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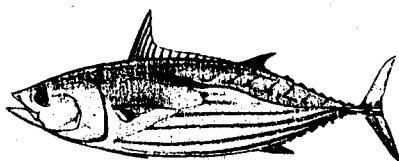
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TOPIC REVIEW No. 27

TRADITIONAL TUNA FISHING IN TOKELAU

Produced in association with the South Pacific Commission
Tuna and Billfish Assessment Programme



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South Pacific Commission
Noumea, New Caledonia
July 1985

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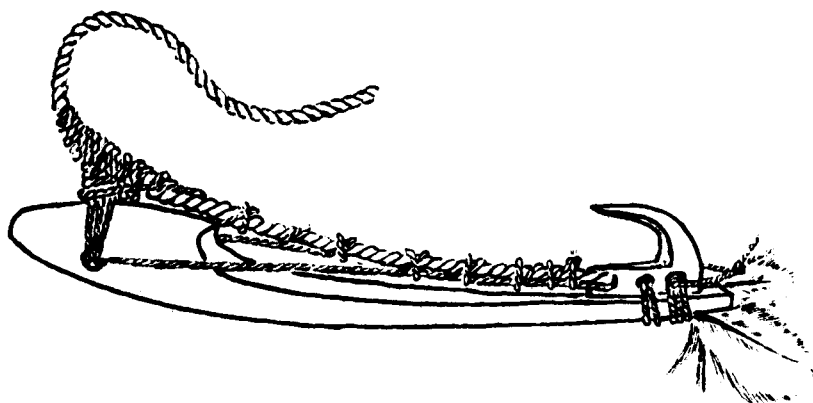
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TRADITIONAL TUNA FISHING IN TOKELAU



Loan No : 2287 (B)

Robert Gillett
July 1985

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PREFACE

Thirteen years ago, the United Nations Conference on the Human Environment (Stockholm, 5-16 June 1972) adopted the Action Plan for the Human Environment, including the General Principles for Assessment and Control of Marine Pollution. In the light of the results of the Stockholm Conference, the United Nations General Assembly decided to establish the United Nations Environment Programme (UNEP) to "serve as a focal point for environmental action and co-ordination within the United Nations system" (General Assembly resolution XXVII of 15 December 1972). The organizations of the United Nations system were invited "to adopt the measures that may be required to undertake concerted and co-ordinated programmes with regard to international environmental problems", and the "intergovernmental and non-governmental organizations that have an interest in the field of the environment" were also invited "to lend their full support and collaboration to the United Nations with a view to achieving the largest possible degree of co-operation and co-ordination". Subsequently, the Governing Council of UNEP chose "Oceans" as one of the priority areas in which it would focus efforts to fulfil its catalytic and co-ordinating role.

The Regional Seas Programme was initiated by UNEP in 1974. Since then the Governing Council of UNEP has repeatedly endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources and has requested the development of regional action plans.

The Regional Seas Programme at present includes eleven regions (1) and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities (2).

(1) Mediterranean, Kuwait Action Plan Region, West and Central Africa, Wider Caribbean, East Asian Seas, South-East Pacific, South Pacific, Red Sea and Gulf of Aden, East Africa, South-West Atlantic and South Asian Seas.

(2) UNEP: Achievements and planned development of UNEP's Regional Seas Programme and comparable programmes sponsored by other bodies. UNEP Regional Seas Reports and Studies No. 1, UNEP, 1982.

The idea for a regional South Pacific environment management programme came from the South Pacific Commission (SPC) in 1974. Consultations between SPC and UNEP led, in 1975, to the suggestion of organizing a South Pacific Conference on the Human Environment. The South Pacific Bureau for Economic Co-operation (SPEC) and the Economic and Social Commission for Asia and the Pacific (ESCAP) soon joined SPC's initiative and UNEP supported the development of what became known as the South Pacific Regional Environment Programme (SPREP) as part of its Regional Seas Programme.

A Co-ordinating Group, consisting of representatives from SPC, SPEC, ESCAP and UNEP was established in 1980 to co-ordinate the preparations for the Conference.

The Conference on the Human Environment in the South Pacific was convened in Rarotonga (8-11 March 1982). It adopted: the South Pacific Declaration on Natural Resources and Environment of the South Pacific Region; and agreed on the administrative and financial arrangements needed to support the implementation of the Action Plan and on the workplan for the next phase of SPREP (3).

To facilitate the Action Plan, this study was undertaken by Mr. Robert Gillett in a joint project between the South Pacific Commission's Tuna and Billfish Assessment Programme and South Pacific Regional Environment Programme. The Sponsors of the study would like to express their gratitude to him for this work.

(3) SPC/SPEC/ESCAP/UNEP: Action Plan for Managing the Natural Resources and Environment of the South Pacific Region. UNEP Regional Seas Reports and Studies No. 29, UNEP, 1983.

TRADITIONAL TUNA FISHING IN TOKELAU

Robert Gillett

Introduction

In July 1984 the South Pacific Commission (SPC) received a request from the Office for Tokelau Affairs for assistance on a project to document traditional fishing knowledge. After several discussions between the staff of the SPC and Tokelau officials it was decided that the assistance would consist of two components: first, a scientist from the Commission's Tuna and Billfish Assessment Programme would carry out an in-depth study of tuna fishing in Tokelau and secondly, the South Pacific Regional Environment Programme would attempt to attract funds to enable anthropologists to record a wide range of Tokelauan fishing practices.

This document presents information gathered during the study of tuna fishing in Tokelau. Anticipating that anthropological work will be carried out in the future, the project concentrated on biological and fishing technique aspects of the tuna fishery. As previous work in Micronesia (Johannes 1981, Gillett ms.) showed that traditional fishermen may be in possession of information of considerable interest to fisheries scientists, an attempt was made to determine if this was also the case in Tokelau.

Methods

On May 16, 1985 the MV Avondale departed Apia, Western Samoa for Tokelau and the field studies for the project commenced. Thirty-eight days were spent on Fakaofu Atoll, one on Nukunonu Atoll, and two on Atafu Atoll before returning to Apia on June 27 aboard the MV Kali.

Due to transportation logistics, it was not possible to devote an equal amount of time to each atoll. Officials of the Office for Tokelau Affairs in consultation with the Acting Director of Agriculture and Fisheries and Tokelau Elders decided that Fakaofu should be the focal point of the study. This decision was based on community enthusiasm and ease of making advance preparations.

Upon arrival in Fakaofu a meeting was held with the Council of Elders ("Toeaina") to establish an operating framework for the project. The council selected 12 masterfishermen and a translator (Table 1) to participate in the study on the basis of expertise in tuna fishing and availability. The wages to be paid to these individuals were also fixed.

Interviews of two to three hours duration were held twice a day. As the presence of several masterfishermen appeared to enhance the response to questions, many of the sessions, especially during the latter portion of the study period, were conducted with three or four masterfishermen present. All of the men interviewed were co-operative but due to age, experience, and eagerness, the first three men listed in Table 1 were heavily relied upon and became principal informants (Figure 1). As the memory of these men concerning fishing activities effectively spans 50

TABLE 1. TAUTAI INVOLVED IN THIS STUDY

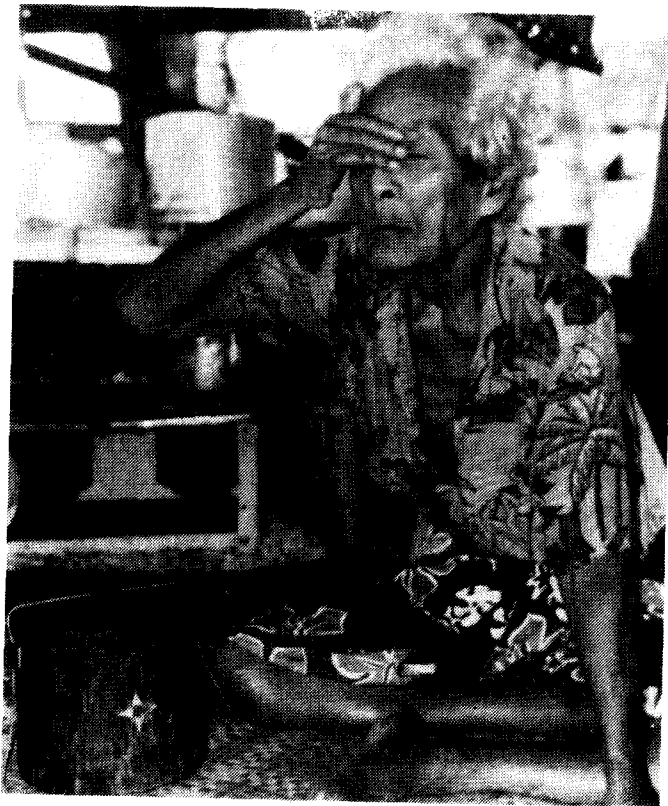
Name	Stated year of birth	Age at this study	Instructor (1)	Approximate year of "kau kumete"	Note
-----FAKAOFO-----					
Teata	1913	72	Konelio (uncle)	1931	One of the most experienced tautai on Fakaofo An elder and a principal informant for this study
Uili	1912	73	Kilifi (uncle)	late 1930s	One of the most experienced tautai on Fakaofo An elder and a principal informant for this study
Teao	1924	61	Gualofa (friend)	1948	Generally considered best active tautai on Fakaofo A principal informant for this study Only remaining active noose fisherman Oldest man alive on Fakaofo A retired elder
Havini	1899	86	Mika (father)	1929	
Gau	1942	43	Teao (friend)	1971	
Logotahi	1902	83	Setu (uncle)	1946	Very experienced lulu fisherman An elder
Peleni	1924	61	Apolo (father) Gau (brother)	1941	
Mika	1942	43	Teaku (uncle)	1971	
Toloo	1910	75	Mika (friend) Apete (friend)	1938	Confined to bed; retired elder
Tu	1927	58	Matini (father)	1951	
Akeimo	1928	57	Fakaofo (father)	1939, 1971	
Dr Iona	1921	64	Teao (brother) Teata (brother)	1971	Translator for this study An elder Brother of two principal informants
-----NUKUNONU-----					
Paulino	1926	59	Tumua (uncle) Tuilave (uncle)	1945	An elder
Apolo	1926	59	Ioakimi (father)	1945	An elder
-----ATAFU-----					
Teve	1931	54	Kalolo (father) Leupena (uncle)	1954	Grandson of informant for MacGregor's <u>Ethnology of Tokelau</u>
Taumanu	1929	56	Feuku (uncle)	1949	An elder

(1) The relationship of the "tautai" to his instructor is given in parentheses.

FIGURE 1



Iona, Teata, Uili, and Teao
The translator and principal informants



Havini demonstrating technique
of diving without goggles

years, the project was essentially an attempt to document tuna fishing during the same period. It is somewhat fortuitous that this period begins at the endpoint of Ethnology of Tokelau Islands (MacGregor, 1937), which has some description of tuna fishing.

Most questions were posed to at least two masterfishermen. Responses that were surprising, puzzling, or contradictory to my previous experience were cross checked with many fishermen. The dating of events that occurred decades ago was done by reference to pastors serving in the church and to overseas excursions made by the informants. On occasions when it was anticipated that an interview would be of special interest, the session was tape recorded.

Whenever possible, I participated in tuna fishing trips to observe first-hand topics discussed in the interviews. Fakaofu tuna fishing catch and effort data were collected for a period of five weeks.

In discussions on documentation of traditional tuna fishing practices the subjects of "completeness" and "secrecy" often arise. Each of the 16 men listed in Table 1 has trained under a masterfisherman for at least a decade and has had 14 to 50 additional years of tuna fishing experience in Tokelau. It would be rather presumptuous to assume that an outsider could acquire a complete understanding of their tuna fishing activities in the 41 days that this study permitted. There were, however, a few favourable circumstances. My fieldwork on tuna in 25 Pacific Island countries and a very similar project on traditional tuna fishing at Satawal Island in Micronesia allowed familiarity with the material. Realising that there could very well be an initial hesitancy to confide fishing secrets, the first subject matter covered was fish taxonomy, a non-controversial topic. Because the masterfishermen were intensely curious about foreign fishing activity and certain aspects of tuna biology with which I am familiar, efforts were made to make the interviews as much as possible an exchange of information and not merely a one-way transfer of knowledge. Elderly masterfishermen who were invalid or bedridden were pleased to have some relief from their boredom and were enthusiastic about the project, to the point of asking about future interview topics and giving the subject several days of thought in preparation. It should also be noted that Tokelauans requested this project, and the elders of Fakaofu, many of whom became informants for this study, urged that the focal point of the study be on their atoll.

Despite these circumstances, it is arguable that a fisherman still might be hesitant to reveal secrets. This is one of the reasons that this report emphasizes the technique of poling skipjack using pearl-shell lures. Because this type of fishing has not been carried out in Fakaofu for over 10 years, there was little concern that giving out information would reduce a fisherman's competitive advantage.

The role of the translator, Dr Iona Tinielu, requires special mention. Having a western medical/scientific education and being a masterfisherman himself, Dr Iona was ideally suited for the task. Involved with writing a book on the history of Tokelau, he strongly identified with the goals of this project. Furthermore, two of his brothers were principal informants for this work.

Fakaofu and the Other Atolls of Tokelau

Tokelau, a New Zealand dependency since 1924, is made up of three low-lying atolls. These atolls, Fakaofu, Nukunonu, and Atafu, lie respectively 267, 276, and 318 nautical miles¹ to the north of Western Samoa. Other neighbouring island groups include Tuvalu to the west, the Phoenix Islands to the north, and the Cook Islands to the east (Figure 2). The Tokelau atolls are all of the closed type; there are no passes through the reef between the lagoon and the ocean. Small blasted channels and even smaller natural depressions permit small craft to travel over the reef in relatively calm conditions. There are no safe anchorages for ships in Tokelau and only rarely do vessels attempt to anchor outside the reef. The atolls are roughly polygonal in shape, the corners forming points ("utua") which are of great importance for tuna fishing.

