THE SOUTH PACIFIC COMMISSION FISHERIES NEWSLETTER

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No. 15 October 1977

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1378/77

EDITORIAL

The last issue of the Fisheries Newsletter appeared in July 1977 and we regret that we were unable to put this edition out earlier, thereby maintaining it on a quarterly basis. However, this was impossible due to the fact that our secretarial and printing services, and especially our translation staff, are labouring under a heavy work-load. Their constant efforts deserve our gratitude and we continue to hope that, through the employment of additional staff, the situation will improve and our Newsletter will become more regular.

We are also much indebted to the periodicals and authors who agreed to help in producing this Newsletter. We are delighted to note that the revival of this publication, after a break of almost two years, has already drawn several voluntary offers of assistance. Potential contributors are reminded once again that information does not have to take the form of a lengthy document. Draft programmes, progress and other reports, surveys, scientific and technical papers, socio-economic data on marine resources, new ideas and thoughts, and even jokes are always welcome in so far as they are of some relevance to the region.

The Skipjack Survey and Assessment Programme in the Central and Western Pacific Ocean is at last under way. After many months of negotiations to obtain the necessary funds, the Hatsutori Maru, a Japanese pole vessel chartered for this project, has begun tagging operations in Papua New Guinea. Dr Kearney, the Programme Coordinator, has submitted a short paper on the present state of the Programme, and periodic progress reports will appear in subsequent issues.

While we were on the topic of Skipjack, we felt it would be interesting to reproduce an article, written by Dr. Habib and first published in Catch 77, on the 1976-77 skipjack purse-seine season in New Zealand waters. In view of the highly migratory nature of this species, one which is increasingly regarded as a major economic resource in the region, there is good reason to believe, pending positive scientific proof, that all or part of the stocks found during the summer off the shores of New Zealand undertake a seasonal migration. Moving towards the tropical Pacific, they enter into a region not yet precisely known. It may well be that the final destination of this migration changes year to year as a result of factors still unidentified. The size of stocks available to fisheries in the tropical Pacific definitely appears to depend, at least in part, on the numbers found in the southern part of the Ocean at a given time. It is essential therefore to co-ordinate research efforts in this field while maintaining stock management throughout the Pacific Ocean as the ultimate goal.

The above mentioned considerations naturally require us to keep in touch with fisheries operations in the Western Pacific, particularly in Papua New Guinea (see Newsletter No. 14), the Solomon Islands, and in northern areas (Trust Territory of the Pacific Islands and Hawaii). This is why, with the kind permission of Mr Gerakas, Chairman of the Pacific Tuna Development Foundation (PTDF), we have published a summary of the organisation's programme for 1977-79. This summary indicates the wide range of activities planned, as well as their underlying economic and scientific motivations at various levels of development.

In view of the forthcoming establishment of 200-mile Exclusive Economic Zones, many countries and territories have shown an interest not only in pelagic but also in demersal fishing, this being evidenced by the surveys carried out on Hawaiian seamounts by the Southwest Fisheries Center. Similar research is being undertaken by other organisations, such as the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM), and we hope to be able to give you the initial results shortly. The purpose of all this research is to make a qualitative assessment of resources, either by bottom trawling on seamounts, or by setting up longlines and trap nets. Some of the fish and crustacea stocks assessed in this manner may soon become the basis of commercial fisheries, particularly in view of the growing world-wide demand for certain seafoods such as crabs. While these deep-sea fisheries, already flourishing in many areas, are bound to spread throughout the region, inshore fishing, which has been a traditional activity for centuries in a number of places, is sure to be a major factor in development. One of the most striking examples of success in this field is provided by Western Samoa. Here, a rationally developed village fisheries project has gradually brought about an increase in local production, thereby greatly reducing the need for imports. One hundred boats have already been delivered to village fishermen and marketing will be greatly improved through the new fish market and the recently installed ice-making and cold storage facilities.

For some communities, like the island of Ongtong Java in the Solomons, the collection and processing of bêche-de-mer for export to Asian markets represent a considerable source of income. It is becoming increasingly urgent to collect basic biological data on these species, especially with regards to their growth and fertility - knowledge of which is essential for the assessment of a stock's commercial potential and renewal capacity.

Certain species of oysters are native to the tropics. However these local oysters are relatively slow-growing and therefore unsuitable for commercial oyster-farming. Furthermore, their spawning and spat settling patterns are not yet fully understood. In the past decade, a special effort has thus been made to establish oysters from Europe Japan, Australia and the United States. Usually imported as spat, sometimes non-settled, these species almost invariably die off within a few months after an initial period of extraordinarily rapid growth. The reasons for this remain a mystery: virus diseases, severe parasitism, inability to adapt to local conditions? Experts seem to favour the third hypotheses. In waters which are warm but deficient in microparticles, the oysters are thought to become exhausted by having to filter large volumes of water for suspended food particles. They then reach such a state of physiological distress that they are incapable of withstanding the least 'shock' resulting from environmental fluctuations (i.e. rise or fall in water salinity, intense sunshine, parasites etc.). The experiment conducted in the New Hebrides, which showed great promise initially but ended in disaster, is but one instance of what has occurred over and over again in several parts of the Pacific.

