm Heavy Duty Brass Swivel Type 5642
- either { 2 x 7 mm " " " " with Corkscrew
- (2 x Swordfish Snaps + 6/0 swivels (to fit Super Toto)
- 3 x No 3 or No 5 Mustad Circle Hooks Type.
- either { 3 x 3 fathom lengths 240/300 lb. monofilament
- (3 x 3 fathom " braided 160 lb. monofilament (3 strand)
- 2 x 1 gall plastic-bottle floats (e.g. Chlorox bottles) with 3 ft rope strop and line snap on end.

Note: In the above, if your fish are of the 100-lb (45 kg) size or less use:

- No 5 Hooks
- Braided 160 lbs. leaders
- 7 m/m corkscrew swivels
- 2 lb 'Banana lead' (unless wind/current is very strong)

(see inset detail in Figure 5).

7. Fishing Locality:

This will depend upon local knowledge and conditions, but will usually be in those areas already designated. If there is any choice in the matter the lee or calmer area is always preferable as regards the fishing operation.

Additional factors which encourage Yellowfin and Big Eye to remain within a specific locality:

- (a) Local upwellings
- (b) Presence of squid or heavy 'Deep Scattering Layer' (DSL) concentration.
- (c) At night, preferable localities can often be identified visually through their high degree of sub-surface bio-luminescence. This gives the appearance, when viewed from the surface, similar to the 'Milky Way' as seen from Earth, with added flashes and 'shooting star' effects, as predators swim in/out of the layer causing the organisms comprising it to react accordingly.

8. The Fishing Method: is based on presenting an acceptable bait at the exact swimming level of the tunas sought. The bait must not be streaming through the water due to surface drift of the vessel - this is the single most important fact governing the whole operation. Consequently, the boat must be held stationary relative to the water-mass so that the line is always "up-and-down". In conditions of surface wind-or-current effect this can be achieved.

- (a) By 'backing-up' (under engine or paddle) the vessel so that the current/wind effect is nullified.
- (b) By using a deep-lying 'sea-anchor' to hold the vessel stationary relative to the sea (this can be achieved through correct use of one or more Bow-lines, see Figure 6).
- (c) By 'streaming-off' a reef, cliff or other solid mooring-point so that the wind holds the vessel over the required depth.

Note:

Since, in the tropics, the wind usually attains its lowest velocities during the night, night fishing for Big Eye Tuna is less prone to this difficulty of surface drift than daytime Yellowfin fishing.

The Bait:

For tunas under 70 lb. (3 kgs) 'cut' bait is acceptable whilst they will accept strip-skipjack; round herring (opelu), flying fish or scad mackerel (atule) is always preferable. Strip bait should only be used on No. 5 Hooks and should consist of whole fillets or fillets diagonally sectioned.

For large tunas whole baits are essential. In order of preference these are:

- | | |
|--------------------------------|--|
| (a) <u>Live Bait</u> (1) Opelu | (difficult to keep alive either in bait well or on hook) |
| (2) Atule | (a strong bait, eminently suitable) |

- (b) Dead Bait
- (1) Fresh squid
 - (2) Fresh opelu
 - (3) Fresh flying fish
 - (4) Fresh atule
 - (5) Frozen squid
 - (6) Frozen opelu
 - (7) Frozen flying fish
 - (8) Frozen atule.

Correct placing of the baits on the hooks is most important.

In general with live bait, the hook must pass through the fish from side to side at the 'shoulder' between the spine and the first dorsal fin section. With dead bait the positioning is the same but deeper, with the hook point first entering the body just behind the pectoral/body junction. Squid provide a special case. Here the hook first penetrates the mantle, then the thorax (or throat), and finally the head, from which the point emerges. In this way the three main sections of the animal are 'skewed' together and the squid does not come apart on the hook. Because of the incurving shape of the Mustad Circle Hooks some difficulty may be experienced at first in correctly positioning the hook. By following exactly the following steps this difficulty should be overcome.

Placing the Hook in the Bait:

1. Hold bait-fish flat on left palm, head towards finger tips with anus pointing to left.
2. Take Circle Hook in right hand with shank and point towards the fingertips and with hook point pointing to left.
3. Lay hook flat on top of bait with point over desired entry point at pectoral/body junction.
4. Press hook point into bait by rotating hook shank away from you and pressing downwards.
5. When hook point has just penetrated flesh continue turning hook shank to left so that line of hook shank is now at right angles to axis of fish with point to left and curve of hook extending up around the fish's back.
6. Press point through with a rotary upward movement of the wrist so that steel of hook follows clearly through without tearing or distorting fish. The final result should have the fish 'hanging in balance', skewered by the hook from side-to-side, between the vertebrae and the dorsal arch.

Streaming the Gear: Daytime Yellowfin Fishery

First Step: On arrival at the selected spot, unless it is totally calm, the bow down-line is streamed first, with each baited 3-fathom leader tossed out at right angles up-wind of the boat. On reaching the down-line bow-line junction a 1-gallon plastic float is snapped on with two others following at 3 to 5 fathom intervals before the main longline-type buoy is attached. The idea of having the smaller buoys set first is that the total system becomes a spring where resistance increases proportionally to the downwards pull exerted upon it. If the down-line terminates initially in a long-line float, the resistance offered is immediately too great and often the hook will get torn from the tuna's mouth before the bait (and therefore hook) is properly engulfed.

Once all the down-line has been paid out, let go anywhere from 20 - 40 fathoms of bow line, in order to give the maximum 'sea anchor' effect and also to make sure that the bow down-line has sufficient clearance from the remaining lines and will not tangle with them.

Note: The bow down-line should only be used:

- (a) To establish the depth range of the tunas
- (b) If the wind effect is sufficient to blow the vessel 'off-station'.

If the wind-effect is very strong, the two bow-lines should be streamed (see Figure 6).

Second Step:

When the vessel has steadied down under the braking-effect of the bow down-line(s) the stern-line is set.

This is done in the same manner, but with the bottom (deepest) hook set for likely tuna depth + 10 fathoms - which will mean that the centre hook is at the most likely depth and the top hook at 10 fathoms above it. When this line depth has been achieved a simple onehand loop is made in the line and a plastic bottle float snapped on to it. Two more small floats follow at 5-fathom intervals.

Line is then paid out and the buoyed line allowed to drift away from the upwind stern quarter of the vessel. At first the line will move forward towards the bow-line float but, as the line diag increases, the stern of the boat will be pulled to windward until the vessel assumes a position about 45° off the wind, (see Figure 6). Like this, both bow-buoys and stern line will be well clear of the vessel to windward.

Third Step:

Set vessel down-lines (bow and stern). The hook depth of these should be staggered to give 5-fathom intervals (see Figure 7) and should hang over the windward side of the vessel.

Fourth Step:

Securing of inboard lines. All lines other than the bow-down-line should only be secured to appropriate inboard cleats by means of strong rubber bands or bread-thread. (For tunas up to 70 lb. 30 lbs. thread should be used, for bigger tunas use 70-100 lbs thread), the remainder of each line should be coiled down in boxes adjacent to the rubber band attachment so that, on 'pull-off' the lines can run out without restriction or snagging. The final line end at the bottom of the coil is made fast to a strongpoint. (An illustration of a hypothetical vessel with all four lines 'down' is shown in Figure 7).

Chumming: An essential part of the system is a periodic release of 'chum' or 'ground bait' at or slightly above, the level at which the tunas are suspected to operate.

For construction and operation of a chum-bag see Powell "Opelu Hoop Net Fishing in the Hawaiian Islands".

In order to open the chum-bag at the required level, measure off the required distance in fathom or meters from the bag and tie the chum-line to a cleat at this point. Thereafter, whenever required, the chum-bag can be dropped over the side and will release itself automatically at the required depth.

Type of Chum: Ground or finely chopped fish of any description (fresh or frozen) including Marlin or toxic (ciguatera-prone) reef fish. The addition of any sand or reef crabs, shrimp or other crustacea help to give the chum 'body'. Chopped fresh skipjack and other very bloody fishes should be avoided if there are sharks in the vicinity.

Timing of Chumming:

Chumming should follow the following pattern

1. On setting-up lines: 1 or 2 bags
2. At low-water or high-water period: every 10 minutes
3. Once tunas are hooked: continuously, in order to hold the school or pod.
4. Other times Every 30 minutes.