Fakaofu, the principal site of the study, consists of about 60 small islets. A total of about 4 square km of land together with the reef encircles 59 square km of lagoon (New Zealand Ministry of Foreign Affairs). It is populated by about 750 Polynesian people, the vast majority living at Fale (the original village) or at Fenuafala (inhabited since 1958). Small craft are able to cross the reef en route from the ocean to the lagoon at about 15 natural depressions in addition to two blasted channels; however the trip over the reef is hazardous with even a moderate swell or wind chop. There are no offshore seamounts, and all fishing activity occurs within three or four miles of land.

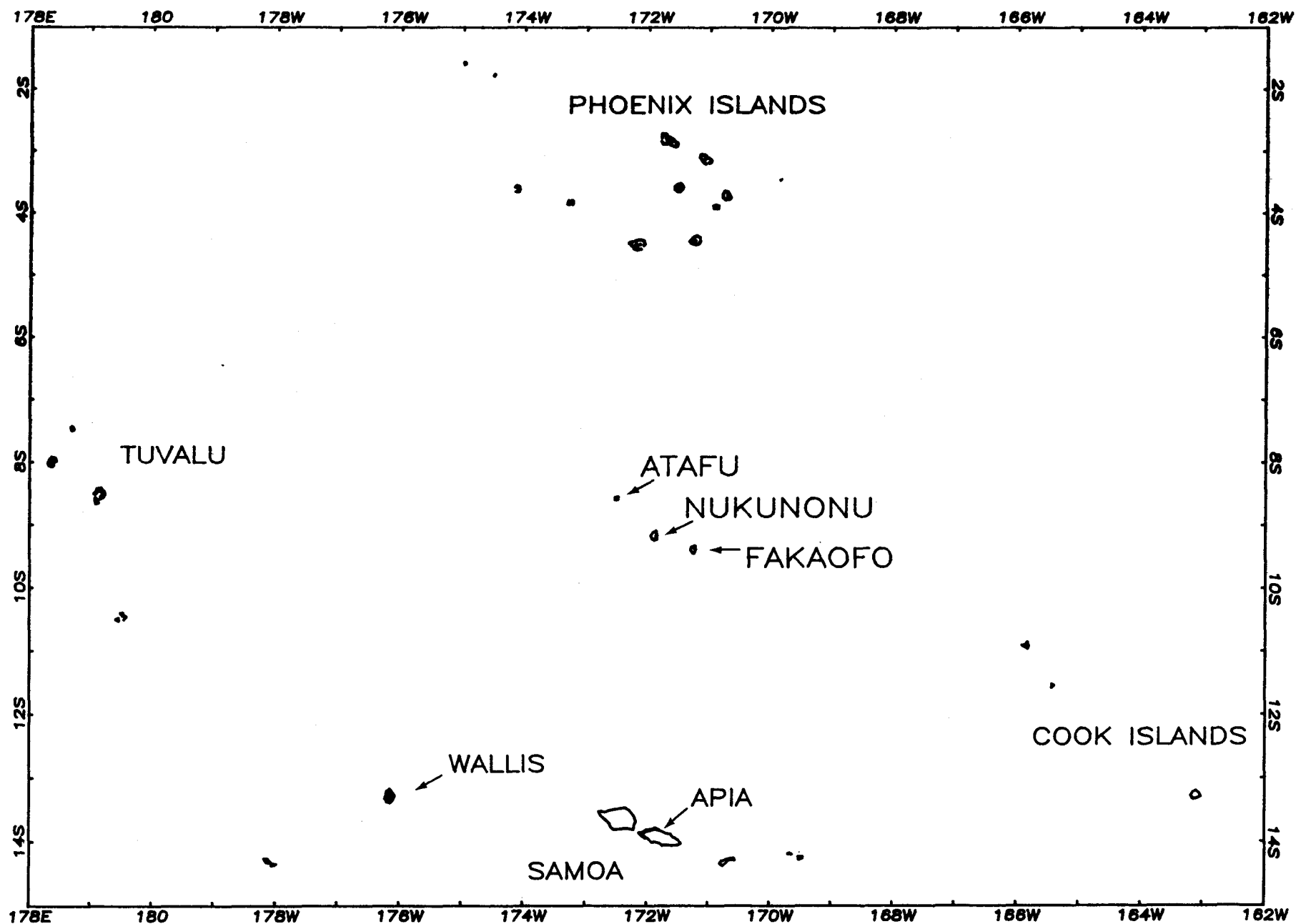
The people of Fakaofu have always been highly dependent on the marine environment for food. With coconut and pandanus the only local food plants at the time of first European contact (Hooper, 1984), it is easily understood why Tokelauans have historically been good fishermen. Tokelau's remote position in the Pacific, reinforced by the absence of suitable anchorages for ships, has limited contact with the outside world until fairly recently. This isolation has resulted in the preservation of traditional fishing techniques to a greater extent than in most neighbouring island groups.

The "Tautai"

The title "tautai", known in many areas of Polynesia, is very important in a discussion of fishing in Tokelau. It could be thought of as a combination of the terms "masterfisherman" in English and the Japanese concept of a "fishingmaster"; that is, a fisherman who has a considerable amount of expertise in the entire spectrum of fish-catching methods and also the leadership skills and experience necessary for directing and managing fishing expeditions. Although tuna fishing is an important part of the training of a "tautai", all forms of capturing wild animals are included, such as the catching of crab and even tree climbing

1. These are great circle distances determined by satellite navigation equipment between Apia harbour entrance and the landing at the major villages at each of the atolls. In this report ocean distances are measured in nautical miles; other units are metric.

Figure 2: Tokelau and Nearby Island Groups



for birds.

In the course of acquiring skills to become a "tautai" a young man will have one or sometimes two older "tautai" to act as teachers. After years or decades of instruction when the teacher feels that his student has acquired sufficient skill, he is eligible for a "kau kumete" ceremony in which the title of "tautai" will be conferred. Hooper (1984) gives a description of the ceremony and its cultural significance. On Fakaofu the most recent "kau kumete" was held in 1971. Knowledgeable residents estimated there were 44 "tautai" present on Fakaofu in June 1985.

Taxonomy

Upon arrival at Fakaofu the first task was to compile a list of local, English and scientific names of pelagic fish and other species important to the tuna fishermen. This proved to be more time consuming than anticipated. Although a variety of taxonomic manuals were available, Fakaofu fishermen had little or no experience identifying a fish from a picture in a book. The situation was complicated by some fish having several local names for different sizes, other names being collective terms for several species, and some fish having one name when found in the lagoon and another in the open sea. Some of the uncommon fish were not known to any but the most experienced fishermen, while one species caught by trolling, a relatively new technique, was known only to younger fishermen. It was tempting to assume that similar or identical fish names from nearby island groups had the same significance in Tokelau. In many cases, however, this proved not to be the situation.

Table 2 gives the various names for the tunas² and other species caught in the pursuit of tuna. For most of the fish species given in the table, the accompanying information differs from that given by Van Pel (1958). Many of the names listed are at present not well understood by the general population of Fakaofu. When approximately 30 non-fishermen were questioned, most did not recognise the terms "tuikaufu", "nakono", "lalavalu", "kavalau", and "atutaoa".

An "atu" is defined as skipjack which can be poled by the "tautai" himself directly into the canoe. A "nakono" requires the assistance of the crew member seated forward of the "tautai" who wraps his hand around the line to lift the fish into the canoe. A "tuikaufu", the largest size skipjack, is a fish of such immense size that the handle of a canoe paddle must be pushed through the gills to lift the fish from the water. Independently, three "tautai" stated that the last "tuikaufu" from Fakaofu was captured in about 1935. The stated size of the fish, "almost a fathom", exceeds the greatest size ever recorded for a skipjack³ by a considerable amount.

2. In this report the term tuna refers to members of the tribe Thunnini within the family Scombridae. In Tokelau Thunnini would be represented by the first five species in Table 2.

3. Matsumoto et al (1984) state that a skipjack in the 106.5 to 108.4 cm class could possibly be the largest size ever recorded.

TABLE 2. TUNAS AND OTHER PELAGIC FISH CAUGHT BY TOKELAU TUNA FISHERMEN

English Name	Scientific Name	Tokelau Name	Note
Skipjack	<u>Katsuwonus pelamis</u>	Atu	Small and medium size fish. General term used by most people. Called "bonito" by residents when speaking English.
		Nakono	Fish too large to be poled unassisted.
		Tuikaufoe	Huge fish extremely rare; must use paddle to raise on board canoe. Name unknown to younger fishermen.
Yellowfin	<u>Thunnus albacares</u>	Kahikahi	Small fish, not distinguished from bigeye.
		Kakahi	Medium-size fish, not distinguished from bigeye.
		Takuo	Large fish.
Bigeye	<u>Thunnus obesus</u>	Kahikahi	Small fish, not distinguished from yellowfin.
		Kakahi	Medium-size fish, not distinguished from yellowfin.
		Lalavalu	Large fish.
Mackerel Tuna	<u>Euthynnus affinis</u>	Kavalau	Caught only in recent years by trolling; name (maybe Samoan) unknown to elderly fishermen.
Albacore**	<u>Thunnus alalunga</u>	Atutaos	
Dogtooth Tuna	<u>Gymnosarda unicolor</u>	Tavatava	Small fish.
		Valu	Large fish
Double-Lined Mackerel	<u>Grammatorcynus bilineatus</u>	Atualo	Used as bait for tuna handling. Plentiful in lagoon; sometimes caught in ocean.
Wahoo	<u>Acanthocybium solandri</u>	Paala	Tokelauans refer to as kingfish when speaking English.
Sailfish	<u>Istiophorus platypterus</u>	Tuanui	Hakulā is the term used for all billfish.
Blue Marlin**	<u>Makaira nigricans</u>	Tiuvaka	Term sometimes includes swordfish; may include black marlin and striped marlin.
Dolphinfish	<u>Coryphaena hippurus</u>	Mahimahi	
Rainbow Runner	<u>Elagatis bipinnulatus</u>	Kamai	
Shark	Carcharhinidae sp.	Mago	General term for shark.
Great Barracuda	<u>Sphyrna barracuda</u>	Ono	Haohao, pananua, and ono namo are names for other smaller barracudas.

** Not verified by direct inspection during study.

The distinction between size categories of yellowfin and bigeye appears more subjective than for skipjack. On the basis of 83 yellowfin and bigeye fish measured during the visit the dividing point between a "kahikahi" (the smaller size) and "kakahi" appeared to be about 65 cm measured from the tip of the snout to the fork of the tail (LCF). "Takuo" and "lalavalu", large yellowfin and bigeye respectively, are distinguished from the smaller "kakahi" at about 150 to 160 cm LCF. A similar measurement was said to divide the categories of dogtooth tuna, "tavatava" and "valu".

The four names for yellowfin and bigeye imply that functional considerations are important in Tokelau tuna nomenclature. Fishermen are well aware that there are two types of "kakahi" but not until they reach the size where they become behaviourally different (and require a different fishing strategy) are separate names used.

Table 3 lists those fish used as bait for tuna fishing and fish that were stated as being important tuna diet items.

Canoes

Offshore fishing activities in Tokelau were traditionally carried out in outrigger canoes. The design of the typical canoe is distinctly a product of the atoll environment. The lack of ideal species of trees for boat building dictates that canoe hulls are laboriously constructed of several pieces of "kanava" (Cordia subcordata). The scarcity of this wood requires that those canoes constructed are long lasting, despite the punishment they may receive crossing directly over the reef en route to and from the ocean. A description of the canoes and their construction is given in MacGregor (1937). The major difference in the canoes of that account of half a century ago and those of today is the present use of monofilament line for lashing and the attachment of an outboard engine bracket onto the outrigger struts.

Information on the Fakaofu canoe fleet during June 1985 is given in Tables 4 and 5. Of the 44 canoes on Fakaofu with intact hulls, 12 are used occasionally for offshore fishing, the remainder of the activity being carried out in aluminium skiffs powered by outboard engines. "Tautai" believe that canoes are more appropriate for most types of tuna fishing than aluminium skiffs. Reasons cited for this include a reduced amount of noise and the ease of holding the bow into the wind, slowly paddling forward ("tautau"), and holding a tuna handline in the preferred position (pleasantly wrapped around one's big toe). Due to speed and manoeuvrability, an aluminium skiff is considered better for modern-type trolling for tuna in surface schools.

Pearl-Shell Lures

The most essential item of gear for skipjack fishing, the pearl shell lure ("pa"), is made from the black-lip pearl oyster ("tifa", Pinctada margaritifera). In addition to its use in fishing, pearl-shell is used for body decoration, wedding gifts, and more recently, graduation presents. As diamonds are cherished in the cosmopolitan world for their ornamental, sentimental, and utilitarian value, so are pearl-shells in Tokelau.

TABLE 3. TUNA DIET ITEMS AND FISH USED FOR TUNA FISHING BAIT

English Name	Scientific Name	Tokelau Name	Note
?	?	o	Very important determinant of skipjack behaviour; occurs in large aggregations. Abundance strongly influenced by moon phase. Any colour pearl-shell lure may be used.
Goatfish	<u>Mulloidichthys</u> sp.	Tikava	Important determinant of skipjack behaviour; similar lagoon species called "kalo".
Layang scad	<u>Decapterus macrosoma</u>	Uli	Used as bait for handlining tuna. Tuna diet item.
Bigeye scad	<u>Selar crumenophthalmus</u>	Atule	Used as bait for handlining tuna. Tuna diet item.
Blue sprat	<u>Spratelloides delicatulus</u>	Haha	Tuna diet item.
Rabbitfish	<u>Siganus</u> sp.	Lotala	Tuna diet item; occurs in large aggregations. More mobile than o; in lagoon larger size called "maeava".
Flyingfish	Exocoetidae	Hipa Malolo Hahave Tuali	Smallest category Tuna diet item used for bait for tuna handlining and trolling; intense spawning aggregations near reef Sept.-Dec. Largest category
Squid	Teuthoidea	Gufeke	Tuna diet item.
Buccaneer anchovy	<u>Stolephorus buccaneeri</u>	Nefu	Tuna diet item; occurs in large aggregations.
Trevally	<u>Caranx</u> sp.	Lupo	Found under drifting logs.
Ashen drummer	<u>Kyphosus cinerascens</u>	Nanue	Found under drifting logs. Large size called "gafugafu".
Boxfish	Ostracidae	Humu	Tuna diet item.
Surgeonfish	<u>Acanthuridae</u>	Manini, Pone	Tuna diet item
Garfish	<u>Hemiramphus</u> sp.	Ihe	Bait for tuna handlining.
Squirrelfish	Holocentridae	Malau	Bait for tuna handlining. Tuna diet item.
Worm	-	Anufe	General term for worm. Can be used for diet item or endoparasite.