The Pacific Islanders have always had a profound understanding of, and much respect for, the concept of nature conservation and stock protection. Parts of the reef were thus periodically declared "tabu" for certain lengths of time. The recent replacement of traditional fishing techniques by more efficient ones has led, often within a few decades, to all-destructive overfishing. In their efforts to prevent certain parts of the lagoons and reefs from becoming entirely depleted, the authorities have been increasingly compelled to take restrictive or prohibitive action. A case in point is the

Kingdom of Tonga, where the Fanga'uta lagoon on the island of Tongatapu has been declared a marine reserve. To have achieved success in banning all commercial fishing in a lagoon both surrounded by dense population, and known for centuries as a traditional fishing ground, is indeed a remarkable feat for the Tongan Government.

Training is of paramount importance in the development of fisheries. Bearing this in mind, we have recalled that in 1972 the University of the South Pacific established a two-year course leading to a Diploma in Tropical Fisheries. The Diploma programme, which we have included in this issue, gives a good idea of the training offered.

Finally, at the end of this issue readers will find a specimen of the fishing log sheet used by the officers of the SPC Outer Reef Artisanal Fisheries Project. The sheet is filled out for each trip and attempts to sum up the various operations carried out between leaving and returning to port. It claims neither to be perfect nor to apply to the entire region. The purpose of its publication in this Fisheries Newsletter is to impress upon every fisherman the necessity of keeping a log book so that he may evaluate his operations.

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SPC SKIPJACK SURVEY AND ASSESSMENT PROGRAMME
BRIEF SUMMARY REPORT TO 23 SEPTEMBER 1977

1. FUNDING COMMITMENTS

Pledged contributions totalling approximately US$ 909,000 had been obtained by the end of July 1977. A breakdown of these contributions is as follows:

Country	Contribution	Approximate US$ equivalent
Australia	A$ 250,000	275,000
France	F 400,000	81,000 (i)
Great Britain	£ 70,000	120,000
Japan	3-month charter	168,000
New Zealand	NZ$ 120,000	116,000
United States of America	US$ 150,000	150,000

Special Skipjack Programme accounts have been opened with the Bank of America, San Francisco, the Commonwealth Trading Bank in Sydney, the Hong Kong and Shanghai Banking Company in Tokyo and the Banque de l'Indochine et de Suez in Noumea. For accounting purposes all four accounts will be considered as one budget item.

2. CONTRACTUAL COMMITMENTS

The Charter Agreement relating to the operation of the Programme's research vessel the 'Hatsutori Maru' was negotiated in Japan by the Programme Coordinator in early July. A draft Charter Contract was modified by the Australian Crown Solicitor's Office in August and the final agreement was signed on behalf of the South Pacific Commission by the Secretary-General, Dr E. Macu Salato, on 23 August 1977 and for Hokoku Marine Products Co. Ltd. by the Managing Director, Mr M. Furuie, on 1 September 1977. The monthly charter rate agreed upon was US$ 56,000, with the South Pacific Commission to meet additional expenses of employing nine Fijian crew. The Charter period commended on 19 September when the vessel commended loading prior to departure for Papua New Guinea. The tagging and survey work will commence from the Port of Kavieng on 4 October.

Contracts for three of the biologists' positions have been signed and recruitment to the additional positions is still being negotiated.

One of the Programme's scientists was despatched to Japan on 30 August to purchase all necessary scientific and research equipment prior to the vessel's departure. The procurement of all such equipment has proceeded smoothly and the total expenditure to date on these items has been slightly below the amount budgeted. The skipjack tags have been ordered from the Floy Company in the United States of America and delivery is anticipated in the first week of October.

(i) Additional support under consideration

3. ADDITIONAL FUNDING

As outlined in the Revised Budget circulated to all donor countries in August, it is anticipated that some additional funding for the Programme will be required, particularly in years 2 and 3. As indicated in the letter from the Secretary-General covering the Revised Budget, the Federal Republic of Germany has been approached as a possible donor of the necessary additional funds. As yet no response to this request has been received.

4. PROGRAMME OPERATIONAL SCHEDULE

On 7 June 1977 all countries and territories for which the Commission works were requested to supply details of the time of peak skipjack occurrence in their waters and at which time they considered a visit by the Programme vessel would be most beneficial. Following receipt of replies to this enquiry, and after considering all relevant information, a detailed cruise plan for the first 5-month charter period was drawn up. All countries and territories on this proposed schedule were contacted for approval and technical details are being finalised between the Programme Coordinator and the respective fisheries officers. All countries and territories have been most enthusiastic about the proposed visit of the vessel.