Procedure on Hooking a Tuna:

1. On Bow-down-line:

- (a) The initial indication of a hook-up will be a sudden jerk in the bow-line which will swing the bow towards the bow-line buoy (i.e. into wind). Thereafter, the bow-line floats will be seen to bob up and down or disappear completely under the surface.

When this occurs sit still and wait. What will probably happen is that some of the accompanying pod, circling their hooked pod-mate, will come across the baits of your other lines. If this is going to happen, and as long as 'pod' is high enough to be on the same level as your other baits, further hook-ups will occur within five minutes.

- (b) After five minutes, if nothing else happens, bring in your other lines and coil them down. (The elastic bands can be left where they are to facilitate setting the lines later.)
- (c) Pull up to the bow down-line and pull it in. As each leader is reached, unsnap it from the mainline and stow separately (if the hooked fish takes a run, then your mainline can run free without the danger of hooks flying all over the boat).
- (d) When the fish is visible and with the leader in hand, lead the line back to the cockpit and fight the fish from there. If the fish runs, allow it to do so but snap on a succession of plastic bottle floats as the fish takes off. The braking effect of these will very rapidly bring the fish to an exhausted halt when it can be easily pulled back up to the surface. (Note: if your 'tunas' turn out to be an unwanted shark, do not waste time fighting the animal. Simply pull in until you have the leader in hand and cut it loose. Then replace with a freshly baited new leaser and hook.)
- (e) Boating and butchering the fish are fully described in Section Four.

2. Dealing with a Hook-up on the Side Down-Lines:

- (a) First indication will be a successive stretching of the cleat-fastened rubber band which you may or may not see. After one or two seconds there will be a more violent tug and the band (or twine) will snap. This you should hear (if preferred you can attach a small

brass bell to the cleat and wind the band (or thread) about it. When the band or thread breaks the bell will tinkle). This will be followed by the coil of line in the box rapidly disappearing over the side. Allow this line to run out freely for at least 20-30 fathoms before

- (a) Breaking it by hand (use gloves)
 - (b) Snapping on bottle-floats.
- (b) When the first run has been arrested you will feel a typical 'thick thud' on the line. At this point,
- (i) Throw the chum-bag over the side
 - (ii) Throw out handfuls of chum all around the boat.
- You then:
- (c) Clip on another bottle-float onto the remaining line and allow it to drift away, upward of the boat for about 10-15 fathoms. This will keep it clear of the line which has the fish on.
 - (d) Bring up the hooked fish steadily and slowly. Throw out more chum at intervals. If things go well, when your fish is near the level at which it was hooked then one or other of your remaining lines will "go-off", as other 'pod-members' accompanying your hooked fish pass within visibility distance of your other baits. Remember: the 'hook-up' of your original fish will have put the remainder of the pod into an excited 'food-conscious' state, in which they will readily feed. The hardest thing is to hook and hold your first tuna in any one pod. With one fish on the line your chances of taking others are significantly improved.
 - (e) When a second line 'goes-off' allow this new hook-up to run free as did the first. If you have a two-crew vessel, handling a second hook-up is easy. With one man it becomes a more difficult but perfectly possible operation providing the system is adhered to.
 - (f) If the top hooks of the lines are free of fish, unsnap them as soon as the leader/mainline junction comes to hand, and coil them down out of the way before bringing in any more line. If, on finding a fish on one of the top lines, more fish are felt further down on the same line, unsnap the uppermost one and lead it back around the transom to the other side of the vessel where the leader should be made fast, by means of the snap, to a ring-bolt or strap. Then this top fish will remain a fathom or so below the surface on the lee side of the boat and out of the way, while you bring up the remaining fish.
 - (g) If, in spite of all your precautions the separate down-lines do tangle due to the circling movements of the hooked tuna, do not try to untangle them. Simply pull them all in together - after all, you have fish, which is the whole purpose of the operation. Laid out on deck the mess of lines will be seemingly impossible to unravel. Do not try to do so on board. Simply bundle them into a corner, set your reserve lines and wait till you get ashore where the tangled mess can be stretched out and the other people can assist you with it.

- (h) When using live bait, you will find that you can only utilise one live fish per line and that one always on the bottom hook. If live bait is used on other mid-line hooks, no matter how free your swivels are eventually the fish will wrap itself around the mainline and foul the whole set.

Night Fishing for Big-Eye Tuna

Prevalence of these fish: In most areas of the Tropical Pacific the Big Eye is considered by in-shore fishermen a relatively rare or unknown fish. This is due to the fact that, during the daytime, the animal is normally too deep to be caught by small boat fishing methods and that not many boats fish close off-shore at night. In actual fact, off many Pacific islands the population of Big-Eye Tuna is greater than Yellowfin. The fact that local fishermen have not caught Big Eye up to the present may merely be due to the fact that they have not been using the right technique.

Areas Likely to Yield Big Eye Tuna:

Those areas that harbour Yellowfin by day often have Big Eye by night. If Yellowfin are seen 'breezing' in the late afternoon that same locality should yield Big Eye after dark. Additionally, any area that gives off the characteristics 'flashes' of squid at night will provide good Big Eye fishing grounds.

Advantage of Fishing for Big Eye:

1. These tunas are 'fatter' than Yellowfin and get much better market prices (minimum price differential + 50 cts per lb).
2. These tunas are far easier to subdue when hooked. Their habit of always diving straight down makes it unlikely that they will tangle other lines.
3. Fishing in the cool of night means less expenditure of ice, calmer seas and more room to manoeuvre in the absence of other boats.

Additional Essential Equipment:

The following items of gear are absolutely necessary for this fishery, in addition to all other gear common to both Yellowfin and Big Eye fishing:

- (1) A 'cap-light' for each fisherman
- (2) 2 Electric hand torches
- (3) Adequate inboard (cockpit) illumination (switchable on/off).

The Fishing Method:

Is exactly the same as laid down for Yellowfin with the following exceptions:

- (1) Locality Choice: Fish in the area having the most sub-surface bio-lumescence.
- (2) Illumination: Once the lines are set, absolute darkness on board is imperative until the fish strike. Once the action starts you can switch on all lights and make as much noise as you wish. Remember that Big Eye are shy creatures - both noise and light drive them away until they start feeding.

- (3) Resting: There is nothing to prevent the crew from sleeping while the boat is adrift providing:
- (a) The drift is safe and not onto a reef.
 - (b) Bells are rigged to the break-away threads or elastic bands.
 - (c) Baits are periodically checked to see that small night predators (i.e. barracuda) have not stolen them. Ideally, baits and lines should be checked every half hour at or near high and low water and at hourly intervals otherwise. Routine 'chumming' should take place whenever baits are checked.

SECTION FOUR : FISH PRESERVATION AND HANDLING

The process of fish preservation and handling begins whilst the fish is still in the water alongside the boat.

The following steps should be carried out in the order given:

1. Bring fish close alongside as quietly as possible. If the fish is making a great fuss - as often happens in the case of Yellowfin - it must be subdued as quickly and as efficiently as possible. Try any of the following:
 - (a) With fish on a "short-leash" (take an "Australian-wrap" about the monofilament leader with the left hand not less than 6 feet away from the hook), pull the fish's head towards you and slightly upward so that the cranium of the fish is out of the water or just awash and the snout is towards the boat. With the right hand shoot the fish diagonally downwards through the top of the head with a .22 pistol so that the slug emerges at the lower gill-vent (See Fig.3).
 - (b) As above, but without a pistol. Raise the tuna's head a little further so that either gill-plate is partially exposed. With a short baseball-bat, fish-club or truncheon hit the fish one really heavy blow flat on the gill-plate. Do not hit the snout, eye or skull.
2. Draw the inert fish towards the boat raising its snout well above the water. In this position the mouth will gape.
3. Insert a tuna "meat-hook" or strong, sharp butcher's hook (with at least a 6 inch gap between point and shank) into the slot presented by the mouth, then turn hook through 90° so that the point now rests against the inside of the upper palate. Make sure ring-end of hook is connected by means of a strong painter of about 10ft to a suitable cleat inboard.
4. Jerk hook upwards lodging point firmly into upper jaw. If pressed home, point should lodge within either nostril.
5. With fish secure, relax tension on leader and pull fish alongside and up, so that whole head is clear of water, by means of "meat-hook". Shorten meat-hook rope so that fish weight is supported by cleat.
6. With a long, thin knife (having a very narrow blade of at least 8 inches in length) in one hand, reach down along fish's body and grasp either pectoral fin with the other hand. Pull pectoral - tip out and away from the body at right angles. Feel for "armpit" aperture at the base of pectoral and insert point of knife into this hollow, making sure blade is at right-angles to body in both planes (see Figure 3). Press home knife smoothly. When knife-tip penetrates the tuna's heart a great gout of blood will usually be voided through the mouth or gill vents. (Note: If aggressive sharks are present, this step can be done after the fish has been boated).