TABLE 4. INFORMATION ON THE FAKAOFU CANOE FLEET, JUNE 1985

Owner	LOA	OUT. LOA	WIDTH	HULL BEAM	DEPTH	NO. OF KIATO	
Manatua	741	-	-	-	53	-	No outrigger
Limoni	412	306	168	50	41	3	Slanted stern
Tai	653	427	203	52	53	3	Slanted stern
(Communal)	857	-	-	63	61	-	No outrigger
Fakaaolofa	848	-	-	61	61	6	No outrigger, but kiato attached
Apo	828	676	202	47	59	6	
Matatia	445	-	-	-	49	-	No outrigger
Tui	693	509	186	47	61	5	Slanted stern
Teata	672	461	208	58	57	5	
Eketi (1)	470	-	-	40	54	-	No outrigger; slanted stern
Lapana	446	321	181	40	47	3	Slanted stern
*Puka	888	791	206	58	63	7	Hull lashed with longline cord
Lapana	756	589	195	56	56	6	
*Teata (2)	810	591	237	67	64	6	Wide hull
Tuielu	411	-	-	46	48	-	No outrigger
Tu	616	-	-	47	50	-	No outrigger
*Hohene	884	629	223	47	61	7	
*Teao	820	606	205	54	58	6	Name is "rocket"
Hohene	405	293	170	43	47	4	
Faafoi	862	-	-	-	65	-	No outrigger
Filipo	855	-	-	-	61	-	No outrigger; slanted stern
Filipo	519	-	-	-	52	-	No outrigger; slanted stern
Itieli	618	459	209	49	?	4	Slanted stern
*Iulio	789	563	197	51	56	6	Slanted stern
Manuele	435	-	-	-	-	-	No outrigger; part of hull missing
Pue	360	-	-	-	-	-	No outrigger; part of hull missing
Henitu	615	-	-	41	51	-	No outrigger
Lui	754	-	-	51	56	-	No outrigger
Vavega	580	-	-	42	46	5	No outrigger; slanted stern
*Muti (3)	714	581	218	52	54	6	
*Gau	899	710	196	49	55	7	Slanted stern
*Nanumea (4)	518	346	195	51	52	?	
*Aukuho	764	565	209	59	-	?	
*Timi	158	474	188	59	60	6	Slanted stern
*Ekueta	733	580	198	56	56	6	
Timi	603	-	-	45	44	-	No outrigger
*Gau	607	469	201	49	49	4	Slanted stern
Fulo	496	-	-	-	54	-	No outrigger; slanted stern
Lapana	523	-	-	-	57	-	No outrigger
Vavega	483	-	-	-	49	-	No outrigger; slanted stern
Malo	433	-	-	48	51	-	No outrigger; slanted stern
Lapana	836	-	-	53	59	-	No outrigger; slanted stern
Peleti	887	-	-	60	61	-	No outrigger; slanted stern
Talaga	933	-	-	49	55	-	No outrigger; slanted stern

(1) Sail rig measured: luff-385, leech-340, foot-343.

(2) Owner stated canoe brought from Atafu in the 1930s or 1935 where it was used for at least two generations.

(3) Previous owner (Uili) stated that a full load for this canoe would be 100 average size skipjack plus 4 crew and "tautai".

(4) Sail rig measured: luff-385, leech-386, foot-406.

* Canoes which are used at least occasionally for tuna fishing.

Notes:

All measurements in centimetres.

LOA = length overall of hull

OUT. LOA = length overall of outrigger

WIDTH = distance between outboard edge of outrigger and starboard gunwale (not including attached rail, if any) at approximately middle of canoe

HULL BEAM = distance between outboard edges of gunwales (not including attached rail, if any) at approximately middle of canoe

DEPTH = distance between top of gunwale and bottom of keel; in many cases an approximation

KIATO = spars which attach the outrigger to the hull

TABLE 5. CONDITION OF THE FAKAOFO CANOE FLEET - JUNE 1985

Location	No. of intact hulls with outrigger(1)	No. of intact hulls without outrigger(1)	No. of disassembled hulls(2)	Total
Fale	14	14	33	61
Fenua Fala	7	9	6	22
Total	21	23	39	83

(1) Canoes in these two columns appear in Table 4.

(2) Includes only canoes that have most or all component pieces stacked at one location and not miscellaneous individual pieces or canoes which may be in graves.

A Tokelau pearl-shell lure (Figure 3) consists of a shank, hook, feathers, lashings, and leader line. The pearl-shell for the shank occurs in the lagoons of Tokelau but it apparently has never been very plentiful and is quite rare at present. MacGregor (1937) reported the supply of pearl-shell in Atafu "has grown less as succeeding generations comb the lagoon for the precious material". Van Pel (1958) stated that "one or two were found occasionally over a period of years". During the present study "tautai" reported that about 10 years has lapsed since the last pearl-shell was found in Fakaofu lagoon.

The distribution of pearl-shell in Fakaofu lagoon appears to be random. Residents state there were no particular areas where the shell was more prevalent than others, although more were probably found in the lagoon area close to Fenualoa due to the increased diving activity in that area in search of giant clam (Tridacna sp.). Pearl-shell was most often encountered inside small caves and underneath rock ledges. The older "tautai" interviewed said that during their youth diving was done without the aid of goggles; divers cupped one hand over the eye (Figure 1) trapping a small pocket of air in the palm which would enable underwater vision. As pressure increases with depth, this technique could only be used to a maximum depth of about eight metres, after which the air bubble would be too compressed to be of any use.⁴

Pearl-shell was also brought to Tokelau from other localities. Missionaries from Tokelau serving in New Guinea from the turn of the century to the early 1940s returned home with thick shell, probably the gold-lip variety (Pinctada maxima). "Tautai" cited other sources of shell as being Pukapuka, Nassau, and Penryhn in the northern Cook Islands, and finished lure shanks from Samoa.

The pearl-shell is cut into pieces to form one or more shanks for lures (Figure 4). The shank size, always as large as possible, is determined by the section of shell from which it is made. The largest comes from the centre cut ("pa matua") with adjacent cuts being progressively smaller. Lure shanks measured in this study ranged in size from 6 to 17 cm.

The hook portion of the lure is usually made from the shell of the hawksbill turtle ("fonu una", Eretmochelys imbricata). Although cow horns, coconut shell, whales's teeth, marlin spikes, aluminium, and plastic are occasionally used, turtle shell predominates despite the rarity of the animal. Most "tautai" interviewed on Fakaofu could not recall the local capture of a hawksbill turtle of a size with a shell of adequate thickness for hooks during their lives⁵, however it is reported in Balazs (1982) that hawksbill are known to nest at Nukunonu

4. I suspect the introduction of diving goggles to Fakaofu in the 1940s was a major factor contributing to the virtual absence of pearl-shell in the lagoon at present.

5. Havini, the oldest man alive on Fakaofu, stated that a suitable hawksbill was captured in the 1920s at Mulifenua. "Tautai" interviewed from Nukunonu and Atafu could not recall ever catching a large hawksbill.

Figure 3

Tokelau Pearl Shell Lure (top)
and
"Matatahi" Hook

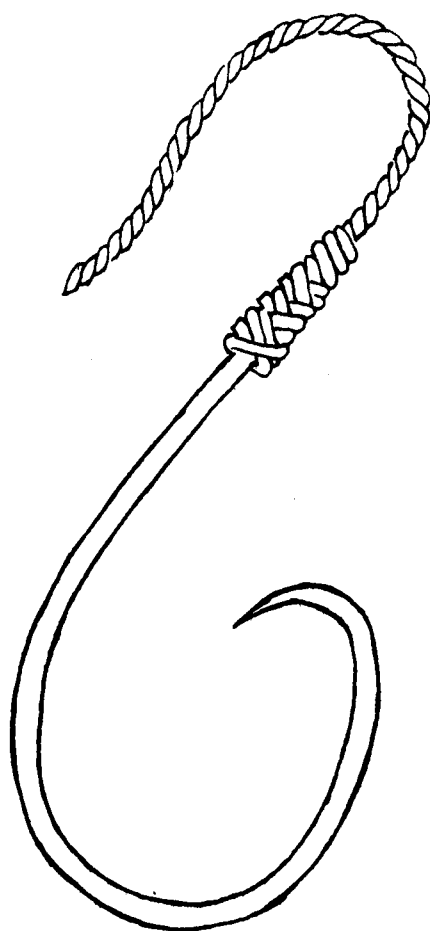
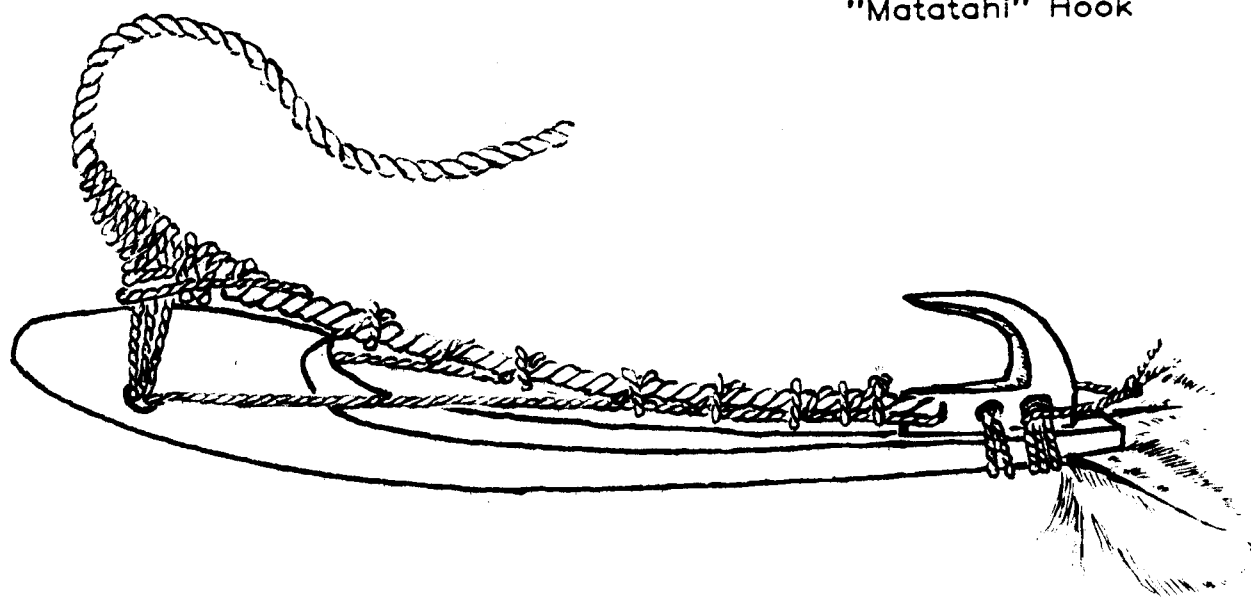
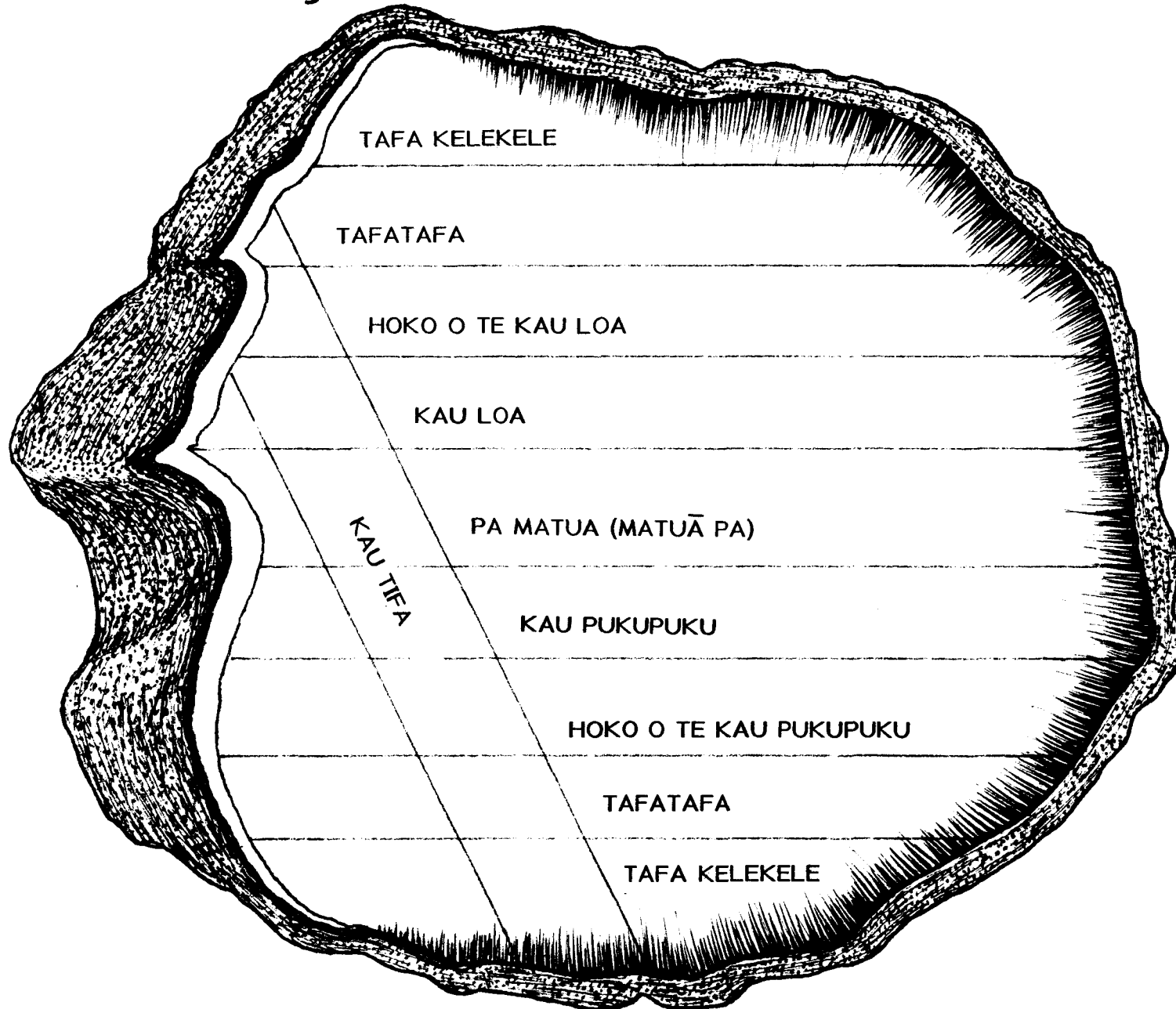


Figure 4: The Cuts of a Pearl Shell



atoll. Sources cited for turtle shell for lure manufacture were similar to that for pearl-shell, with the addition of Hull Island in the Phoenix group.