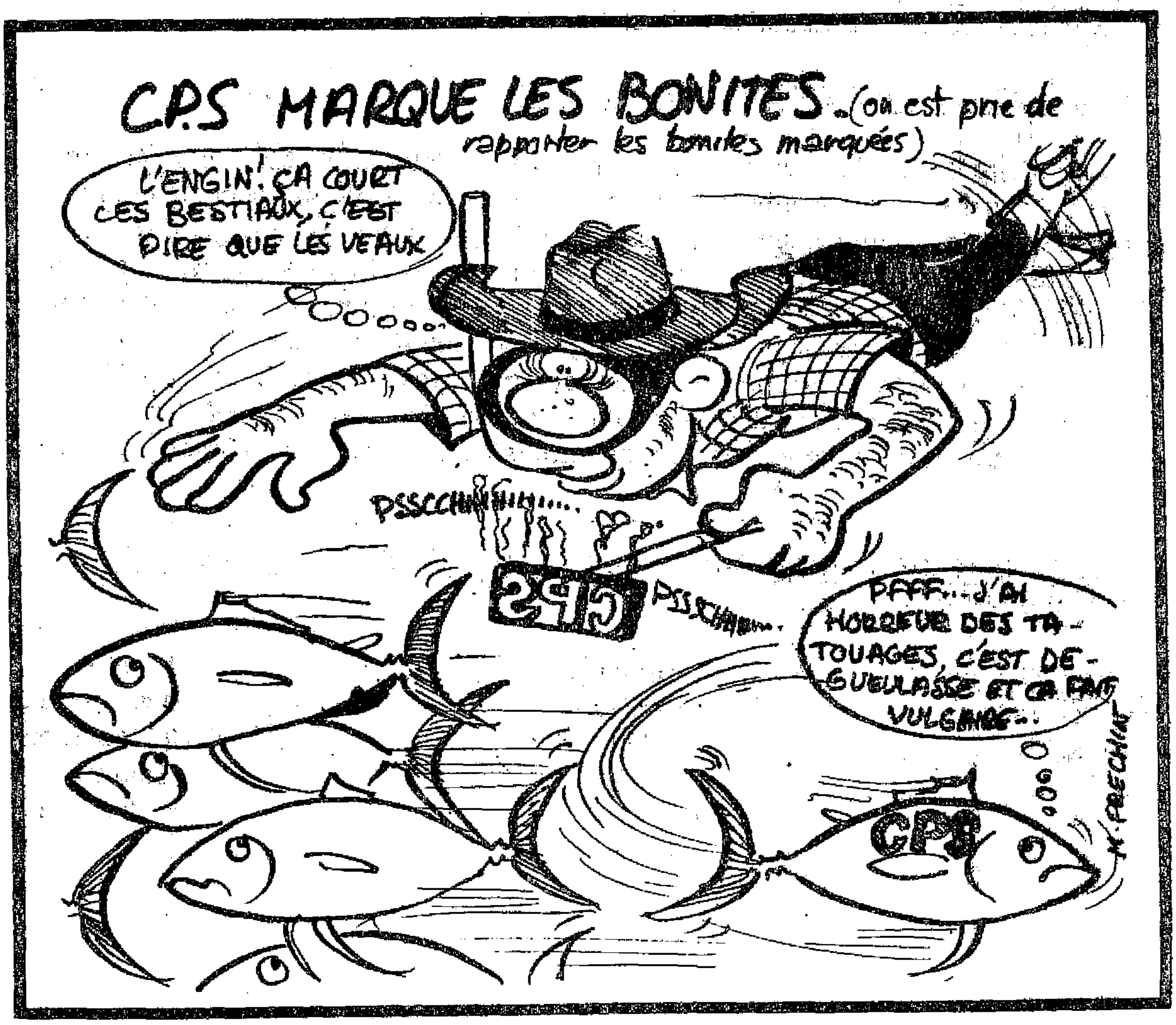
PROPOSED SCHEDULE OF ARRIVAL DATES OF 'HATSUTORI MARU' AT PRINCIPAL PORTS

Papua New Guinea	Kavieng	4 October
Solomon Islands	Honiara	10 November
New Hebrides	Vila	10 December
New Caledonia	Noumea	5 January
Fiji	Suva	5 February

SPC MARKING SKIPJACK (please hand in all marked fish caught)

Hell! These brutes move a darn sight faster than cattle

Ooogh! I do dislike tattoos, so dirty and O! so vulgar



The cartoon on this page originally appeared (in French) in La France Australe of 15 October 1977.