This thrust to the heart will often stimulate the tuna into a brief flurry. With the head out of water and the meat-hook securely lodged and on a short-leash no harm will ensue and the brief activity will merely assist in full "bleeding" of the animal.

7. When the tuna is quietescent again, bring the fish into the boat. Do this very gently and avoid bruising the flesh by simply pulling it up and over the gunnel. If two fishermen are present, put on a tail-rope and hoist the body up and inboard clearing the gunnel completely.
8. Lay the fish gently on its side on deck - preferably on a canvas (army-surplus) stretcher. With a knife, make a deep incision right to the vertebrae on the flanks between the fourth and fifth finlet from the tail (see Figure 3). Some slow bleeding may result.
9. Take the spinal probe (see Figure 4) and with one hand bend-up the nearly-severed tail to expose the lower section of the vertebra (see Figure 3A). Insert the tip of the 3-foot probe in the exposed spinal canal and push it up and along this opening until it is judged that the probe's point has reached the animal's head section. (Note: this action will cause the fish to quiver and flap in reflex activity.) Withdraw the probe slowly and wait for a clear jelly-like fluid to flow out of the pierced canal. (Note: some sashimi buyers do not require this "spinal probe" portion of the butchery.)
10. With a short, sharp knife make a dead-straight slit from anus to a point midway between the pectoral junction, thus exposing the intestinal and vital organs cavity. Use the knife tip only and do not rip into intestine, merely cutting through the abdominal wall. Run the blade of the knife round the inside of the anal sphincter, neatly severing the junction of intestine and sphincter. Do not remove guts or organs at this stage. This procedure is mainly to allow the cooling ice-mix to circulate in the abdominal cavity for rapid cooling.
11. Pick up the fish gently and evenly and lower it into the iced-brine tank which should be standing ready-cooled and filled to one third of its depth with a seawater/fresh ice slush mix of anywhere from 28 - 32° F (-2 to 0°C). Allow fish to lie out straight on its side in the slush. Make sure slush covers top flank.
12. If the weather is rough and the box very big some movement of the tuna within the brine-tank may result, which could damage the nose and tail of the fish through repeated contact with the end walls of the box. Under these conditions it is wise to insert the fish into an already wet-chilled empty sack, nose first, before placing the tuna in the tank. The sack will act as a "brake" on the fish's movement and also as a cushion.
13. Once in the slush-ice the fish should be left alone. Do not turn it over any more unless it is absolutely necessary. Additional fish should be added nose-to-tail. If several layers of tunas result, make sure the top ones are covered with slush-ice (add flake-ice and clean sea-water as necessary), and the larger fish are at the bottom.

14. If the sea is rough and choppy on the return to port do not drive the boat so that it slams or pounds. The condition of your fish is far more important than an hour's extra travelling time, so reduce speed to give the most comfortable ride.

Fish-handling after arrival in port

If possible leave the fish in the brine-box undisturbed till you are ready to store or pack them for shipment. Make sure the slush-ice condition is maintained within the box and that the bottom-most fish are not being crushed. When ready to store or pack fish remove them from the box in the cool of the evening or take the whole box into the cool-room where you propose to work on them. Lift fish out individually and carefully. If you have to carry them even a little way use a stretcher. Whichever flank was down in the brine, keep the same side down on the stretcher.

Storing sashimi tuna prior to shipping-out

More than likely you may have to stock-pile your fish for a few days before dispatching them. Storage must be in a chill-room not a freezer. Minimum temperature should be a bare 32°F (0°C), preferably 34° - 36°F (+1° to +3°C). The fish should be hung on overhead rails by means of a short tail-rope noosed around the caudal peduncle. When the fish are first hung, sponge each one down with clean chilled sea-water to remove slime. Sponge fish daily or spray lightly with a hose. In this way the fish will not dehydrate and their skins will remain glossy and without cracks or wrinkles. The maximum time the fish should be hung prior to shipment is three to four days. If a period of four to six days is necessary then the fish must be kept in iced brine within the chill-room.

Final cleaning of the fish

Once securely hung, the fish can be prepared for packing. Clean and cut as follows:

1. With a sharp knife cut away membrane holding gills to rear walls of mouth.
2. Loosen guts and organs within abdominal cavity by easing free through belly-slit.
3. With a sharp pointed knife make a circular cut around gullet/windpipe passage. Wrench free (from mouth) gills, gullet, organs and intestines. These should all pull away easily if properly done.
4. Wash out abdominal cavity and inside of head removing blood clot which may form around gullet cavity.
5. Trim off pectorals, upper and lower lobes of tail according to buyers' instructions. (Different markets have different requirements in this respect.)

SECTION FIVE : PACKAGING AND TRANSPORTATION

The only shipping method possible for chilled sashimi tunas is by air. Therefore the packaging must be done in compliance with International Air Freight Regulations. There are a number of lightweight, collapsible chilled-goods containers on the market especially made to comply with air-line regulations. Most of them consist of various sized sheets of glazed or waxed, preformed, pre-cut paperboard. These sheets, when folded and erected according to the manufacturers instructions, form secure containers into which whole single tunas can be consigned with confidence. Typical international manufacturers of such collapsible boxes are:

'WETLOCK' Ltd.

'International Box Co.'

etc.

Your local Chamber of Commerce or Trade Commissioner will advise as to your nearest supplier.

Such boxes are usually supplied in 'lots' of 100,500 or 1,000 sheets, with each sheet making up into one box. Typical sheet sizes for representative tunas might be 7 ft x 6 ft (for the larger fish) and maybe 5 ft x 4 ft (for smaller ones). Your local supplier or the manufacturers themselves will be pleased to advise you as to the precise specification of the boxes you require once you have furnished them with the details of the fish you intend to air-freight (i.e. average fish weight, length and girth). Prices for such boxes (landed cost) would be of the probable order of \$US3-4 per box for most Pacific Islands.

Most sashimi tuna dealers will allow you to trim the lobes of the tail right back in order to allow the fish to fit in the box and some agree to severing the tail completely at the point where you blood-drained and spine-probed it.

Internal Padding: In order to prevent the tuna from rolling around within the box some sort of padding or stuffing is necessary.

This can vary from simple wads of rolled up newspaper or even coir-husks to sophisticated foam-moulds or shredded foam. All packaging materials, including the boxes themselves, should be stored within the cool-room for at least 48 hours prior to use, so that they take on a low temperature and themselves act as a partial insulating agent against the ambient temperature.

Packing the tunas:

1. Erect as many collapsible boxes as you require on pallettes in the chill-room adjacent to the hanging tunas. Make ready padding material, your box-strapping gear, a stapling machine, some label tags and a 'magic maker' waterproof pen. Position your weigh-scale at a convenient point near the hanging-rack.
2. Place as much bottom padding as you think necessary within each box.
3. Using heavy-gauge large size plastic garbage bags, or using pre-cut lenth of soft vinyl tubing (obtainable from abattoir or butchery suppliers overseas) pull the bag or tube up over the hanging tunas nose and draw or roll it on as far as the root of the tail. Grasp the tuna as you would a shoulder of beef or a sack of flour and lift it up off the hook (the plastic bag will prevent you getting all slimey and will afford a good grip).