After European contact, metal replaced local materials in hooks for many types of fishing, but such was not usually the case for pearl shell lures. Ironically, turtle shell was regarded as superior to metal due to its weakness; under a very heavy load a turtle hook would break before the extremely valuable pearl-shell shank. A turtle hook was also less likely to cause injury to a fisherman when rapidly poling tuna. Furthermore, the colour of the turtle hook, opaque-brown mixed with translucent amber, was thought to attract skipjack.

Bird feathers are attached to the distal portion of the shank. The white breast feathers of the red-tailed tropic bird ("tevake") are considered by most fishermen to be the best type, but due to the scarcity of this animal, feathers of two species of boobies, and occasionally chicken feathers or even plastic, are used.

Formerly, the line which attaches the lure to the pole and the more delicate lashings which attach the various lure components was three-stranded line made from "fau" (*Pipturus argenteus*). The strength of the line was given as about 50 kg and that for the lashings as about 12 kg. Although this line ("laufau") is thought to be superior to synthetic materials due to its durability and tendency not to kink, it had been replaced by nylon monofilament on all lure specimens examined during this study. The amount of effort required for "laufau" manufacture was given as the reason.

As rigged for a fishing expedition, from three to seven lures are attached by separate lines to a single pole. In the selection of these lures an attempt is made to include a wide range in colour, size, shape, and hook angle. Tokelau fishermen recognise five colours of pearl-shell⁶, nine cuts of a large shell, two head (proximal end of the shank) shapes, and two classifications of hook angle. Table 6 lists these variations. Each of these factors is considered critically important by "tautai" in the functioning of the lure. Nordhoff (1930) stated "an accomplished fly fisherman in Europe or America does not carry in his head one half of the practical knowledge a bonito (skipjack) fisherman uses every day." A great deal of this practical knowledge concerns when to use the different variations of pearl-shell lures.

Pearl-shell lures are known in many areas of Polynesia, Micronesia, and Melanesia. Information in Hiroa (1932) and Anell (1955) helps clarify the relationship of the Tokelau-style lure to those of other areas. Lures from Tokelau are considered typically Polynesian due to the attachment of the leader line to both the head of the pearl-shell shank and to the base of the turtle shell hook. In Melanesia and areas of Micronesia the line is characteristically attached only to the shank

6. Two of the four variations in colour of pearl-shell recognised by fishermen in Tuvalu, as given by Kennedy (1930), are similar to the Tokelauan names.

TABLE 6. VARIATION IN PEARL-SHELL LURES

Character	Variation	Description	Note
Colour of convex surface	Lau mīlo	Golden with some red and green	Used first in Takafakauli-type school. Name also used in Samoa and Tuvalu for pearl-shell; also called lautiale; New Guinea lures are this colour. Other shell colours can be changed to hiku uli by additional grinding.
	Pa hina	White	Used first in Fakapula-type school. Other colour lures can be changed to hiku uli by additional grinding.
	Hiku uli	Blacktail	Some fishermen say works well when tuna feeding on goatfish.
	Fulu fakalupe	Shiny blacktail with some red/green	Also called fakanuanua.
	Lanu faka pugapuga	Entire surface brownish	
Head shape	Ulu faka kalo	Sharp head	Lure tends to dive. Preferred for use when skipjack are feeding on goatfish.
	Ulu faka ula	Round head	Lure tends to stay on surface and wiggle; used in tahikupa-type school.
Hook angle	Tala humu	Dull angle	Fish can be unhooked faster; turtle shell material for this type must be thick.
	Maga	Sharp angle	Less chance of fish falling off hook prematurely.
Shell cuts (20 cm diameter shell)	Ni ulu fenua	Edge cut	Smallest size; used on completely calm days, e.g. no wind or swell.
	Hoko o te Kau Pukupuku	Adjacent cuts	↑ Decreasing size
	Kau Pukupuku		↑
	Pa Matua (Matua Pa)	Centre cut of shell	Biggest; never used first in school; good to use when fish biting fast. Usually pa hina or hiku uli; never use with yellowfin.
	Kau Loa		↓
	Hoko o te Kau Loa	Adjacent cuts	↓ Decreasing size
	Tafatafa		↓
	Tafa Kelekele	Edge cut	Smallest size
	Kau Tifa	Cross cut	Only one possible from each shell; many colours present.

head. Polynesian-type lures are subdivided into eastern and western groups, the Tokelau lure being in the western group along with those from Samoa, Pukapuka, Tuvalu, Wallis, and Polynesian outliers in Melanesia, due to the hook base (the interface between the pearl-shell and turtle shell) extending towards the head of the shank rather than away from it. Tokelau lures have three holes in the base of the turtle shell hook; one for attaching the line and the other two for lashing the hook to the shank. Outside of Tokelau, the western Polynesian, three-hole lure is found only in Wallis⁷ and Tuvalu.

The value of a pearl-shell lure to its owner should be stressed. An idea of the importance can be given by relating that in the speeches which accompany a funeral ceremony, it is common for the death of a family member to be compared to the loss of a well-known pearl-shell lure.

Other Gear

In traditional times the pole for skipjack fishing was made from the wood of "puka" (*Hernandia sonora*). Presently the stock is of imported bamboo attached to a butt of kanava wood. Five poles that were measured during the study ranged in length from 461 to 529 cm. When not in use the poles are stored on the overhead beams of houses and are a common sight in Tokelau.

Pearl-shell lures, spare lines, and hooks are stored in an oval container ("tuluma") made of kanava. These gear buckets, which measure from 20 to 40 cm at the base, have tight-fitting lids and will float in the ocean. If a canoe capsizes, the precious lures and other gear stored inside will not be lost. Because the containers are very buoyant, the larger ones have been used in the past as life preservers.

The hooks used in tuna handling are presently made from metal in three different shapes: the barbed "U" shaped hook, the barbed tuna circle hook, and the traditional barbless "matatahi" (literally: "one eye") hook. Modern barbed hooks are called "matalua" or two eyes, the eyes referring to the point and tip of the barb. Older "tautai" claim that a "matatahi" hook (Figure 3) is best due to its ability to "hold a fish until it dies of hunger". Johannes (1981) has a good description of these barbless hooks.

Plants used in the manufacture of Tokelau tuna fishing gear are listed in Table 7.

Tuna Fishing Methods

Fakaofu fishermen catch tuna and related species using a variety of techniques. Table 8 summarizes and compares the seven methods used during the last fifty years.

7. I suspect that the 3-hole Wallisian lure has a Tokelau origin as Hinds (1969) reports that at the time of World War I tuna fishing in Wallis was carried out by Tokelauans.

TABLE 7. PLANTS USED IN THE MANUFACTURE OF TUNA FISHING GEAR

Tokelau Name	Scientific Name (English)	USE / NOTES
KANAVA	<u>Cordia</u> <u>subcordata</u>	Older tree called "taiuli" Canoe hull, outrigger spars ("kiato"), gear box ("tuluma") paddle, butt of fishing pole
GAGIE	<u>Pemphis</u> <u>acidula</u>	Very hard wood Attachment of "kiato" to outrigger Fish hooks in former times
FAU	<u>Pipturus</u> <u>argenteus</u>	Strong 3 stranded string called "laufau" from inner-bark Nets, lashing on hooks, fishing line Sometimes misidentified as Hibiscus
NIU	<u>Cocos</u> <u>nucifera</u> (coconut)	String from coconut husk Fishing line, lashing for canoe hull components Fish hooks from coconut shell, oil from coconut meat used to calm ocean surface for noose fishing
ULU	<u>Artocarpus</u> <u>altilis</u> (Breadfruit)	Sometimes used for canoe hull Leaves for Lulu fishing
LAUMEA	<u>Asplenium</u> <u>nidus</u> (Bird nest fern)	Leaves for Lulu fishing
PUKA	<u>Hernandia</u> <u>sonora</u>	Sometimes used for canoe hull Outrigger, bailer In former times, fishing pole, and hull for double sailing canoe Sail supports ("toko, tila")
PUAPUA	<u>Guetarda</u> <u>speciosa</u>	Sometimes used for kiato Leaves called "lauvao" - used for Lulu fishing Stick for noose fishing
FALA	<u>Pandanus</u> <u>tectorius</u> (Pandanus)	In former times, sail
TAUHUNU	<u>Argusia</u> <u>argentea</u>	Bailer
KOFE	<u>Bambusoideae</u> (Bamboo)	Fishing pole Sometimes wash ashore but mostly imported from Samoa
FETAU	<u>Callophyllum</u> <u>inophyllum</u>	Sometimes small canoe hull

NOTE: Scientific names from Whistler (1980, 1983),
and by ORSTOM botanists.

TABLE 8. METHODS USED BY TOKELAU FISHERMEN TO CAPTURE TUNA

METHOD	DESCRIPTION	MAJOR SPECIES (*target)	DEPTH	GEAR (1)	BAIT	SEASON (2)	DAY OF LUNAR MONTH (3)	AREA	NOTE
ALO ATU	Poling skipjack	Skipjack* Small Yellowfin	Surface	Pole "Laufau" line Pear-shell lures	-	Sept-Oct best Nov-Feb good	1 - 3 23 - 25	Anywhere offshore, especially near the points	Described in Kirifi (ms.) Moon nights 23-25 are when o fish are available Large canoe required Has not been done since about 1974 from a paddled canoe, occasionally done at present from canoe or skiff with outboard
LULU	Handlining using rock and chum	Yellowfin* Dogtooth tuna Wahoo Rainbow runner Bigeye Billfish Albacore Shark	30 - 100 fathoms	Line(40-140kg) 40cm steel leader Size 6 circle hook Rock Leaves	Flying fish Double-lined Mackerel Sclar Decapterus Squirrelfish	April-Sept	5 - 10	1) East & West of South point 2) South & NW of West point 3) East and West of North point	Also done at FAD Described in Kirifi (ms.) Most productive technique at present
FAKA POAPOA	Shallow handlining using chum	Yellowfin Wahoo Dogtooth tuna Barracuda	10 - 30 fathoms	(same as for lulu above but without rock & leaves)	Skipfish Flying fish Double-lined Mackerel Sclar Decapterus	May-Oct	1 - 3 15 - 18	Closer to reef and down current from above lulu areas	Called "faka opeope" when targeted on barracuda
FAKATU	Deep hand- lining	Shark* Yellowfin Dogtooth tuna Bigeye Albacore	80 - 110 fathoms	Line(150-300kg) 40cm steel leader 13/o "big game" or no.4 tuna circle hook	Skipjack Double-lined Mackerel Flying fish	May-Oct	1 - 6 23 - 25	150 metres seawards from lulu spots	Only done during daylight as large sharks dangerous at night Uses large piece of bait
TAKIULU	Noose fishing	Wahoo* Yellowfin Shark Billfish	Surface	Line for bai' (25-35 lbs) Noose line Stick for noose Coconut meat	Skipjack Flying fish Double-lined Mackerel	May-Nov	5 - 10	All along reef 100-200 metres offshore	Best at low tide; at present only one Fakaofu fisherman uses this technique regularly Described in Kirifi (ms.)
TOHO	Trolling by sail near reef	Wahoo Dogtooth tuna Barracuda Caranx sp.	Surface	Line(15-50kg) large matatahi or barbed hook	Flying fish	May-Nov	23 - 25	All along reef 100-200 metres offshore	Closer to reef when targeting on barracuda Fishermen stopped using this method when outboard trolling became popular in about 1980
TROLLING	Modern trolling by out- board	Skipjack Yellowfin Rainbow runner Mackerel tuna Wahoo Barracuda	Surface	Line(25-100kg) Optional steel leader Lure	-	Sept-Feb	Anytime especially 1-3, 23-25	As for Alo Atu	Many fishermen believe that this method detrimental to "alo atu" and noose fishing Yellow translucent handle of screwdriver popular for lures Pear shell lure not usually used for fear of loss to large fish

Notes: 1) Mustad brand names and sizes used.

2) Methods listed can be used year round, months given are most productive times.

3) Methods listed can usually be done on most days of the lunar month; days given are most productive days. Some variation in opinion exists between fishermen.

It should be pointed out that a tuna fishing expedition is not confined to the use of a single technique. A good fisherman takes his pole and pearl-shell lures on every occasion when he ventures into the open sea. "Fakapoapoa" and "lulu" are frequently carried out simultaneously in the same canoe by different men. By using a diversity of techniques, the chances of having a successful expedition are increased.

Handlining, noose-fishing, and poling skipjack are of special interest and require further description. Some aspects of these techniques are covered in MacGregor (1937), Keen and Foai (1976), Hooper (1984), and Kirifi (ms.).

Handlining

The three handlining techniques ("lulu", "fakapoapoa", and "fakatu") utilise a similar fishing strategy to capture subsurface tuna. The dotted areas in Figure 5 show the handline fishing areas, each of which is close to a point⁸ of the atoll. On days favourable for handline fishing the current flows along a coast towards a point. Fishermen believe that tuna approach a point from offshore swimming against the current in search of food. The six handlining areas shown in Figure 5 are located up-current from the points so that a fish, following chum or odours from bait, will arrive at the fishing gear in the course of their normal path.

The varying productivity of handline fishing with respect to the lunar month (Table 9) is thought to be due to the moon's effect on current and on tuna food. As the areas for handlining are well defined, the relative success of different handline fishermen on a particular day is dependent on which of the three methods is utilised, the selection of depth, and especially for "lulu" fishing, the baiting technique.