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1976-77 PURSE-SEINE SKIPJACK FISHERY (1)

George Habib *

The 1976-77 summer saw the second season of the developing skipjack tuna fishery in New Zealand waters. As in the previous season, MAF's fisheries divisions placed observers aboard the purse seiners working the fishery to record catch and effort data.

This information was related to time of season, time of day, geographical position, moon phase, bottom depth, water temperature, and sea and weather conditions. In addition, a continuous log was kept of vessel movements and school-fish sightings.

The vessels were the Apollo (1558 tonnes, 78.8 metres long, 2000 tonne carrying capacity); Zapata Discoverer (1340 t, 77 m, 1600t); Finisterre (965 t, 61.8 m, 1150 t); Michelangelo (967 t, 62 m, 1270 t); Kerri M (837 t, 53 m. 740 t); Janet D (498 t, 34.7 m, 333 t); Irene M (498 t, 34.7 m, 333 t); San Benito (248 t, 33.5 m, 120 t); Marine Countess (approx 135 t, 27 m, 130 t); and Lindberg (159 t, 23.5 m, 90 t). In addition, MAF logs were completed by the crew on the Voyager (1335 t, 72.6 m, 1597 t) - the US seiner which fished outside the 12-mile limit during the season. The vessels' nets ranged in length from 640 to 1372 metres, and in depth from 64 to 165 metres.

The season was about 5 months long, beginning in mid November and finishing in April. During this time, the purse-seine fleet worked a total of 792 season-days. Of these, 455.5 days were spent searching and fishing (57.51%), 92.5 days were spent in port (11.68%), and 86 days were spent travelling (10.86%); 90.5 days were lost through poor weather (11.43%), and 67.5 days owing to breakdowns (8.52%).

During the 455.5 days spent fishing, 7572 tonnes of skipjack were caught. Quantities of fish taken by month were 181 tonnes in November (2.39% of total catch), 229 tonnes in December (3.02%), 3110 tonnes in January (41.07%), 1877 tonnes in February (24.79%), 2134 tonnes in March (28,18%), 41 tonnes in April (0,55%). The average catch per month was 1262 tonnes.

Effort by month, as represented by number of season-days and number of sets made, were for November, 13 season-days and 6 sets; December, 86 days, 28 sets; January, 174 days, 209 sets; February, 258 days, 178 sets; March 233 days, 179 sets; and April, 28 days, 9 sets. Catch per season-day and per set by month were November, 13.92 tonnes per season-day and 30.17 tonnes per set; December, 2.66 tonnes and 8.18 tonnes; January, 17.87 tonnes and 14.88 tonnes; February, 7.28 tonnes and 10.54 tonnes; March, 9.16 tonnes and 11.92 tonnes; and April, 1.46 tonnes and 4.56 tonnes. The average catch per season-day was 9.56 tonnes, and per set 12.43 tonnes. In contrast, the average catch rate recorded by the Voyager was 24.2 tonnes per set each season-day.