4. Lay bag-wrapped tuna gently down on scale. Weigh it. Record weight on two label-tags, also date and name of fisherman. Use waterproof felt marker-pen. Staple one label to plastic bag or protruding tail. Staple the other in your record book.
5. Lift tuna gently off weigh-scale and place in prepared box. Fill remainder of box with packing. Strap-up box, preferably using plastic-strapping and clips specified by box manufacturers. Label box clearly with marker-pen, including Flight Number if known. On either end of box write "Net fish weight" and "Gross weight" also box number within consignment, e.g. :

"97 kilos net 101 kilos gross
Box No.3 of 15".
6. When all boxes are packed and labelled store on palettes near loading door of chill-room

Air Transportation

Convenience and Cost : Ideally, the best method is by "renting" an entire "chilled goods container" - usually referred to as our LC1 or LC2 - from the airline concerned. These containers are tailored to fit into the special cargo-holds that all big international jet aircraft (such as 747s, DC 10s etc.) provide. The containers have full-width roller-type access doors, can be fitted with internal shelving to suit customers box requirements and carry up to one ton of freight per container. The containers are separate from the aircraft and fit onto trolley-platforms for easy ground-handling. If your airport has a chill-room you will find the access doors are tailored to permit easy "roll-in", "roll-out" of these containers. Shipping by container is simple, efficient and usually cheaper than normal air-freight rates. Even if one only has say 8 tuna weighing some 650 kgs. gross, it will often pay to "hire" a whole container rather than send the boxes separately.

With regard to cost the following representative rates for chilled fish applied as of December 1976.

Fiji	-	Hawaii	46 cts. per kg.
Fiji	-	U.S. West Coast	73 cts. per kg.
Fiji	-	Tokyo	\$1.79 cts. per kg.

(Note: The rates quoted are for "casual" and intermittent roads. Regular consignments or "container" shipments are considerably cheaper.)

Service frequencies vary between twice a week to daily. Where trans-shipment of the cargo must be made at an intermediate airport, JAL provide excellent cargo-handling services as do Qantas.

Finally, when shipment has been made always cable or telex your buyer giving Flight and Airway Bill Number. This additional minor cost will ensure that your sashimi tuna will be collected from the airport of destination with the minimum of delay and will arrive on the auction floor in prime condition.

Representative Storage, Freight and Handling Costs

If possible try and get your buyer to accept the consignment 'freight-forward'. Most established fish-brokers will do this.

The following approximate break-down should give you your total costs on top of the fishing-operation itself.

(a) Cold Storage awaiting shipment	
1 ct per lb of fish per day	
Say 3 days maximum	= 3cts per lb.
(b) Box and packaging materials	
Say \$5.00 per 200 lb. fish	= 4 cts per lb.
(c) Transport to airfield	
Say 10 miles with 1000 lb. load	
at \$1.00 per mile	= 1 ct per lb.
(d) Cables and Correspondence	= 1 ct per lb.
Total..	...= <u>9 cts per lb.</u>

Appendix
Suppliers of Suitable Equipment and
Fishing Gear.

1. Fish-finders: JMC (Japan Marina Co)
Kogyo Bldg.
1-20-13 Jinnan
Shibuya-Ku
Tokyo 150 Japan

- make a series of excellent, low- priced reliable commercial fish-finders for small vessels. All their equipment is characteris- tical by having very high transducer output and therefore sensitivity.

2. Commercial Fishing Gear in General:

Yamaji Fishing Net Co
P O Box 24
Toyohashi City
Aichi pref.
Japan.

▼ supply commercial fishing gear of all description at very reasonable prices.

Examples -

Nylon Monofilament	1000 metres	No 24 (320 lb test)	= \$24.16
"	"	1000 " No 19 (180 lb test)	= 13.59
		1000 " No 15 (100 lb test)	= 7.19
Heavy Corkscrew Swivels	10 m/m		25 cts ea.
Fishermens Nylon Gloves	Large Size	per doz.	\$2.48
Super Toto handline	Size 100 (240 lb test)	per 100 meter	- \$9.13
Cap Lights	- various.	approx.	\$5.00 each

- price lists available on request. .

An excellent Company for supplying bulk order.

Tuna Hooks: Use MUSTAD CIRCLE HOOKS

Qual 39960T

Sizes 3

price

Size 5

- these hooks are superior to any other for this fishery. Hook-points are needle-sharp, readily and although the hook will bend and distort it never breaks as do all others in this class.

Braided Line: Use the following:

- (1) For bottom section of line:

either Super-Toto (size 100 or 120) (see Yamaji Fish Net Co)
or Sunset Neptune size 400 (315 lbs test) 70 fathoms=\$5.95
obtainable from -

Kolstrand Supply Co.

4714 Ballard Avenue NW

Seattle Washington 98107

U.S.A.

2. For upper section of line

Nylon Braid Type 125C-320 kg. per 100 metres = \$6.00

from Donaghys

Dunedin

New Zealand.

Bells: Brass Trolling Pole

price 0.90 cts each.

obtainable from Kolstrand Supply Co.

Swordfish or Halibut Line Snaps

with 8/0 swivels

price approx. 0.70 cts ea.

(send sample of your line for matching snap size)

obtainable from - Kolstrand Supply Co.

YELLOWFIN and SKIPJACK TUNAS. DIURNAL BEHAVIOUR PATTERNS.