The "lulu" baiting technique has many variations. The following was confided by a "tautai" who, although long retired, was once considered a master of the technique. It gives an indication of the importance attached to careful baiting.

A double-lined mackerel, or preferably a flying fish is bisected from head to tail along the dorsal surface. One of the two resultant pieces is again cut in half lengthwise. Fins and most attached flesh are removed and the piece is trimmed to produce a rectangular strip about 5 x 15 cm. An incision is made in one end of this piece about half of the length. The end without the incision is lashed with thin line to the shank of a hook with the skin side of the bait on the outside. Another similar but smaller rectangular bait piece is hooked onto the bend of the hook with the skin facing the opposite direction to the first piece. The eye of the baitfish is inserted onto the hook close to the tip. This baited hook is placed on a leaf of the breadfruit tree or bird nest fern. The flesh that was removed from the original baitfish is partially chewed

8. The east point, Te Utua O Matagi, is rarely fished due to the long distance a canoe must travel from the channel at Fale.

FIGURE 5: FAKAOFO ATOLL

Based on chart NZM 272-7-3
modified to show underwater reef
contour at the four points

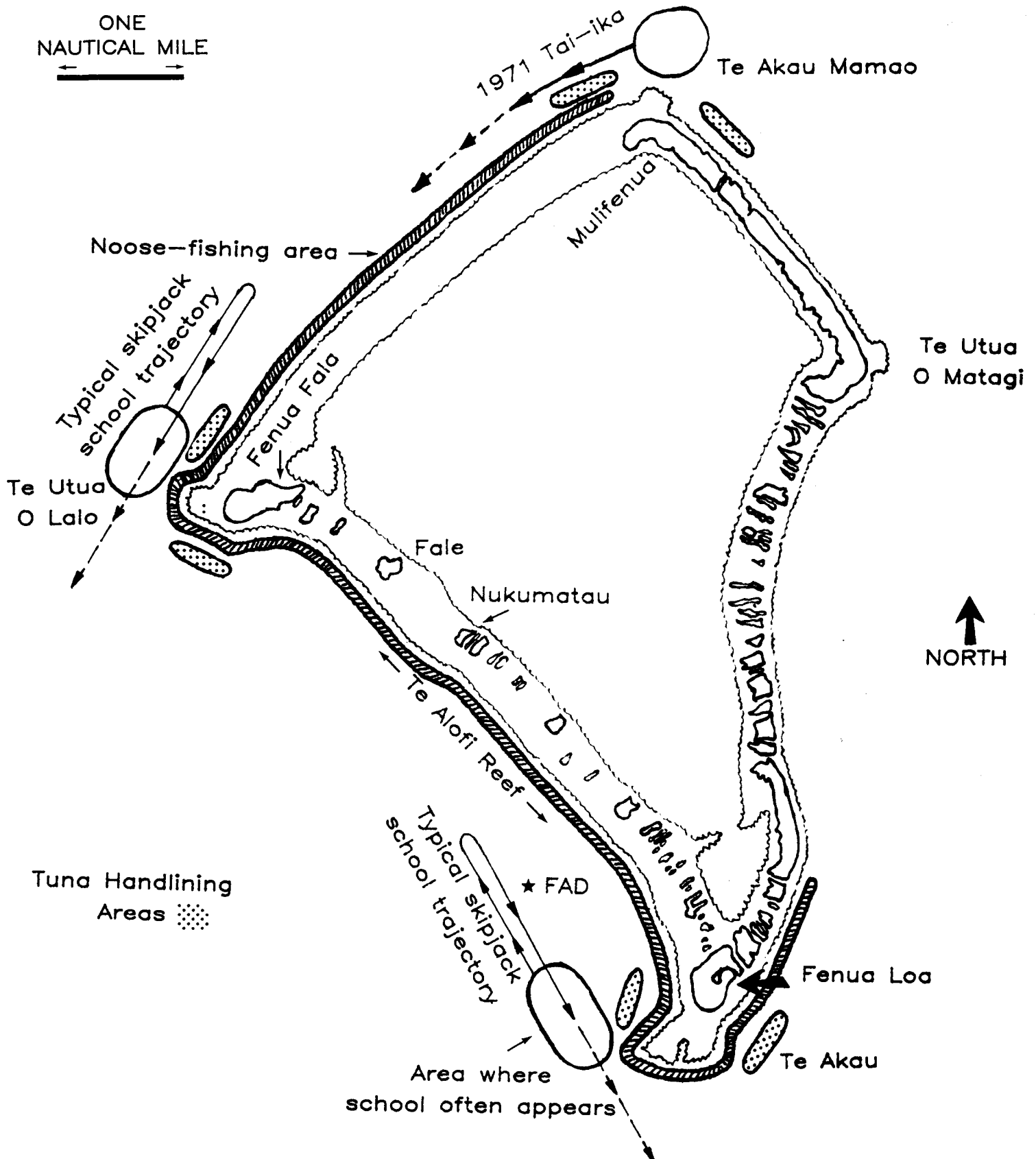


TABLE 9. THE SYNODICAL LUNAR MONTH

Day	Tokelau Name	Moon Phase	"O"	Skipjack Abundance	Optimum (1) Fishing Method	Notes
1	Fakatahi	new moon		+	alo atu,fakatu fakapoapoa,trolling	Beginning of "kua pala te mafua"
2	Fakalua			+	alo atu,fakatu fakapoapoa,trolling	"Kua pala te mafua"
3	Fakatolu			+	alo atu,fakatu fakapoapoa,trolling	"Kua pala te mafua"
4	Fakafa				fakatu	Shark liver reported to be large
5	Fakalima				lulu,fakatu takiulu	Shark liver reported to be large Small siganids plentiful in ocean
6	Fakaono				lulu,fakatu takiulu	Small siganids plentiful in ocean
7	Fakafitu				lulu,takiulu	Small siganids plentiful in ocean
8	Fakavalu				lulu,takiulu	Small siganids plentiful in ocean
9	Fakaiva				lulu,takiulu	
10	Magahulu				lulu,takiulu	
11	Fakatahi					
12	Fakalua					
13	Utua					
14	Malama	full moon				
15	Fakatahi				fakapoapoa	
16	Fakalua	maybe o			fakapoapoa	
17	Fakatolu	maybe o			fakapoapoa	
18	Fakafa	maybe o				
19	Fakalima	maybe o				
20	Fakatutupu	maybe o				
21	Poagafulu	maybe o				
22	Poiva	maybe o				
23	Povalu	usually o	+		alo atu,fakatu toho,trolling	"kaimafua" school common
24	Pofitu	usually o	+		alo atu,fakatu toho,trolling	"kaimafua" school common
25	Po-ono	usually o	+		alo atu,fakatu toho,trolling	"kaimafua" school common
26	Polima	maybe o				
27	Hanouluata	maybe o				
28	Hanolotoata	maybe o				
29	Matekiluga					
30	Hanoloa					

(1) Some difference in opinion between "tautai"

and put with the baited hook on the leaf which is then folded lengthwise then widthwise. The resultant packet is placed on a stone of perhaps three times the size of a fist. The line attached to the baited hook inside the leaf is wound round the stone and the leaf packet four to eight times. A bight of the running end of the line is pulled under the windings to form a slipknot. When fishing, the stone/leaf/bait arrangement (Figure 6) is heaved into the water and sinks. When it reaches the desired depth, the fisherman jerks the line, and the slip knot is released freeing the leaf from the rock. The chum is dispersed and being only slightly negatively buoyant, flows down current at about the same depth as the baited hook.

The gear used for tuna handlining is described in Table 8. Items listed are those presently used by a "tautai" who is generally recognized to be the most skilled of the active fishermen on Fakaofu. Prior to the 1940s a metal "matatahi" hook (6 cm in length), "laufau" line leader (about 100kg), and coconut fibre cord (90kg) were used for "lulu" and "fakapoapoa" fishing. A larger "matatahi" hook (without leader) and coconut fibre cord (140kg) were used in "fakatu" fishing. A change to cotton line was made in the early 1940s and nylon monofilament was introduced in the late 1960s.

Noose-Fishing

Noose-fishing is one of the most remarkable fishing techniques in use in the Pacific Islands at the present time. Once widely practiced in Tokelau and Tuvalu, only one "tautai" on Fakaofu regularly uses this method at present. A summary of the technique used by this fisherman follows.

The general area for noose-fishing, 100-200 metres offshore along the reef, is given in Figure 5. In choosing the specific fishing area for a particular day, consideration is given to cloud patterns⁹, state of the moon, and current. A whole, scaled flying fish with a line through the eye-sockets is towed behind a canoe. Upon arrival at locations known to be especially good for this type of fishing (about ten places along Te Alofi reef), the canoe is slowed allowing the flying fish bait to sink almost vertically to a depth of 20 to 30 metres. The crew member in the bow chews coconut meat and separates the solid portion from the oil in his mouth. The oil alone is blown out of the mouth ("puhipuhi") to produce a mist which covers a sizeable area on the ocean surface to starboard of the canoe. The change in surface tension caused by the oil enables the crew to view the bait below.¹⁰ Jiggling the bait line and repeated casting of the line are used to attract wahoo, yellowfin, shark, or billfish to the area. If successful, the "tautai" will make special noises (like sh-sh-sh-sh) to help entice the fish closer and alert the crew. By casting the bait line and throwing egg-size pieces of bait to different areas, the fish is manipulated to about two metres off the

9. Although the validity of using cloud patterns ("kaumana") is doubted by some experienced Fakaofu "tautai", it is interesting to note that Kennedy (1930) mentions this practice in conjunction with offshore fishing in Tuvalu.

starboard quarter. At this point the crewmember in the bow slowly paddles the canoe forward while the "tautai" in the stern stands and with the aid of a stick ("kauhele") will quickly sink the noose (about three metres in circumference) vertically into the water¹¹, the forward motion of the canoe assuring that the noose opens. All is quiet in the climactic moment as the final piece of bait is placed in the centre of the loop and the stick is removed allowing it to drift astern. If the "tautai" has been clever in anticipating the motion of his adversary, the fish darts for the bait and passes through the centre of the loop. A precisely timed jerk on the noose line (Figure 6) tightens the loop on the fish's caudal peduncle. The captured fish, usually a wahoo, puts up a fair but futile struggle. If a billfish has been captured the crew is in for what was referred to as a "Nantucket sleigh ride" in the days of whaling.

Skipjack Poling Using Pearl-Shell Lures

Until fairly recently catching skipjack with pearl-shell lures was tremendously important in Fakaofu. In both the skill required for its mastery and the physical effort needed to carry it out, fishing for skipjack was second to none. Although it has been ten years since tuna were last caught using authentic poling techniques, it is on this subject that most of the "tautai" involved in the present study wished to speak. As they used (perhaps somewhat hopefully) the present tense when referring to this demanding fishery, so does the following account.

Skipjack poling is carried out by a "tautai" and three to five additional crew on a relatively large canoe. A diagramme of a typical canoe, names of the crew positions, and their respective duties are given in Figure 7.

Most of the surface schools of tuna accessible to Fakaofu fishermen first appear close to one of the westerly points of Fakaofu. As these areas are located from 2.5 to 4 nautical miles from Fale, a considerable amount of time is expended in transportation to the fishing grounds. The prime fishing time at Te Akau being about one half an hour on each side of sunrise (about an hour later for Te Utua O Lalo), a very early departure from Fale village is required. A sail is used in favourable wind conditions, however in the absence of wind, or wind from an unfavourable direction, the canoes are paddled.¹² During the actual poling the sail is never used. Reasons for this include reduced manoeuvrability, the need for the "tautai" to scramble to the opposite

10. This procedure works surprisingly well, allowing better vision below the water than polaroid glasses.

11. The noose is laid flat on the surface for yellowfin. For billfish a vertical noose is used, but a whole baitfish is tied onto the top of the noose.

12. The size of the paddle blade is remarkably small. Stated advantages of this include that more strokes are allowed per unit time (the noise of a paddle stroke is thought to attract tuna), less chance of a paddle blade hitting the canoe and causing noise (repels tuna), and less need to feather the paddle.

end of the canoe during tacking, and difficulty for the "foeliu" crewman simultaneously to steer, control the sail, and assist in the landing of fish.

In the course of the fishing expedition the first indication of a school ("taumanu") of tuna is usually given by bird activity. Nearing the area, the school type, size/species of fish, and finally the type of feed ("mafua"), may become evident. Each of these factors is important and is critically evaluated by the "tautai" in formulation of the fishing strategy.

Table 10 lists the birds which are at times associated with surface schools of tuna at Fakaofu. Of the species listed, the two noddies and especially the fairy tern ("akiaki") are of prime importance in tuna fishing. In the silent Tokelau canoes it is possible to distinguish two different cries of the fairy tern, one of which is used only upon spotting a new source of feed in the water. During the actual poling, this can be a useful advance indicator that a school of skipjack is about to shift position.

As a canoe proceeds closer to the area of bird activity, the school type ("laga") becomes apparent. Table 11 gives the different types known to present-day Fakaofu "tautai". The list is notable for the large number of classifications, compared to the number recognised by, for example, Japanese or American fishermen working in nearby waters. Tokelau fishermen may be the only tuna fishermen in the Pacific Islands who discriminate between two types of "finner" school (which apparently behave very differently), or recognise "white spot" or "smooth surface" schools.

Nearing the school vicinity, the fishing pole is placed into the holder and one of the pearl-shell lures is cast so that it trolls astern. In the immediate area of the school the "tautai" may take several very shallow paddle strokes to starboard which serve to splash water on the surface of the ocean near the lure to excite the tuna. This procedure of splashing, called "fakamafua" in Tokelau, is also known from traditional times in both the Maldives Islands of the Indian Ocean and Japan. When either a fish strikes the lure or it is anticipated that one will shortly strike, the "tautai" will stand and face aft. From this point decisions concerning the movement of the canoe, considered of secondary importance to poling, are made by the "foemua" crewman¹³ who relays his orders to the "foeliu" man.