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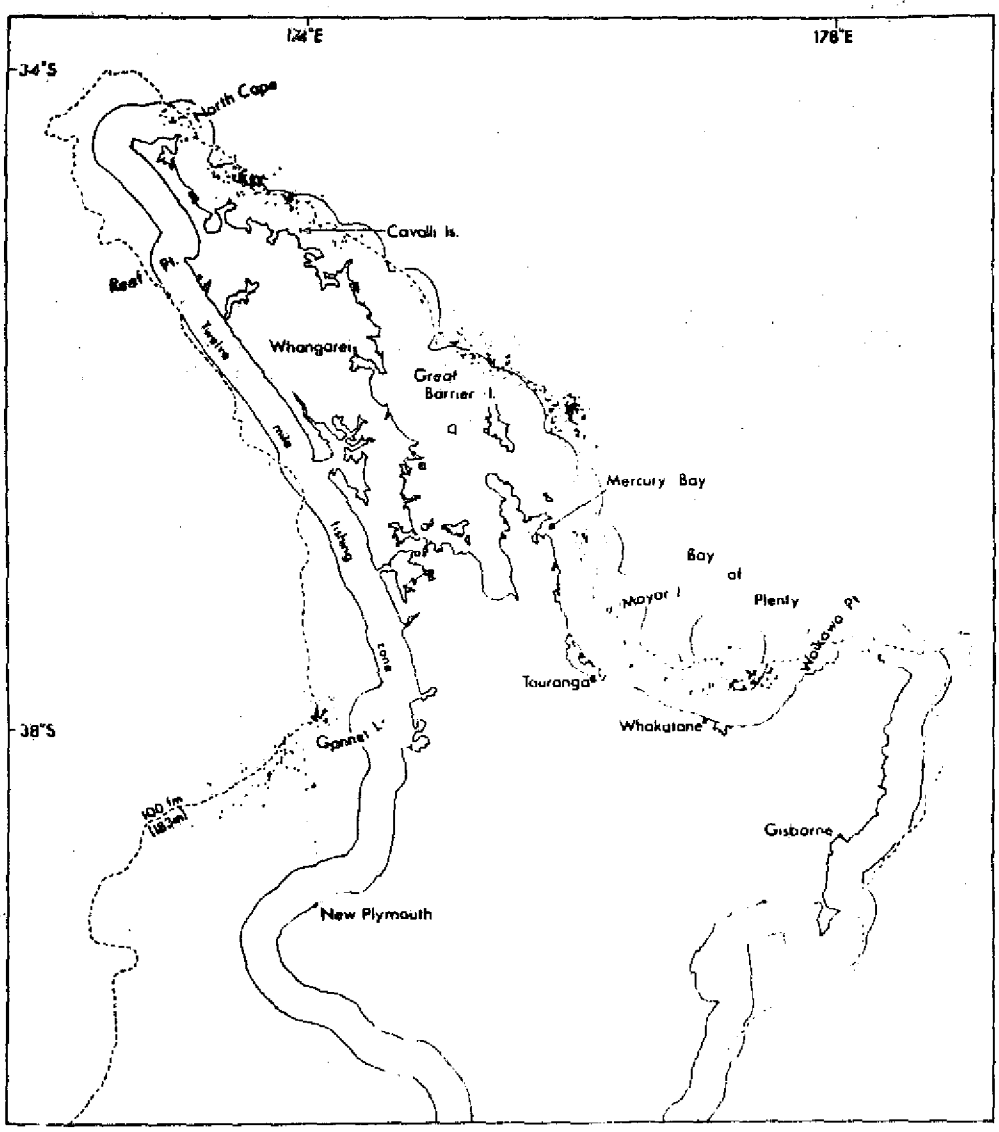
1. This article originally appeared in vol. 4, no. 4 of Catch 77 and is reproduced here by kind permission of the editor.

* Scientist, Fisheries Division, Ministry of Agriculture and Fisheries, New Zealand.

Fish caught during the moon phases were new moon, 1912 tonnes (25.25% of total catch, with 150 sets, yielding 12.75 t per set); first quarter, 2534 tonnes (33.47%, 187 sets, 13.55 t); full moon, 1444 tonnes (19.07, 130 sets, 11.11 t); and last quarter, 1682 tonnes (22.21%, 142 sets, 11.84 t). Although there were fluctuations in catch and effort, with the highest values being recorded during the first quarter, there was little variation in catch per set from one phase to another.

Seining was carried out in five areas on the coast of the North Island. These were area A, north-west of North Cape; B, North Cape to Cavalli Island; C, Cavalli Island to Great Barrier Island to Shoe Island; D, Bay of Plenty; and E, New Plymouth to Gannet Island. Fifty-seven percent (4334 t) of all skipjack were caught in area C with 282 sets (46.31% of all sets) at a rate of 15.37 tonnes per set. Catches and effort for other areas in order of importance were B, 1494 tonnes (19.73% of the total catch, with 132 sets, at 11.32 t per set); E, 1138 tonnes (15.03%, 88 sets, 12.93 t); D, 458 tonnes (6.05%, 97 sets, 4.72 t); and A, 148 tonnes (1,95%, 10 sets, 14.8 t).



Sets made by purse-seiners during 1976-77 skipjack tuna season.

Area C predominated as a catching locality, because there were consistent showings of skipjack for much of the season. It was also the site of one of the major influxes of skipjack into New Zealand waters during the season. On 17 January, some 1500 tonnes of fish in 20 schools were sighted east of Great Barrier Island. A number of big schools were caught in this area, including six containing over 100 tonnes of fish; one, which was taken by the Voyager, contained 188 tonnes - the largest school of skipjack landed in New Zealand waters to date.

In area B, the biggest influx of skipjack probably occurred in November when the Apollo sighted and fished a number of large schools south-east of North Cape. Although poor weather hindered fishing operations, a catch rate of over 30 tonnes per set was recorded. Fish showed only sporadically during the rest of the season, and catch rates were considerably lower.

The biggest body of skipjack to move into New Zealand waters during the season was that off Gannet Island (area E). First sighted by spotter pilot Graham Bell on 6 March, it contained at least 2000 tonnes of fish. During the next 2 weeks, the fleet fished this body and recorded the third-highest catch by area. However, schools were generally difficult to catch as shown by the low proportion of successful sets (29, or 33%, c.f. 130, or 53%, in area C).

The other areas contained only small quantities of skipjack during the season.