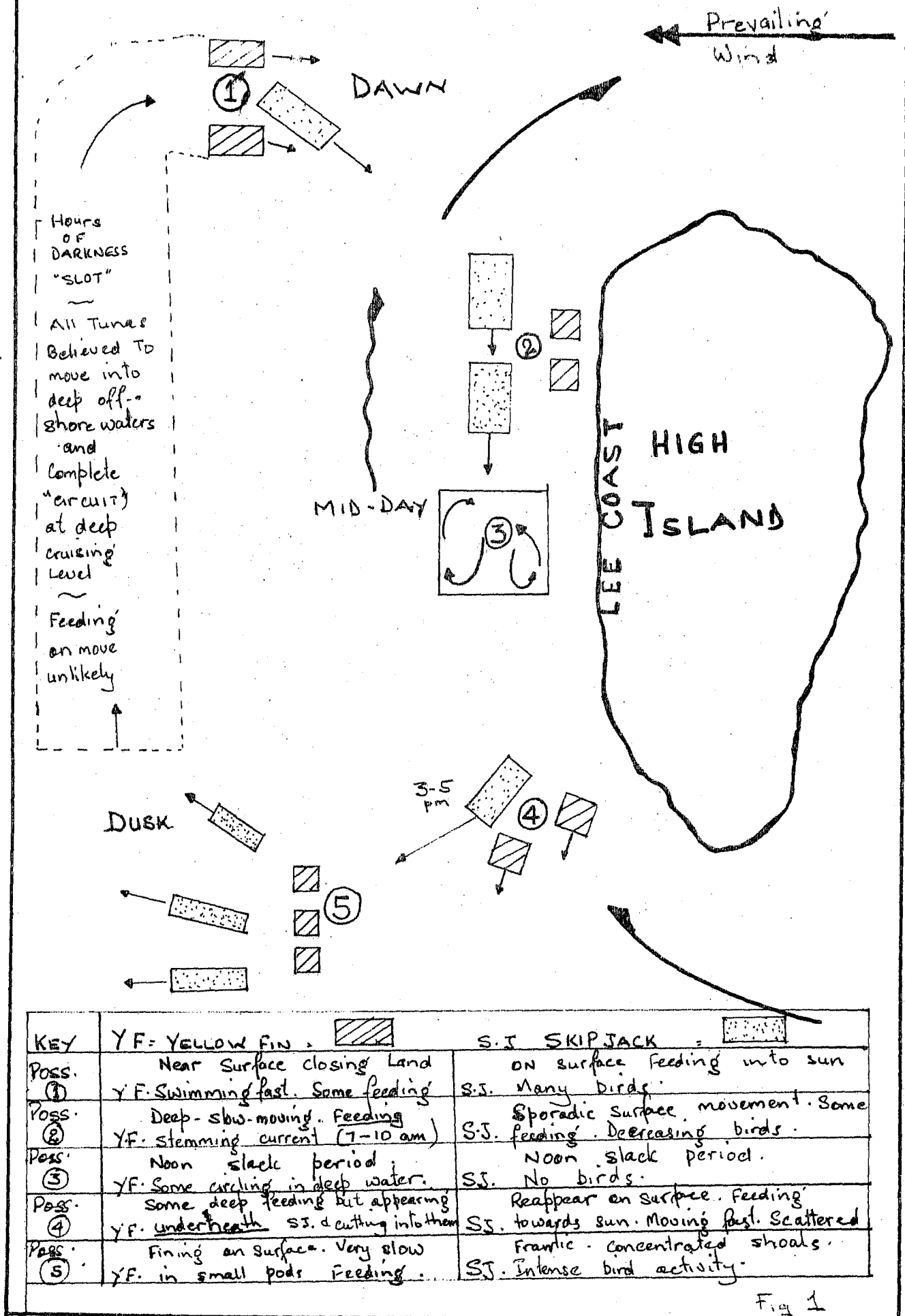


Fig 1

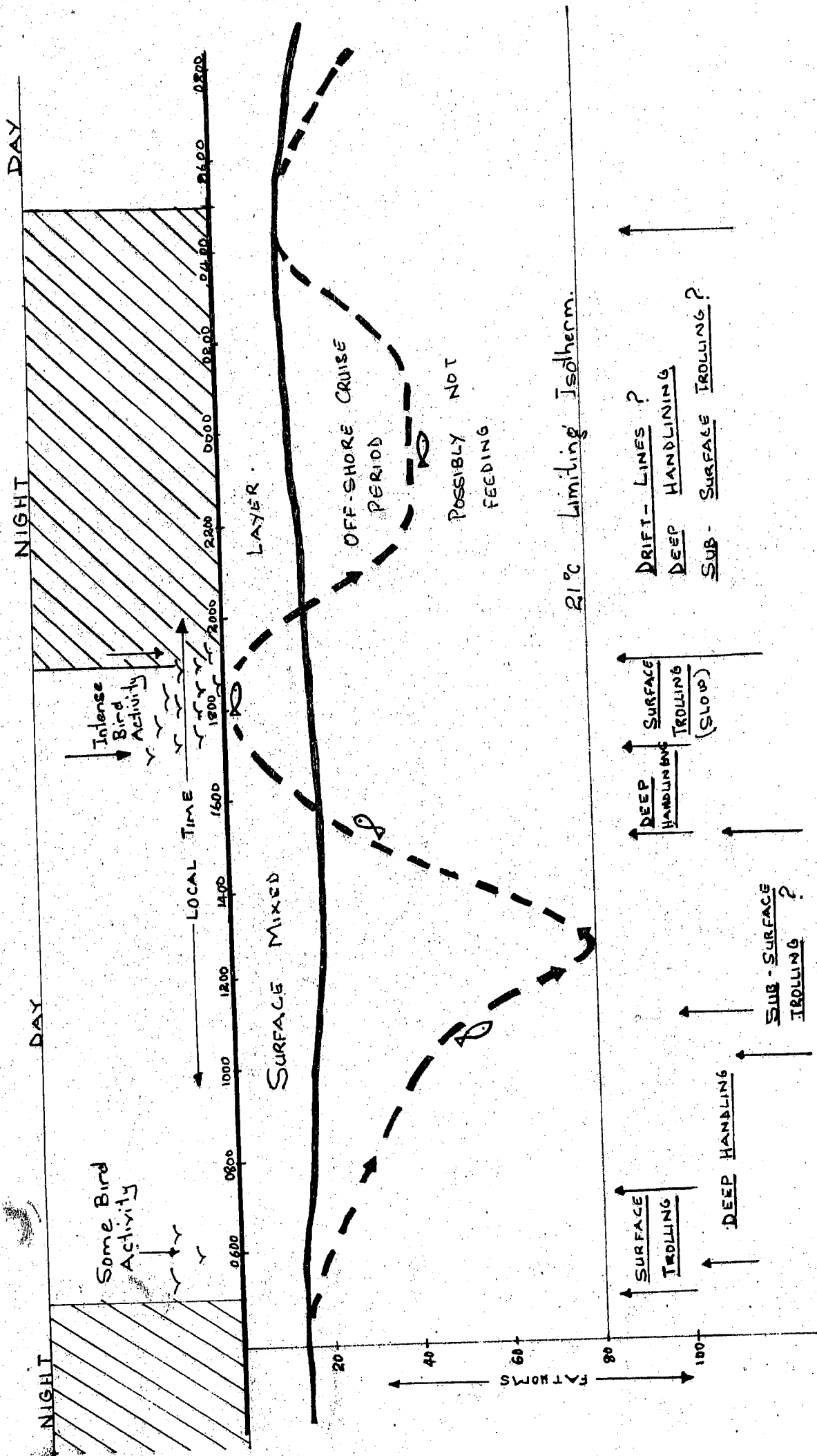
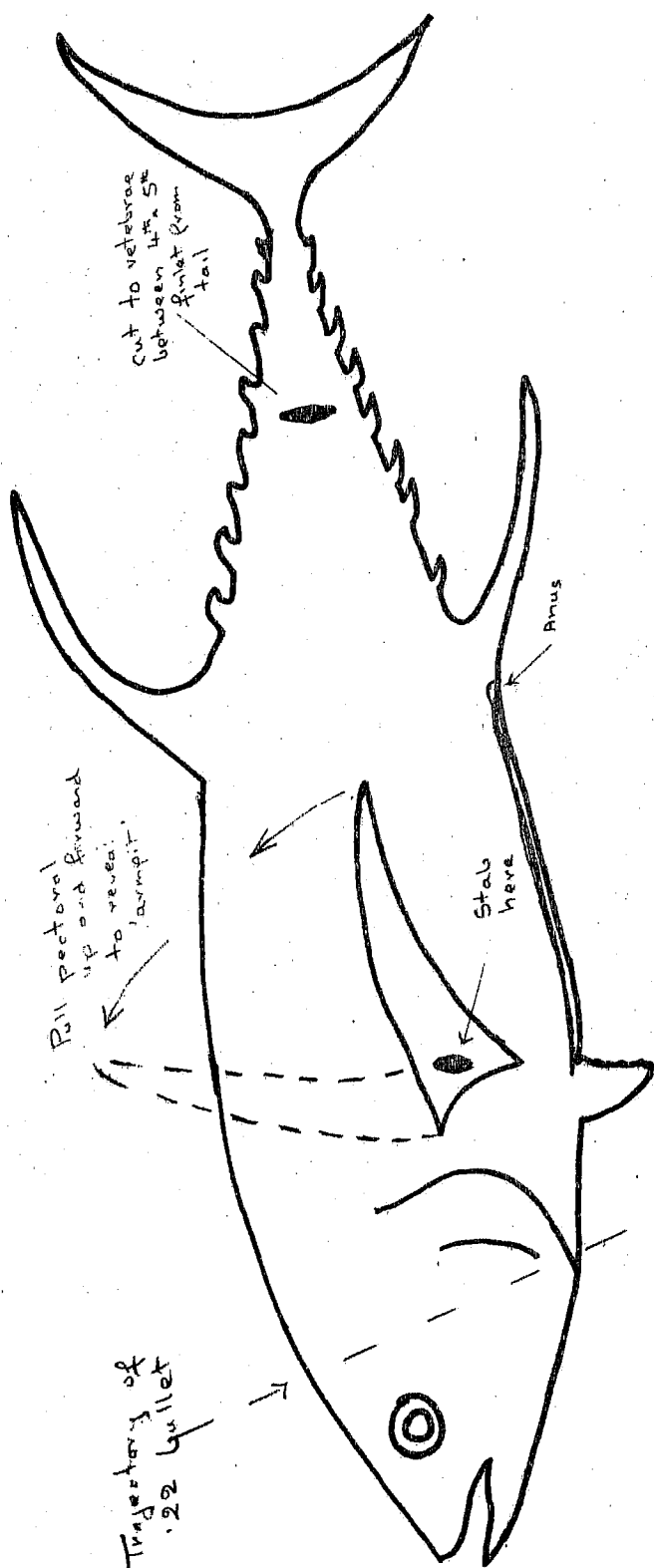