To incite the tuna to bite, a good "tautai" has a vast arsenal of tricks at his disposal. Table 12 is a partial listing of these mechanisms, the selection of the colour of the pearl-shell lure being most important. There is general agreement among the "tautai" of this study that a pure white lure ("pa hina") should be used first in the white-spot ("fakapula") school and a golden lure ("lau milo") be used in

13. This is markedly different from both Japanese and American tuna poling where the fishingmaster or skipper controls the vessel movement, considered the most critical task, while the deck crew does the poling.

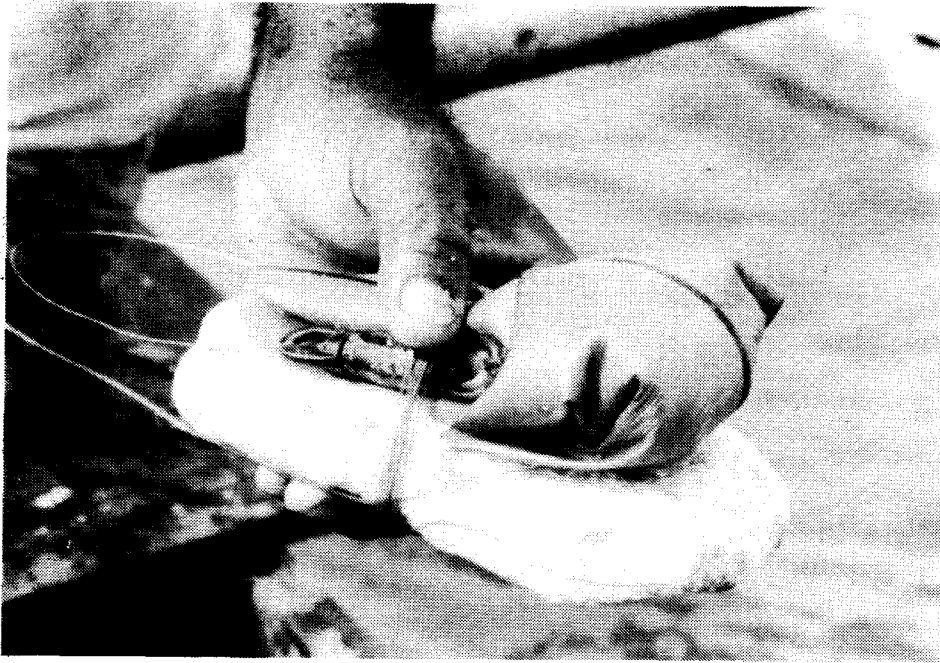


FIGURE 6

The lulu packet (left)

Tokelau postage stamp
depicting noose—fishing

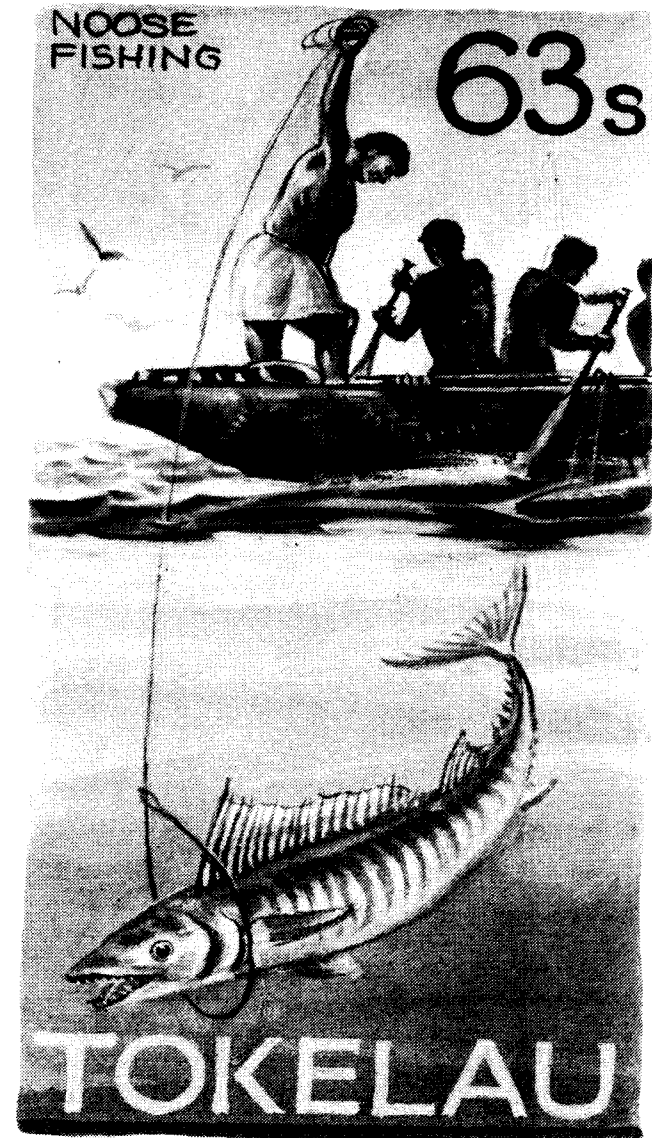
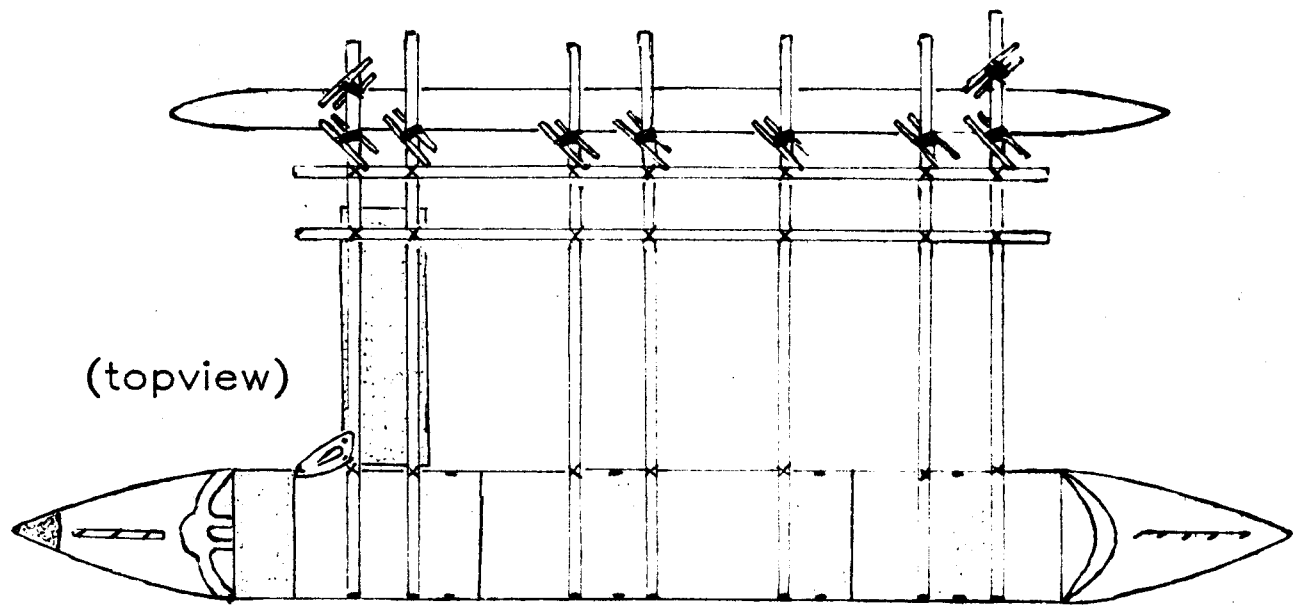


Figure 7: The Canoe and Crew



"Tautai"

In command

Poles fish

Steers when seated

"Foeliu"

Steers when "tautai" poles

Splashes during poling

Helps land fish

"Nahoaliu"

Bails water

"Lagofoe"

"Foemua"

Sets rhythm of paddling

In command when "tautai" poles

Communicates with "foeliu"



TABLE 10. BIRDS FOUND ASSOCIATED WITH SURFACE SCHOOLS OF TUNA AT FAKAOFU

Tokelau Name	English Name (Scientific Name)	Note
Akiaki	Fairy tern (<u>Gygis alba candida</u>)	Most useful bird for skipjack fishing at Fakaofu has two types of cries; one is used only when it spots feed in water. This cry useful for predicting shifting of tuna schools. If only this species of bird present over school, probably will be good school and probably school will contain only skipjack. Closely observed while pursuing a school as more accurate indicator of tuna movement than other bird species over school. Fishermen report they would follow this bird to land if lost. Sometimes closely watched in very early morning to observe in which direction it heads to sea.
Lakia	Black or white-capped noddy (<u>Anous minutus minutus</u>)	Most common bird on Fakaofu. Sometimes kept as pet. Fishermen report they would follow this bird to land if lost.
Gogo	Brown noddy or common noddy (<u>Anous stolidus pileatus</u>)	Second most common bird on Fakaofu. Sometimes kept as pet. Fishermen report they would follow this bird to land if lost.
Tala gogo	Sooty tern (<u>Sterna fuscata</u>)	Sometimes kept as pet. Caught with net similar to flying fish net. Forbidden to catch this bird at nesting grounds.
Tala	Spectacled tern (<u>Sterna lunata</u>)	
Katafa-ua-leuleu	Greater frigate bird (<u>Fregata minor</u>)	Other frigate bird types recognised are "katafa-ua-tala", "katafa gogo" and "katafa koti".
Takupu	Red-footed booby (<u>Sula sula sula</u>)	Sometimes kept as pet. Young bird called "talaga". Feathers sometimes used for pearl-shell lures.
Fuako	Brown booby (<u>Sula leucogaster</u>)	Usual feathers for pearl-shell lures.
Tovivi	Black-naped tern (<u>Sterna sumatrana sumatrana</u>)	Only associated with schools when they occur close to shore.
Manutagilua	Wedge-tailed shearwater (<u>Puffinus pacificus</u>)	Called "takatai" when at sea. Some fishermen believe when this bird cries at night, it is a good sign for skipjack fishing the following day.
Tavake-ulu-gahu	Red-tailed tropicbird (<u>Phaethon rubricauda</u>)	Best feathers for pearl-shell lures. Folktale on relation between this bird and certain fish given in Wodzicki & Laird (1970). Fairly rare; not commonly found associated with surface schools of tuna.

Note: Most English and scientific names from Wodzicki & Laird (1970).

TABLE 11. SCHOOL TYPES RECOGNISED BY TOKELAU "TAUTAI"

Tokelau Name	English name	Tuna species present	Note
Tahihina (Tamimiha)	Foamer	Skipjack Yellowfin	Ocean surface churned white; very noisy school; canoe crew not required to be silent; most common November to January.
Takafakauli	Finner	Skipjack	Dorsal of fish barely breaks surface; very common school type; "lau milo" colour lure used first; fairly slow moving school; not many birds; porpoise sometimes associated with this school type.
Fakapula	White spot	Skipjack	No sign of fish on surface - large white area visible below; best school type for fishing, but not very common; "pa hina" colour lure used first; school moves straight and slowly; no birds associated; no bait in area or gut; almost always in early morning.
Tahikupa	Finner	Skipjack	Only caudal fin breaks ocean surface; fishing usually poor; difficult to entice to bite; round head pearl-shell lure thought to work best; presence of this school type frequently signals the end of a run of good fishing.
Fakaliki	Rippler	Skipjack	Small rippling waves made at ocean surface; fish do not break ocean surface; fishing usually very good.
Kaimafua	Jumper	Skipjack Yellowfin	Fish jumping clear of ocean surface; typically feeding on 5 fish; common during days 23 to 25 of lunar month.
Fakalelei (Tukuhakalelei)	Smooth surface	Skipjack Yellowfin	Ocean surface in area of school very calm; common school type; fishing usually good.
Lagafakakatoa	All action	Skipjack Yellowfin	All school types are present; largest schools are of this type; very noisy school; canoe crew not required to be silent; some older "tautai" consider fishing is best on school perimeter.
Lagatutuku (Taufakalae)	Shifting	Skipjack Yellowfin	School remains at surface for only short period, moves quickly to another area and re-resurfaces; caused by billfish or fast moving feed; typically very fast school.
Koga-ika (Takavalevale)	No sign	Skipjack Yellowfin	No indication of school on ocean surface; no birds present; detected by trolling strike.
Kata	Log	Skipjack Yellowfin	Local name applies to any log associated fish; usually not fished because fear of shark attack or lure loss.
Lagafakaikavale (Fakamanumanuvale)	Subsurface	Skipjack Yellowfin	No signs of fish visible to fishermen; presence indicated by birds; very common school type.

* Alternate name in parentheses.

TABLE 12. ITEMS BELIEVED TO INDUCE SKIPJACK TO BITE

Item	Note
Changing the colour of lure used	Most important item; 5 colour categories.
Using paddle to splash water around lure	Called "fakamafua"; crewman forward of "tautai" splashes water with paddle; canoe should be pointed into wind.
Chumming with dead bait	Called "fakatata"; only "o" fish are used; crewman forward of "tautai" chums.
Bending leader of lure at point of attachment towards the hook	Causes lure to wiggle more.
Using rounded head lure	"Ulu faka ula" shape head; causes lures to wiggle more.
Trolling lure in wake of canoe	
Changing speed of canoe	
Paddling	"Gurgling" noise of paddle stroke thought to be attractive to tuna.
Making special noises	Called "polili"; "tautai" produces sounds like "rrrr", "chu-chu-chu", or "sh-sh-sh".
Shaking pole	Spare lines slap against bamboo and make noise; not done by all "tautai".
Chanting	Called "fakanau"; skipjack are asked to come up, then "tautai" call out each of the school types by name ("fakapula", "tahihiina", etc.) in a low voice.
Moving to different area of school	Usually area of maximum intensity is sought; if unsuccessful, other areas are tried.
Using a longer pole	Enables the placement of a lure further from the canoe as fish may be hesitant to approach.

a finner ("takafakauli") school. For other school types, individual "tautai" have strong ideas, but there was no unanimity in expressed opinion. In general, the favoured colour for the school type or feed in the water should be used, and if unsuccessful, another should be tried. A lure is cast astern on the outrigger (port) side and with a swing of the pole trolled to starboard where it is jerked from the water and cast astern again.

During poling three important themes guide the action of the "tautai" and the crew. They are the efficient use of the short time interval when tuna can be poled, the avoidance of doing anything which could possibly scare the fish, and the conservative use of the pearl-shell lure to avoid loss.