A number of comparisons can be made between the skipjack fisheries of the last two seasons (for last season's results, see Catch '76, September). The 1976-77 season was of similar duration to the last, and fish were more or less distributed in the same area of coastal water. However, the major concentrations occurred in different localities. Whereas in 1975-76, these were off Reef Point, between North Cape and Cavalli Island, and in the Bay of Plenty, this season's concentrations were off Gannet and Great Barrier Islands. Also, there was less fish sighted this season.

Catch was higher this season (up 61%), although made with substantially more effort (number of vessels up from 5 to 11; number of season-days up 63%; number of sets up 100%). Proportionately more time was spent searching and fishing (up 11%), less in port (down 11%), less travelling (down 8%), and more time was lost through bad weather (up 1%) and breakdowns (up 6%).

Proportions of catch per month also varied, with notable differences being the replacement of February by January as the prime month in the 1976-77 season, and the rise to prominence of March (catch up 15% as a proportion of total catch).

Catch in relation to moon phase differed with the prominence of the new moon in 1975-76 being replaced by the first-quarter period this season, and the last quarter increasing substantially in importance.

Catch by area differed; the main differences were the replacement of area B by C as the main catching area, the drop in catch in area D (18% of catch last season; 6% this season), and the dramatic rise in catch in area E (less than 1% of catch last season; 15% during 1976-77).

The variability and changes in the skipjack fishery over the last two seasons illustrate the need for further observations by the fisheries divisions. Additional work will include tagging, which will provide information on age and growth and on movements of skipjack within the fishery and beyond the New Zealand region.

SKIPJACK OBSERVER PROGRAMME

The development of the skipjack tuna fishery is a unique situation for New Zealand. From preliminary observations, the fishery appears to exhibit some special features making it difficult to draw upon the experience of other fishing countries. With this in mind, and recognising that in any new fishery the collection of comprehensive baseline data is essential for the determination of the basic characteristics and limits of the fish stock and the fishery, MAF's fisheries divisions again placed observers aboard the purse seiners during the 1976-77 season. Information was collected on:

1. Size, distribution, and seasonality of the skipjack resource.
2. Size composition of the New Zealand skipjack stock including seasonal and area fluctuations in fish size.
3. Age and growth, reproduction, food, and feeding habits.
4. Genotypic (blood, liver, pyloric caeca) features characterising the New Zealand stock in relation to stocks in other parts of the Pacific.
5. Catch and effort.

The programme began on 9 December and ended 31 March. During this time 17 observers spent a total of 297 days (37% of all season-days) aboard the vessels. Periods of observation ranged from 2 to 46 days, with the average period being 13 days. Up to six observers were at sea at any one time. The programme was co-ordinated by Dave Taylor, Assistant Director of MAF's Fisheries Management Division, with assistance from Bob Cooper and George Clement, also of FMD, and from George Habib of Fisheries Research Division.

BIOLOGICAL DATA ON SKIPJACK

During the 1976-77 skipjack season, MAF observers on the purse seiners measured over 15 000 skipjack.

Most fish were 48 to 52 cm long and 2.0 to 2.7 kg in weight. This contrasts with last season when most of the fish were 41 to 47 cm and 1.3 to 2.0 kg (see Catch '76, September) and compares with the 1974-75 season when 48 to 52 cm fish again predominated. However, in 1973-74, 41 to 47 cm fish predominated. Therefore, over the last four seasons, two sizes classes of skipjack have alternated as the predominant fish in the catches of purse seiners.

Also, when one size predominated the other was present only in small numbers. For example, during the 1976-77 season there were very few fish measured less than 47 cm.

On the basis of these observations, it might be expected that 41 to 47 cm skipjack will dominate the fishery next season. However, because both size classes have failed to turn up in the New Zealand fishery in past seasons, it is possible that both could fail to arrive in the same season. For the sake of the developing skipjack fishery, it is hoped that this does not happen, and if it does, that yet another size class of skipjack arrives in quantity.

A considerable number of large skipjack were also taken in the purse-seine catches, particularly in the area off Great Barrier Island.

Three fish measured were over 80 cm long, and one weighed 12.2 kg. Gonads collected from 343 fish (195 females, 148 males) during the season were examined and weighed. Female gonads ranged in weight from 3.4 to 49.7 grams, male gonads 0.2 to 48.0 grams. Most gonads weighed less than 30 grams, and all were immature.

Stomach contents were investigated in these fish. About 25 per cent of the stomachs were empty. Those with food contained predominantly the euphausiid Nyctiphanes australis; one particularly full stomach contained 210 grams of this species. Other food items included lantern-fish, seaperch, pilchard, squid, and amphipods.

GENETIC ANALYSES OF SKIPJACK

As a result of recent discussions between leading geneticists working in the field of skipjack population identification, it was decided that blood and tissue samples collected from skipjack in various parts of the south-western Pacific during 1976 and 1977 would be sent for analysis to Dr K. Fujino, Kitasato University, Japan, and/or Dr B.J. Richardson, Australian National University.