Fig. 2

SCHEMATIC OF YELLOWFIN TUNA MOVEMENTS + FISHING METHODS



Bleeding & Killing of Sashimi Tunas

Fig 3

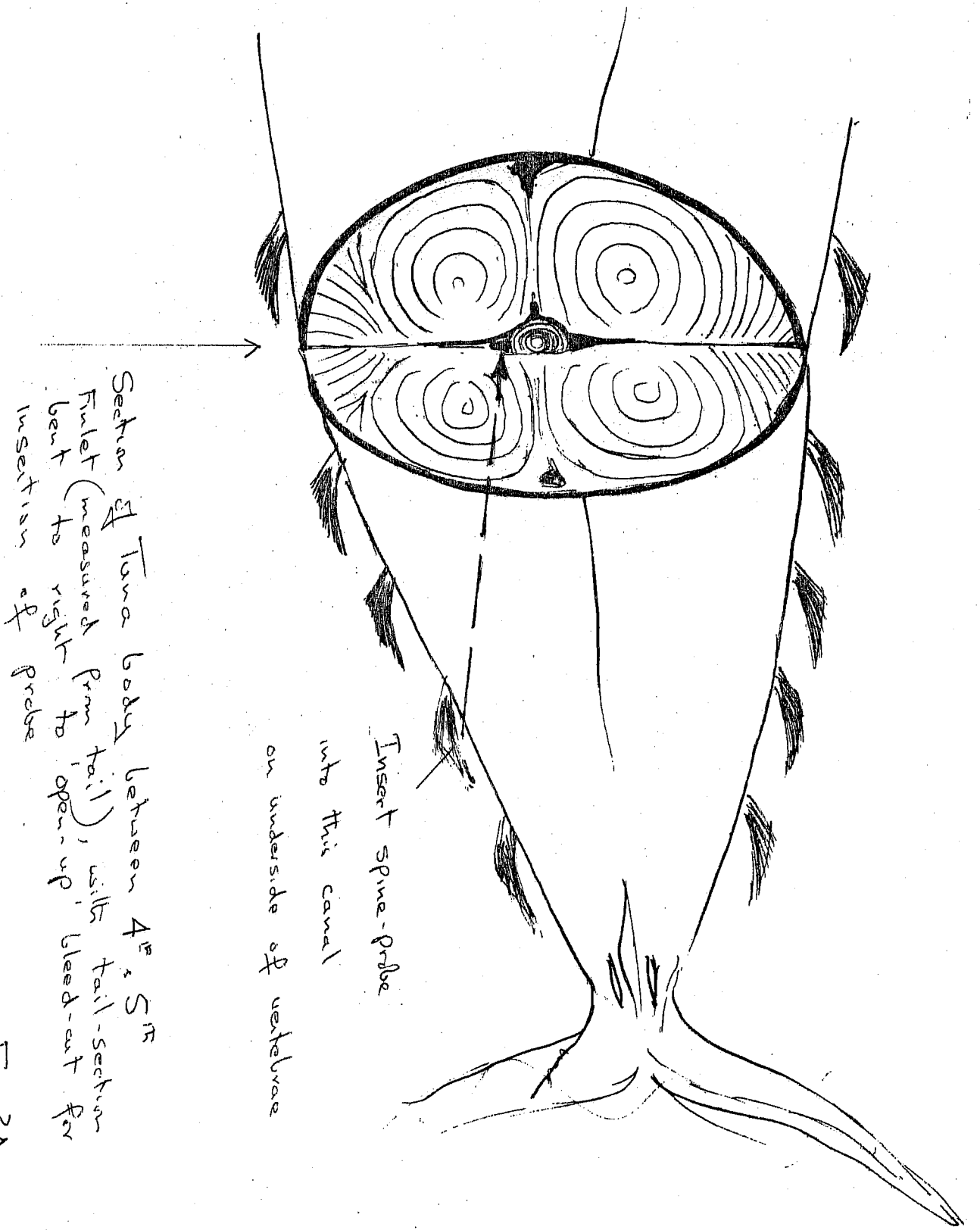
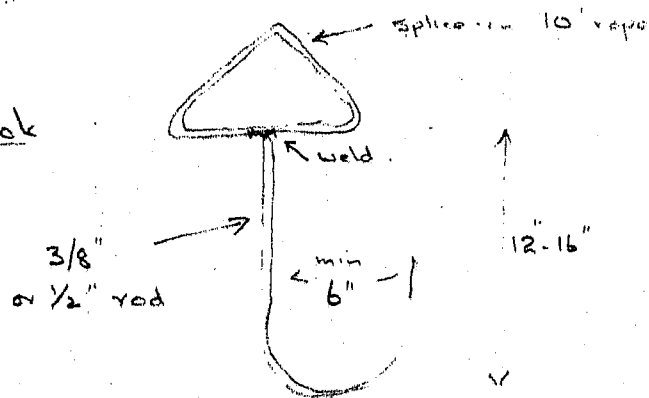