For the "tautai" and crew who may have risen from bed in the middle of the night and paddled hours to the fishing ground, the only productive time is that short period, perhaps only several minutes in duration, when the school is on the surface, near the canoe, and in a biting mood. Everything possible must be done to utilise the short time efficiently. Table 13 lists some of the ways that this can be done. The physical manipulation of rapidly jerking a fish from the water and unhooking it is of utmost importance. It is this skill that separates a good "tautai" from an average one, the point that causes Tokelauans to think that they are better tuna fishermen than those of Tuvalu or Samoa¹⁴, and what "tautai" from the past are remembered for. One sometimes hears the story of Havaiki, a "tautai" who died in the 1800s, who used to pole skipjack with such a regular action that he was compared to the motion of the clock pendulum in the meeting house, or of Mika who could pole fish so fast with a flip that it was often not visible to other canoes in the area due to the intervening ocean swell.

There are several named styles of poling ranging from the fast, daring mid-air unhooking ("haetu") to the slow, amateurish dragging the fish in the water to the canoe ("toho"). Other styles include straight poling ("hamutonu") and poling with a swinging action ("haulafalafa"). When a small tuna is hooked from a school in which large fish predominate, it will sometimes be jerked clear of the water with a disproportionate amount of vigour. A skilled "tautai", instantly realising the predicament, will swing the fish in a great arc a full 360 degrees around the canoe and then land it.

The speed with which a "tautai" will attempt to pole tuna is a compromise between his desire to maximise the number of fish landed and his fear of doing something that could frighten a school, especially having a fish fall back into the water. Some factors thought by fishermen to repel tuna are listed in Table 14.

As pearl-shell lures are extremely valuable possessions in Tokelau, fishermen are very conservative in situations that could lead to their loss. Because the chance of losing a lure is much greater with big fish,

14. Burrows (1937) mentions that fishermen on Wallis Island formerly poled skipjack like the Samoans but later adopted the Tokelau technique.

TABLE 13. TECHNIQUES USED TO INCREASE THE NUMBER OF FISH LANDED

Technique	Note
Unhook fish in mid-air	Called "haetu"; done by jerking pole while fish is airborne; very difficult and somewhat dangerous.
Pole fish so caudal peduncle hits starboard gunwale of canoe	Upon impact, fish flip into canoe and are thus unhooked "automatically"; somewhat less difficult than "haetu".
Use large lure	Little chance that fish will swallow entirely.
Use obtuse hook angle	Hook called "tala humu"; faster unhooking, however more chance of premature unhooking.
Change colour of lure	When one colour lure works, another may perform better; other "tautai" in area may give advice on best colour.
Troll lure mainly on starboard quarter	As fish are usually landed on the starboard side, fish travel a shorter distance to canoe after hooking.
Troll lure with only distal (hook end) portion in water	Less chance that a fish will swallow lure entirely.
Fish as far to starboard of the fleet as possible	Direction of lure trolling by pole of other "tautai" is from port to starboard; upon reaching the starboard extreme, lure is jerked from water and cast to the port extreme; to the fish it appears that the lures are "swimming" to starboard so fish proceed to that area.
Shoot lure back to water	By pulling the lure towards the pole butt, tension is applied to line; when released the springiness of the bamboo can be used to propel the line towards the water faster than if merely tossed.
Use short pole	Faster because the fish travel shorter distance and less tiresome; when good fishing is anticipated, a "tautai" will take two poles, one of which will be short.
Use short line	After poling a large number of fish the line made of "fau" stretches.
Have crew push fish in the bilge forward	Fish piling up around the legs of the "tautai" can result in unsure footing.

TABLE 14. ITEMS BELIEVED TO REPEL SKIPJACK DURING FISHING ("MAUMAU")

Item	Note
Poled fish hitting canoe and subsequently falling back into water	Called "tamate"; thought to cause school to disappear; worst "maumau" possible brings disgrace to the "tautai" does not apply in "o" school.
Fish biting off lure from line, lure remaining in fish jaw	Thought to cause school to disappear; second worst "maumau".
Poled fish falling back into water without hitting canoe	Several in succession may cause school to disappear.
Fish biting lure without being hooked	Caused by premature jerking on the pole.
Fish falling off hook due to slack in line	Sometimes caused by rough sea conditions.
Object from canoe being dropped overboard	Most commonly hat or bailer.
Striking side of canoe with paddle	Before fishing school "tautai" sometimes warns crew of this.
Talking loudly	Does not apply in a noisy school, e.g. foaming school.
Dipping pole into water	Either tip or butt.
Intercepting the path of a school head-on en route to fishing area	Canoe should take longer route along reef to avoid school.
Commencing fishing too early in the morning	Tautai should wait until sun above horizon.
Vomitting in water	
Carrying out other types of offshore fishing during good skipjack fishing	In runs of good skipjack fishing all other offshore fishing, especially for billfish and shark, are forbidden.
Using a skiff for trolling	Both the engine noise at high speed and hull crashing into waves thought to be "maumau".
Tagging fish	The SPC tagged 64 skipjack and 1 rainbow runner in November 1978.

fishermen shy away from schools of large yellowfin, rarely fish around logs for fear of the occasional large fish or shark lurking in the area, and never use the prized centre-cut lure ("pa matua") as the first lure to be tried in a school. As mentioned previously, using turtle shell for the hook helps ensure that the shell will not be lost through breakage. Despite the fact that tuna schools contain sharks and billfish, a "tautai" will not hesitate to dive after a lure lost in the course of fishing.

When the "tautai" is poling fish in the stern, the "foemua" crewman will carefully watch the school and attempt to keep the canoe in the area where surface tuna activity is most intense. The success of other canoes that may be in the area is monitored, and the direction of fish movement after making a pass at a lure is observed along with changes in bird activity, especially the fairy tern.

Skipjack schools are rarely stationary in Fakaofu so the canoes must move with them. Although schools may appear in the ocean almost anywhere and move in many directions, most schools are first spotted west of the southern point, north of the western point, and north of the northern point. Figure 5 shows these areas and gives trajectories of typical schools emanating from them.

Fakaofu Tuna Fishing at Present

Traditional skipjack poling was last done at Fakaofu in about 1974. Many fishermen still take their poles and pearl-shell lures with them on trips outside the reef, but the gear is usually trolled in conjunction with the use of outboard motors. Only one fisherman occasionally makes noose-fishing trips.

The tuna handline fishery is still quite active. Most of the pelagic species landed during the study were caught by either "lulu" or "fakapoapoa". A fish aggregation device (FAD, "poe"), purchased with funds from the United Nations Development Programme, was deployed in January 1985 about one mile northwest of the southern point of Fakaofu. Much of the tuna handlining activity is presently centred around the FAD.

Catch and effort data for tuna and related species were collected between May 22 and June 21, 1985. In this period of 27 fishing days 114 offshore trips were made, 57 of which visited the FAD. A total of 95 trips were made in aluminium skiffs while traditional canoes equipped with outboard engines were used in 19 trips. Table 15 presents catch and effort data for these expeditions.

The most controversial fishing issue at present concerns trolling using outboards. Many "tautai" have a disdain for the technique and claim the noise of aluminium skiffs and the large number of fish that escape injured have ruined the chances of successful skipjack poling and noose-fishing. Some fishermen do not believe this, while others, although they recognise the negative effects of trolling, state that because others troll, they are obliged to troll if they wish to catch reasonable amounts of tuna.

Nukunonu and Atafu

During the three days spent on Nukunonu and Atafu, four "tautai" were interviewed. Obviously an in-depth study of tuna fishing knowledge at these two locations was not possible in the very limited time, so an attempt was made to determine how similar tuna fishing practices are to those of Fakaofu. Some of the more surprising information given by Fakaofu "tautai" was discussed and effort was devoted to determining variation in pelagic fish nomenclature between the atolls.

Although they may well exist, no major differences in tuna fishing practices were detected during the limited time. The names of pelagic fish (Table 2) appear identical throughout Tokelau. Comments on various aspects of knowledge about tuna reinforced the opinions of Fakaofu "tautai".

It was reported that the most recent "kau kumete" ceremonies were held in about 1981 in Nukunonu and 1975 in Atafu. Traditional skipjack poling was last done in about 1975 on both atolls. As in Fakaofu, tuna handling is still quite popular. At Nukunonu it was stated that fishermen have ceased regular noose-fishing, while it appears that several fishermen on Atafu occasionally use the technique.

Skipjack "Tai-ika"

A phenomenon known as "tai-ika" is a special characteristic of skipjack fishing in Tokelau. A "tai-ika" is a large school of skipjack which appears at one location every day at the same time for a period of three to eight weeks. They have occurred near all of the westerly points of Fakaofu, but are perhaps more common at Te Akau in the south. Typically a "tai-ika" will remain on the surface for a period of four to six hours each day. Figure 5 shows the daily trajectory of the most recent occurrence, that of 1971.

During the 20 to 60 days that one of these large schools remains in the area of Fakaofu, fishermen in their small canoes notice that several changes occur. At the early stage of a "tai-ika" the tuna are hesitant to approach a canoe and will frequently make passes at the pearl-shell lures without biting ("tutuli"). During the progression of days fishermen see the skipjack gradually lose fear, approach the canoe more readily, and fishing success increases. As the "tai-ika" continues, large skipjack become more common in the catch, yellowfin (which are occasionally caught in most skipjack schools) become rarer, and the eggs in the female gonads become progressively more mature. In addition, with each passing day the school remains on the surface for slightly less time and moves a shorter distance. A change of school type to finner, smooth surface, or white spot ("tukufakalelei", "tahikupa", or "fakapula") signals that "tai-ika" will soon end.

An attempt was made to determine the number of "tai-ika" that have occurred during the previous half century. Table 16 was compiled from the recollections of the principal informants of this study, individuals responsible for dividing the catch among the community ("tauvaega"), and people thought to have good memories. Information in the table should be considered only indicative. It is, however, adequate to show that

TABLE 15. PELAGIC FISH CATCH AND EFFORT INFORMATION, FAKAOFO, MAY 21
-JUNE 21, 1985

Week	<u>Effort</u>		<u>Catch</u>								TOTAL
	No. of fishing days	No. of fishing trips	YF/BE	SJ	BAR	WAH	RR	DT	SAIL	DF	
1	4	14	112	9	44	6	14	1	0	0	186
2	6	19	27	2	34	8	112	0	1	1	185
3	6	30	112	9	37	6	14	1	0	0	179
4	6	27	91	14	24	0	46	0	2	0	177
5	5	24	30	1	9	4	94	0	0	1	139
Total	27	114	372	35	148	24	280	2	3	2	866

YF=yellowfin

BE=bigeye

SJ=skipjack

BAR=barracuda

WAH=wahoo

RR=rainbow runner

DT=dogtooth tuna

SAIL=sailfish

DF=dolphinfish

TABLE 16. SKIPJACK "TAI IKA" AT FAKAOFO

Year (1)	Location	Notes
1934	Te Akau	Long lasting
1938	Nukumatau	Close to Fale
1942 (2)	Te Akau	
1946 (2)	Te Utua O Lalo	Very fast poling
1960	Te Akau	Large fish, short time period
1965	Te Akau/Te Akau Mamao	Shifted location
1971	Te Akau Mamao	Many canoes towed to location each day

(1) Except for latter two dates, years given are to be considered reliable only to within one year.

(2) Two people mentioned that during World War II fishermen may have sighted other "tai-ika" but they were not fished due to fear of Japanese naval activity.

"tai-ika" are fairly rare events. Many "tautai" expressed the opinion that "tai-ika" will probably never again occur at Fakaofu if some fishermen continue to use outboard engines to troll for tuna.

Although "tai-ika" are not common, much of the tuna fishing lore of Tokelau centres around these events. It is said that dried skipjack from these large schools sometimes lasted for a period of longer than a year. Minute details about past "tai-ika" are discussed when old "tautai" reminisce about the past.

In addition to the skipjack "tai-ika", fishermen also recognise yellowfin-bigeye "tai-ika" when large quantities of these fish are caught by handlining. It was reported that they have occurred about five times since 1955 including the most recent ones in 1975 and 1976 which both lasted about a month.

Mafua

The small fish and other animals upon which tuna and other pelagic fish feed are locally referred to as "mafua", and are considered the prime determinant of tuna abundance. Table 3 lists the major species of "mafua" at Fakaofu. Current, moon phase, and the season of the year affect "mafua" and therefore indirectly determine the abundance and distribution of tuna. The absence of the huge size of skipjack, "tuikaufu", for many years is attributed by some "tautai" to the "mafua" situation. When suitable "mafua" return, it is believed that so will the occasional "tuikaufu".

A species of "mafua" is thought to be "good" or "bad" depending on how it affects the success of tuna fishing, especially skipjack poling. A good "mafua" species occurs in large balls or moves slowly. Bad "mafua" either moves fast or dives frequently. It is interesting to note that juvenile siganids ("lotala") are considered a good "mafua" even though they are fast. It is believed that the siganids excite the fish, but their sharp spines hurt the mouths so the fish are especially anxious to attack a pearl-shell lure.

The species of "mafua" is sometimes a factor in the determination of which particular pearl-shell lure is to be used. Many "tautai" believe, for example, that a "hiku uli" colour lure works best, or at least should be tried first, when skipjack are feeding on goatfish ("tikava").

The "o"

The most important species of "mafua" in Tokelau is a fish locally called "o". Absent during most of the month it is frequently present in vast quantities the 23rd, 24th, 25th days of the synodical lunar month (sometimes slightly earlier or later) in the open ocean and areas seaward of the reef. Due to a religious event and preparations for a funeral, Fakaofu residents were preoccupied during the "o" period which occurred during this study and no specimens were obtained for identification. It was described as a red fish 4 to 5 cm in length, similar to a fusilier but with a different type of dorsal fin.