Some 1100 blood samples and 300 liver samples were collected by MAF scientists during the 1976-77 skipjack season. Most of the samples were sent to Dr Richardson, the remainder to Dr Fujino (see table below).

Results of analyses will be jointly discussed by Drs Fujino, Richardson, and Sharp (the last-mentioned of the inter-American Tropical Tuna Commission), and the outcome of their discussions should be available soon.

Dr Fujino				Dr Richardson			
No.	Date	Position	Sample	No.	Date	Position	Sample
60	27.12.76	34° 35 9′ S 173° 17 6′ E	liver & pyloric tissue	200	26.12.76	34° 40 5′ S, 173° 34.3′ E	blood
				200	5.1.77	35° 39.5′ S, 175° 19.0′ E	"
50	6.1.77	36° 03 9′ S, 176° 02 2′ E	"	200	17.1.77	36° 11.1′ S, 176° 07.9′ E	"
50	11.1.77	34° 19.0′ S, 172° 57.2′ E	"	200	12.3.77	37° 25.5′ S, 176° 17 0′ E	"
50	23.1.77	35° 55.7′ S, 175° 36.7′ E	blood	200	28.3.77	38° 20.0′ S, 173° 40.0′ E	"
50	25.1.77	36° 00 9′ S, 175° 56.9′ E	"	50	27.12.76	34° 35.9′ S, 173° 17.6′ E	liver
				50	6.1.77	36° 03 9′ S, 176° 02.2′ E	"
				50	11.1.77	34° 19.0′ S, 172° 57.2′ E	"

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THE THREE-YEAR PROGRAMME (1977-1979) OF THE PACIFIC TUNA DEVELOPMENT FOUNDATION (PTDF) [1]

PROGRAMME

The PTDF proposes an interlocking programme of activities which covers the three major types of fishing - purse-seine, trolling, and baitboats - and includes all constituent areas of the PTDF.

The scope of developmental activity can be summarized as follows:

1. Purse-seining
   - (a) Surveys with small and medium sized seiners.
   - (b) Artificial attraction (e.g., tuna aggregation).

2. Trolling
   - (a) Emperor Seamount area utilizing Hawaii and Guam as bases for U.S. West Coast trollers.
   - (b) Micronesian trolling using local vessels and crews.

3. Pole-and-Line
   - (a) Baitfish Supplies
     - i) Production and testing of mollies in American Samoa
     - ii) Anchovy transfer from California to Hawaii
     - iii) Field testing of Hawaiian mullet and milkfish
   - (b) Fishing Operations
     - i) Development of multi-use vessels in Micronesia
     - ii) Survey of Leeward Hawaiian Islands grounds
     - iii) Aerial spotting feasibility for Hawaiian fleet
     - iv) Market expansion for Pacific Islands
     - v) Trans-shipment infrastructure in Guam

Programme phasing can only be generally prescribed, and will depend on each stage of the results from previous efforts. The development of purse-seining will involve experimentation with different sizes of boats, types of nets and methods for finding and attracting tuna. If there is substantial growth in the purse-seine catch, then the development impacts will be felt in the American Samoan and Hawaiian canneries and dock facilities, Guam's trans-shipment facilities, etc. Such impacts will require substantial capital improvements, which is a further stage in the overall development needs of the Pacific Island areas, and a substantially different order of funding magnitude.

In Hawaii, almost any of the three types of fishing will require improvements in harbour facilities. Growth in the pole-and-line fleet will depend on considerable rejuvenation and expansion of the currently aging fleet, with seasonal basing of both trollers and purse-seiners.

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1. SPC gratefully acknowledges the assistance of the Chairman/President of the Pacific Tuna Development Foundation, Mr A.Gerakas, who kindly gave permission for these programme proposals to be reproduced.

For Guam, the major requirements for the future will be expansion of trans-shipment facilities to meet increased loads from purse-seiners, and growth in fresh fish marketing for troll-caught tunas.

In American Samoa, two sets of circumstances will be faced. On the one hand, expansion of Pacific purse-seining would mean increased volume for the canneries. On the other, growth of baitfish culturing and pole-and-line fishing would mean a commitment to job training, financing, and industrial diversification.

A similar situation would pertain to Micronesia for development of both pole-and-line and troll fishing. Developmental needs will not be solely determined in capital costs - the development of the fisheries will have to meet local social needs as well and not threaten subsistence fishing in the shallow reef areas. Expansion of purse-seining can be accomplished unilaterally by the large U.S. corporations, but development of Micronesian, American Samoan, and even Hawaiian local fisheries will have to be in close cooperation with the people of these areas. Therefore, one requirement for the PTDF in the forthcoming years will be a very active commitment of soliciting and recognizing the ideas and assessment which must come from knowledgeable local authorities, particularly the district fisheries officers. A structure, such as the Pacific Islands Fisheries Development Committee, must be created, staffed, and funded to help in this process.