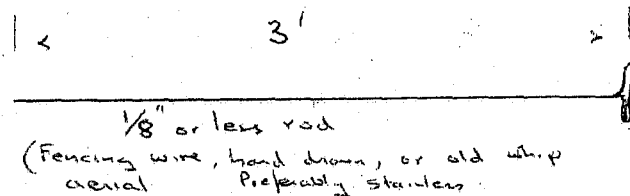
Fig. 3A

Special Butchery Gear for Sashimi-Tunas

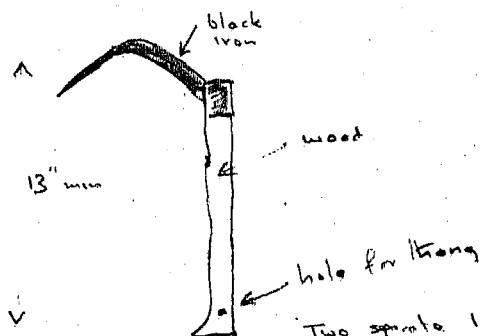
1. Meat Hook



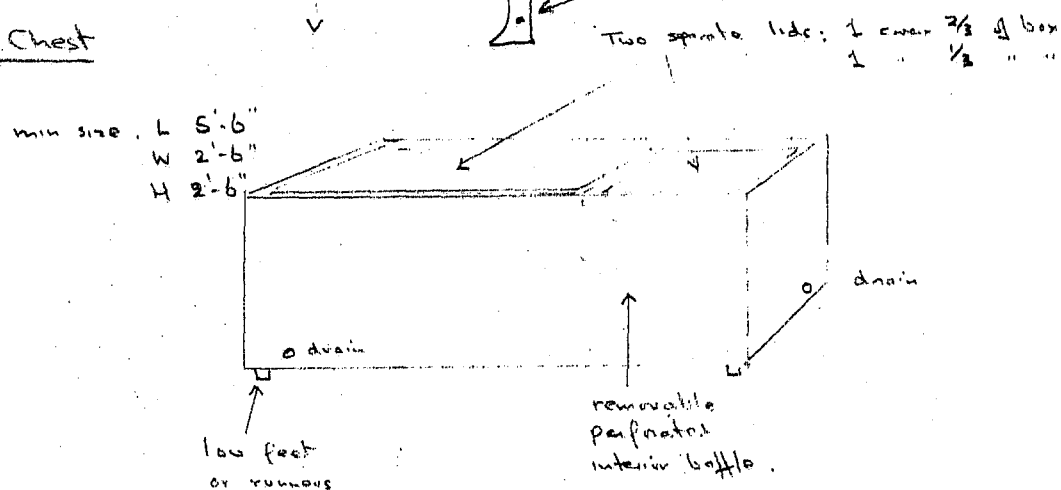
2. Spine-probe

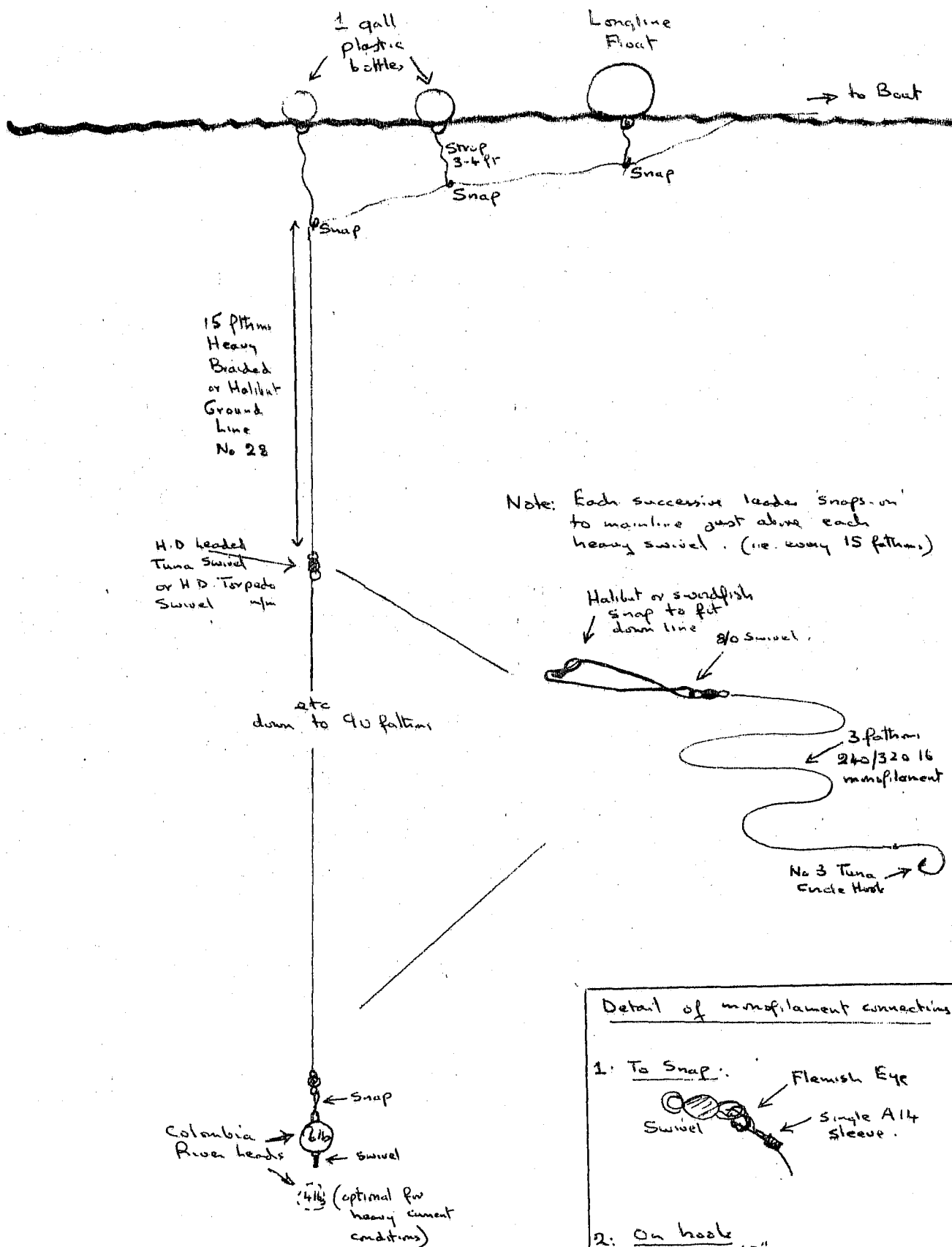


3. Killer Gaff 'Tekagi-type'

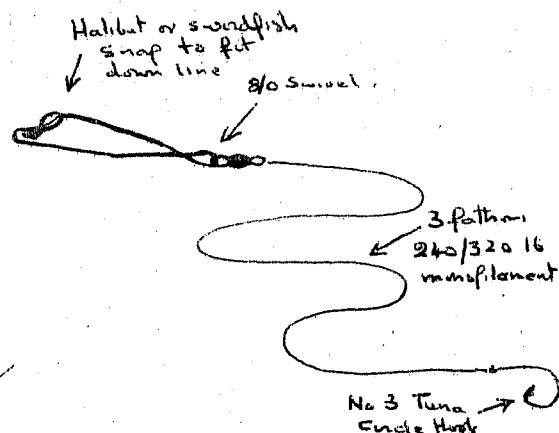


4. Brine Chest



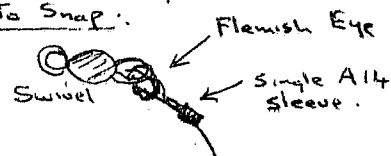


Note: Each successive leader 'snaps-on' to mainline just above each heavy swivel. (ie. every 15 fathoms)

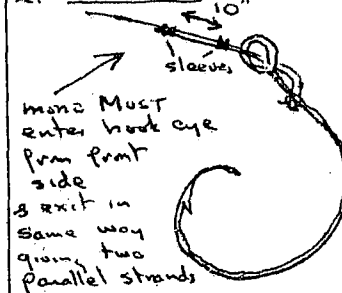


Detail of monofilament connections

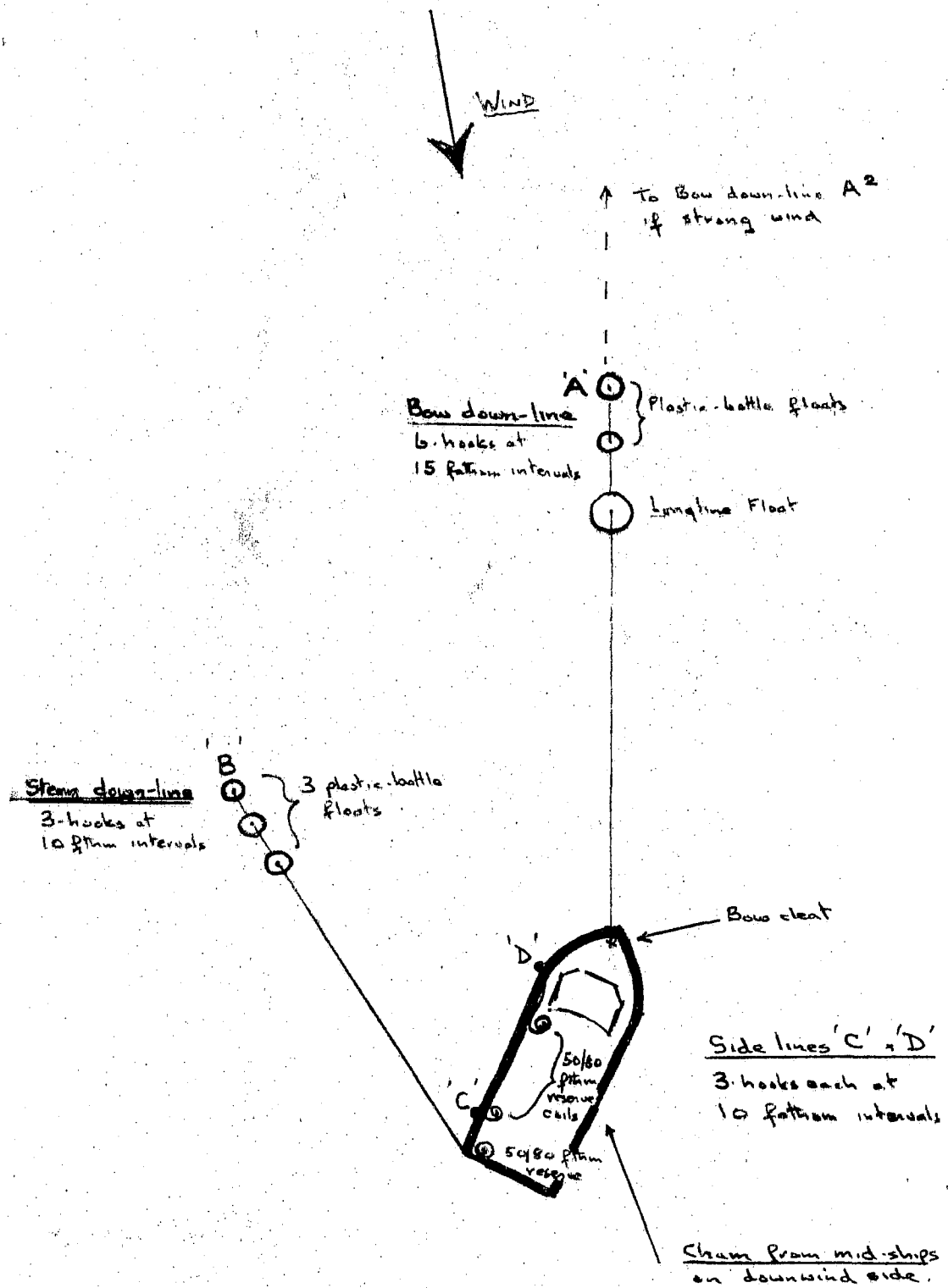
1. To Snap:



2. On hook



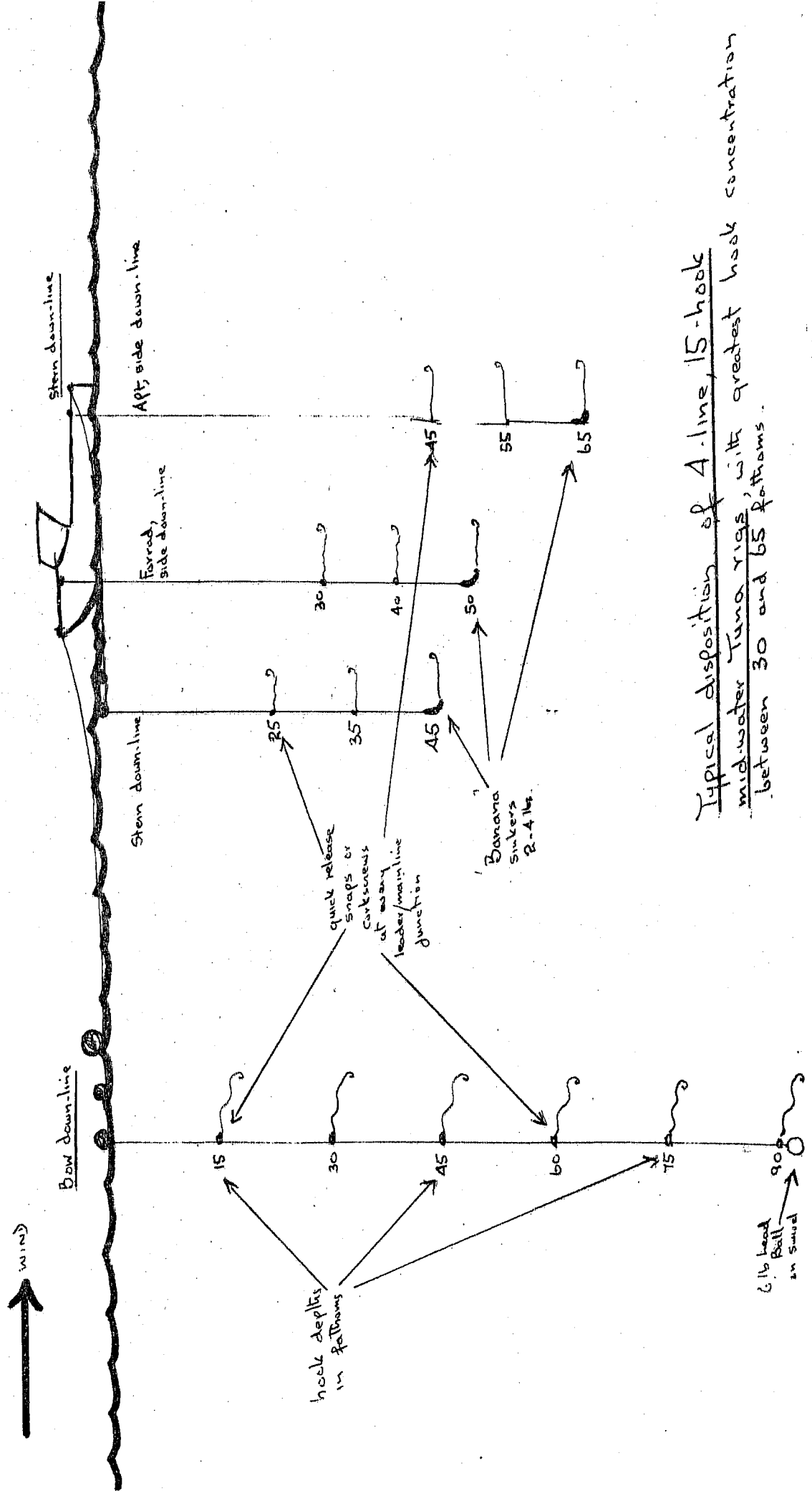
Down Line Schematic



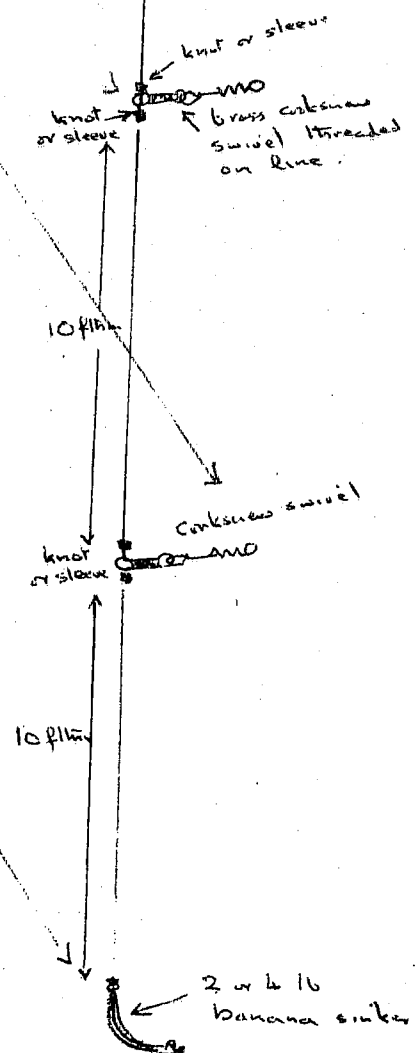
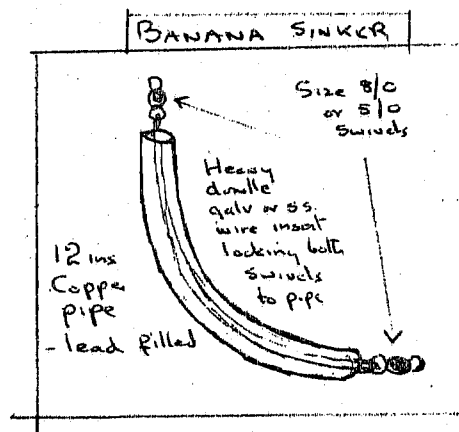
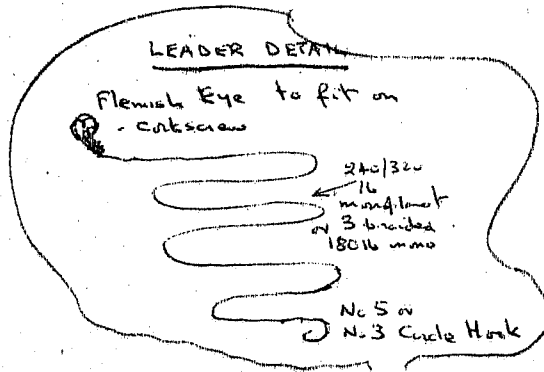
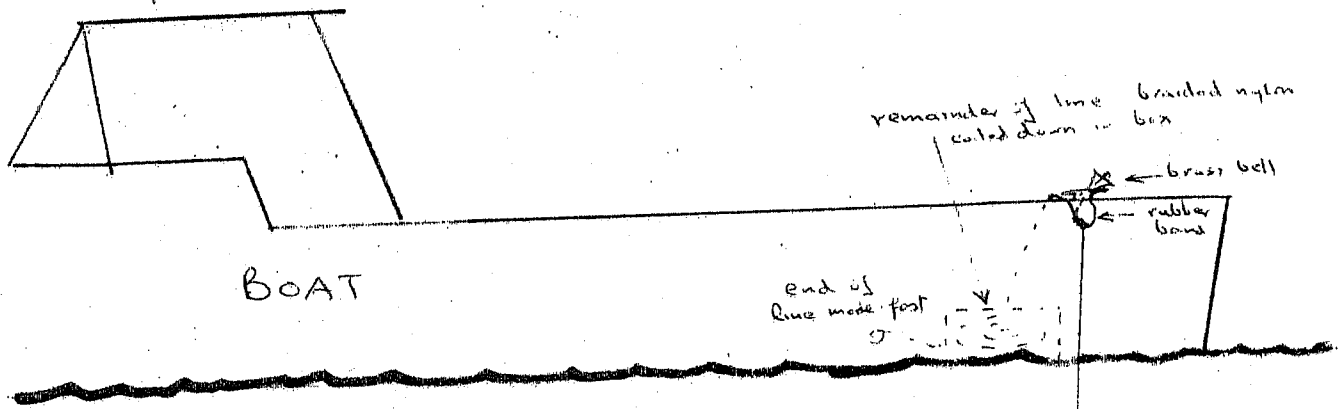
Line disposition for mid-water Tuna hand-lining

4 down-lines having a total of 15 hooks and covering a depth range 15-90 fathoms

Fig 7



Typical disposition of 4-line, 15-hook mid-water Tuna rigs, with greatest hook concentration between 30 and 65 fathoms.



Side down line

Schematic