All "tautai" interviewed commented on the increased amount of tuna

present just prior, during, and after the time when "o" are present. Tuna fishing at this time was reported to be quite productive. Although "o" were not observed during the study, a marked increase in the number of schools visible on the horizon was noted during the "o" period.¹⁵

The "o" appear on the prescribed days throughout the year, but are most abundant November to February (Table 17). Failure of these fish to appear during the month is attributed to either extra subsurface predation or strong currents. "Tautai" reported that "o" occur in large aggregations upon which many species of pelagic fish feed. When skipjack are feeding on these balls of "mafua", pearl-shell poling is quite successful. The skipjack feed with such vigour that factors which normally repel tuna ("maumau", Table 14) have no negative effect. Fresh, dead "o" are sometimes thrown into the water ("fakatata") to incite the tuna to bite during pearl-shell poling.

Kennedy (1930) mentions that an important tuna food in Tuvalu is a fish called "o" but it is described as silver and bluish-green in colour. A recent inquiry to fisheries officials in Tuvalu revealed that "o" is a small red baitfish which "does not occur throughout the year in all islands and seldom appears for more than a few days, but not on a lunar cycle" (M.Batty, personal comm.).

The "Kua pala te mafua" and "Tugaki o ika katoa"

Two important phenomena which relate "mafua" to the abundance of tuna in Tokelau are termed "kua pala te mafua" and "tugaki o ika katoa". During the "o" period the skipjack gorge themselves on the abundant small fish. "Tautai" believe that after the "o" disappear there is a period of seven days in which the food is digested and during which time the tuna are only minimally active. At the completion of the digestion period, skipjack begin searching for food with renewed vigour and aggressively attack pearl-shell lures. This period, called "kua pala te mafua", lasts for three or four days during which time the success of skipjack poling is comparable to the desirable "o" period.

In Tokelau many species of lagoon fish, in an attempt to reduce predation on their offspring, cross over the reef at various times and spawn in the open ocean. This occurs throughout the year at specific times for each species.¹⁶ During September and October the open ocean spawning activity of "nearly all" lagoon species occurs concurrently. Juvenile fish which result become "mafua" and attract large amounts of tuna, more than at any other time of the year. This period, called "tugaki o ika katoa", has characteristically good weather and favourable wind for sailing to the fishing ground. In addition, the currents are

15. The SPC Skipjack Survey and Assessment Programme visited Tokelau in 1978 during days 17 to 23 of the lunar month (Kearney and Gillett 1979). The number of surface schools of tuna sighted per hour of searching, 2.03, was the second highest result obtained for the 21 countries that the Programme visited.

16. These times are well known and form an important part of the fishing lore of Tokelau.

TABLE 17. MONTHLY TUNA FISHING CONDITIONS AT FAKAOFU

Month	Prevailing wind	Ocean swell	Optimal fishing (1)	"O" abundance	Skipjack abundance	Note
JAN	West or NW	Large swell at Fale	Alo atu trolling	high	high	Frequently too rough for offshore fishing Strong NNE to NW wind called Laki most common this month Goatfish abundant in ocean
FEB	West or NW	Large swell at Fale	Alo atu trolling	high	high	Frequently too rough for offshore fishing Goatfish abundant in ocean
MAR	West variable	Large swell at Fale				Frequently unfavourable current for tuna fishing Goatfish abundant in ocean
APRIL	Calm East		LULU			
MAY	East	Sometimes large swell	LULU Fakapoapoa Hakatu Takiulu Toho			
JUNE	East	Sometimes large swell	LULU Fakapoapoa Fakatu Takiulu Toho			
JULY	East	Sometimes large swell	LULU Fakapoapoa Fakatu Takiulu Toho			
AUG	East	Sometimes large swell	LULU Fakapoapoa Fakatu Takiulu Toho			
SEPT	East variable calm		Alo atu LULU Fakapoapoa Fakatu Takiulu Toho Trolling	very high		"Tugaki o ika katoa" season Usually good current for tuna fishing
OCT	East variable calm		Alo atu LULU Fakapoapoa Fakatu Takiulu Toho Trolling	very high		"Tugaki o ika katoa" season Usually good current for tuna fishing
NOV	West or NW	Large swell at Fale	Alo atu Takiulu toho Trolling	high	high	Frequently too rough for offshore fishing
DEC	West or NW	Large swell at Fale	Alo atu Trolling	high	high	Frequently too rough for offshore fishing

NOTE: 1) Listed are the optimum months for each method.

said to be usually very good for both tuna handling and skipjack poling.

Skipjack Spawning Activity

Skipjack are thought by Tokelauans to be a monoecious animal; separate sexes are not recognized and it is believed that eggs develop fully without fertilisation. Two stages of female gonads are recognised. "Tama moto" are immature gonads (stages 1 to 3 of the scheme given in Argue (1982)) and "tama pula" are mature and ripe gonads (stages 4 and 5). It appears that male gonads are thought to be immature female gonads. Gonads are a prized food item and the distinction between the two maturity stages is quite important as "tama pula" are considered more tasty.

During a run of good fishing "tautai" notice changes in the gonad maturity. When a school first appears near the atoll the gonads are typically immature. Fishermen believe that as long as the gonads remain in this condition the school will stay at Fakaofu. The presence of some near ripe gonads signals that the school will soon move away to spawn far from land where predation on their offspring is minimal(17), a similar strategy to what they observe for lagoon fish. It is such a consistent phenomenon that gonad stage can be used for prediction. A "tautai" will sometimes ask the women who gut the skipjack about the maturity. If many mature gonads are present he may plan his fishing strategy around the idea that the school will soon disappear.

The actual spawning of skipjack is somewhat of a mystery to scientists who study tuna. Rarely, if ever, have spawning aggregations been documented. In this context the white-spot school type ("fakapula") recognised by Tokelauan fishermen deserves a closer examination. The fact that the school reportedly moves in a straight line with few or no associated birds and the fish have no fresh diet items in the gut suggests the skipjack are not in a feeding mode. Many "tautai" stated that the white colour of the school comes from the bellies of the fish which appear to be "playing with each other, pairing up, swimming together, and turning on their sides next to each other". It is very likely that this is a description of spawning behaviour. This is consistent with the reports that these schools are most common during the summer months when skipjack spawning is probably most intense (ARGUE et AL (1983) and fish from these schools have "very soft tama pula". Further support is given to the contention that fish in white-spot schools might be spawning by observations on "tai-ika" schools. In a previous section of this report the fact was noted that gonads become more mature as a "tai-ika" progresses and that the school type frequently changes to white-spot just before the school disappears.(18)

17. This is consistent with ARGUE et AL (1983). On the basis of 12,135 tuna stomachs examined, it is shown that the abundance of juvenile skipjack increased with increasing distance from land.

18. The most recent "tai-ika" at Fakaofu (1971) and Nukunonu (1975) both changed to white-spot school type just before disappearing.

Fish Movement

Fakaofu "tautai" having fished for countless generations in a relatively small area have accumulated a number of ideas on fish migration through simple observation. Fragments of fishing gear found on captured fish provide much of the information.

Tuna caught by handlining sometimes have hooks lodged in their mouths. Yellowfin and bigeye landed at the southern point of Fakaofu sometimes contain hooks that have been lost by local fishermen at the western point and vice-versa. From this fishermen reason that these fish move between different areas of Fakaofu and are not territorial with respect to the points. The capture of yellowfin, bigeye, and albacore with hooks and other gear used by Asian longline vessels when vessels of this type have not been seen in the area has led to the belief that these fish move to Fakaofu from considerable distances. The recovery of fish at the FAD with at least two sets of handline gear lost at the FAD over a week previously, has led to the belief the FAD somehow "holds" fish in a small area.

The cord used in noose-fishing was traditionally made of the bark of the "fau" plant. The great amount of effort required for its manufacture and the long period of use of a cord, in some cases generations, permits the recognition of the cord by its owner. A Fakaofu "tautai" several years ago caught a wahoo which had on the caudal peduncle a frayed section of noose which did not belong to any local fisherman. This led to the belief that at least some Fakaofu wahoo come from Nukunonu and Atafu.

The typical trajectories of surface schools of tuna, shown in Figure 5, are a matter of simple observation and are well known. Ideas concerning the movement of subsurface schools come indirectly from fishing results. It is thought that tuna move from offshore to the points of Fakaofu then along the reef against the current due to the order in which fish are caught by various canoes. A canoe at the handlining area (Figure 5) fishing farther down current from another canoe whose crew is fishing at a similar depth will likely hook a tuna slightly earlier. Similarly, deep swimming tuna are believed to travel in schools as several fishermen in one area, when fishing at the same depth, often catch tuna simultaneously.

Long-distance movement of skipjack is thought to be a result of the balance between feeding and breeding strategies. These fish take advantage of the period of high food abundance near Fakaofu as shown by the increased number of schools present during the "o" and "tugaki o ika katoa" periods. They then move far out to sea to spawn as evidenced by the mature gonad stage at the time that schools disappear.

The "Tamate"

Tokelau "tautai" feel that a number of factors can frighten surface schools of tuna (Table 14). The most extreme case, called "tamate", occurs when a skipjack or yellowfin is hooked and poled to the canoe but inadvertently hits the side of the canoe, becomes unhooked, and falls back into the water. It is believed that the stunned fish behaves

erratically and "cries" which alarms other fish in the area. "Tautai" feel very strongly that the "tamate" will quickly cause the school to disappear, or at the very least, cause the fishing success to decrease sharply. An error of this type is considered an inexcusable blunder. Because it may result in the waste of an entire fishing expedition involving several canoes and many man hours of strenuous paddling, it brings considerable shame to the responsible fisherman. In the case of a "tai-ika", a "tamate" could result in the disappearance of the school which might otherwise provide dried fish for an entire year.

It is interesting to note that the "tamate" situation is not applicable when the skipjack are feeding on aggregations of "o" fish. Many fish may fall back into the water injured without causing the school to disappear. This observation may help reconcile the strong Tokelauan belief in the negative effects of a "tamate" with the results of researchers who have studied the phenomenon, usually on commercial live-bait boats, without detecting detrimental effects. Possibly when tuna are excited by quantities of "o" or live bait, injured fish will not frighten the school.

The concept of "tamate" is not unique to Tokelau. It is reported from several areas including Tuvalu (Kennedy, 1930), Pukapuka (Beaglehole, 1938) and Satawal (Gillett, ms). The strong insistence of traditional fishermen on the deleterious effects of "tamate" and its widespread distribution suggest that it is indeed valid.

Billfish

Tokelau fishermen occasionally catch billfish ("hakula"), usually by the "lulū" technique. Of the two species of billfish recognised locally, the sailfish ("tuaniu") is most commonly caught at present. It is reported the blue marlin ("tiuvaka") was landed much more often and at a larger average size a few decades ago. (19)

Fisheries scientists believe that tuna, especially skipjack, must swim constantly. In the introduction to Tuna and Billfish, a good general reference on many aspects of tuna, it is stated "Because they (tuna) depend on their own motion to pass oxygen-rich water over their gills, the tuna can never stop swimming" (Joseph et al, 1980). This conventional wisdom is somewhat contradictory to the experience of Tokelau fishermen. All 16 "tautai" interviewed at Fakaofu, Nukunonu, and Atafu have several times seen a skipjack which, after being chased by a sailfish or blue marlin, takes refuge next to a canoe. They report that the skipjack remains stationary "quivering with fear" and will stay at the canoe until the billfish leaves the area. All the "tautai" stated that it is easy to catch the skipjack by hand, but one must be careful to keep the fish from flopping about in the bilge for fear that the noise

19. Asian longliners began operating in the area in 1954. It is reported (Klawe, 1978) that in 1976 these vessels captured in what is now the extended economic zone of Tokelau a total of about 22 tonnes of billfish comprised of blue marlin (57% by weight), swordfish (23%), striped marlin (10%), sailfish (6%), and black marlin (4%).

will cause the billfish to attack the canoe. This phenomenon has been previously documented from traditional fisheries in the Society Islands (Nordhoff, 1930) and in Samoa (Hiroa, 1930).

Conclusions

Tuna fishing in Tokelau in the previous half-century appears quite similar to that of Tuvalu as described by Kennedy (1930) with respect to both gear and fishing techniques. This relationship seems to be stronger than that of Samoa (Hiroa 1930, Hornell 1950) to Tokelau. On the basis of limited experience on Nukunonu and Atafu, it appears that there are no major differences between the three atolls of Tokelau concerning tuna fishing practices and beliefs. Traditional knowledge of the tuna fishery throughout Tokelau could therefore be considered as basically one body of lore.

The tuna fishing grounds at Fakaofu are very small. The size of the area fished by a "tautai" during his entire life, about 40 square nautical miles, is about ten percent of that which a modern purse seiner could cover in one hour. Fishing knowledge of this small area has most likely been accumulating for hundreds of years and passed down for generations through the traditional "tautai" education system. The small canoes used for tuna fishing in Tokelau permit close observation of fish not possible on commercial craft in use in most of the Pacific Islands today. Examples of this are the fine discrimination between school types, skipjack which are chased by billfish, and observations on what might be spawning behaviour. The canoes being very quiet, even more so than traditional sailing vessels used for fishing in other island groups, enable fishermen to associate different noises with the attraction and the repelling of tuna. Expertise on the fishing ground is strongly encouraged by both the status of a highly productive "tautai" and by the need for food on an island where the number of edible plants has historically been very limited. All of the above factors result in Tokelau fishermen knowing their tuna fishing ground to a degree which is unsurpassed in other tuna fisheries of the Pacific.

The extent to which Tokelau "tautai" know their fishing grounds permits them to detect, observe, and monitor phenomena which are much less known, or even unnoticed, in other documented tuna fisheries. The fishermen are quite aware of tuna movement, its relationship to spawning behaviour, lunar and seasonal changes in tuna abundance, and the relationship of food items to tuna behaviour. The degree to which "tautai" know their area also permits some prediction. "Tautai" can be reasonably confident that during the periods of "o" and "kua pala te mafua" the likelihood of fishing success will increase. They are also able to predict when a school will leave the area by the use of gonad stages and school types.

The knowledge of "tautai" concerning the interrelationship of gonad stages, school type, tuna movement, and spawning behaviour is of considerable scientific interest and the subject should be pursued. Other worthwhile areas for further examination are likely to be the topics of lunar effects on tuna and the "o" fish.

In the 1930s Macgregor stated that skipjack fishing was "the

greatest sport of Tokelau men". This era has now passed, probably never to be revived, but the results of this study, however incomplete and inaccurate they may be, show that the traditional knowledge concerning tuna is still very much alive.

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