PROJECT SUMMARIES

1. Purse-seining

The PTDF has been involved in two aspects of West Coast purse-seiner development of the Central, Western, and South Pacific: actual surveys and improvement in equipment and techniques. The programme for the next three years will involve further survey work with smaller seiners, as well as attempts by the NMFS Honolulu Laboratory to develop artificial aggregation devices.

(a) Tuna Purse-Seining, Western Pacific (1977)

The project will test the economic feasibility of seining with smaller vessels, preferably in the 400-700 ton size range. PTDF will furnish a light, fast-sinking net for use during the charter. Special emphasis will be placed on fishing floating objects, including artificial aggregators.

(b) Tuna Purse-Seining, Western Pacific (1978, 1979)

The scope of the second and third years of the programme will be determined following analysis of the 1976 and 1977 surveys. However, it is anticipated that the project will investigate areas identified to have good potential and will test and modify equipment as suggested by the previous survey.

(c) Aggregation of Skipjack Tuna - Anchored System (1977-1980)

The NMFS Honolulu Laboratory will design and construct various types of anchored aggregating systems. The purpose of these devices is to artificially attract tuba in regions where they are dispersed. The objects will be placed both inshore and on banks 200 miles south of Oahu, with constant monitoring of tuna aggregation and fish catch by commercial vessels.

(d) Aggregation of Skipjack Tuna - Free-Floating System (1978-1979)

The free-floating system will be a modification of the anchored aggregation devices and will be capable of use on the high seas. The project will allow comparison of the two systems.

2. Trolling

Two areas of trolling have attracted PTDF interest: the Emperor Seamount area near Midway and Guam, where it is believed substantial amounts of albacore migrate from Japan to California; and Micronesian trolling with smaller vessels utilizing local crews.

(a) Mid-Pacific Albacore Trolling Project (1977)

Previous PTDF and AFRF trolling charters in the Emperor Seamount region have indicated that an extended charter period is required to insure that the vessels do not miss the albacore season. The project will involve two long-range albacore trollers fishing in northern mid-Pacific waters for 150 days each between April and September 1977. The vessels could also explore the Leeward Hawaiian Islands on their return to Honolulu.

(b) Guam-Midway Albacore Trolling Survey (1978)

The project will take advantage of previous PTDF and AFRF surveys of the northern Mid-Pacific to investigate the potential for trolling in the Marianas chain during early season periods with follow-up in the Emperor Seamount area.

(c) Truk Trolling Project (1977)

The project will involve the demonstration of a 30-35 foot trolling boat under the guidance of a trolling expert from the West Coast United States. It is believed that, by upgrading trolling methods in Truk, a viable commercial fishery of direct benefit to the people can be established.

3. Pole-and-line

(a) Baitfish Supplies

There are three major facets in PTDF's programme to help develop baitfish resources for the pole-and-line skipjack fishery in the tropical

Pacific - mollie culture in American Samoa, milkfish and mullet cultures in Hawaii, and systematic baitfish transfer from areas of high concentration to areas of low concentration. Aspects which might warrant future development are current baitfish handling techniques (such as aging Hawaiian nehu before its use) and use of artificial lures and attractions. However, these possibilities need further exploration and are not included in the PTDF programme.

(i) Bait Culture and Test Fishing, American Samoa (1977-1978)

The Government of American Samoa has successfully been raising mollies which may be suitable for baitfish in a pole-and-line fishery. The project will involve thorough tests of the efficacy of the mollie as bait, both in terms of attractiveness to tuna and economic efficiency. A west coast style bait boat and captain will carry out the trials, which will include training of American Samoa crews.

(ii) Hawaiian Bait Field Trials (1978-1979)

The Oceanic Institute in Hawaii is launching an extensive programme to mass-culture mullet and milkfish, two species which may be suitable alternative baitfish. The project will test the suitability of these fish as a commercial bait in Hawaii's pole-and-line skipjack fishery. If the project proves successful, similar programmes could be launched in other Pacific island locations.

The project will include the charter of a Hawaiian skipjack vessel for 50 trials during the period April 1978 to September 1979.

(iii) Conducting Final Tests on the Feasibility of Transporting Northern Anchovy from California to Hawaii

The project is the culmination of several PTDF and NMFS efforts to perfect a system of transporting baitfish from regions of high availability to regions of lower availability such as Hawaii. It appears that the engineering aspects of the system have been resolved and the major question is whether the system will be economically viable.

The project will involve bringing three shipments of California anchovy to Hawaii, with the bait being used by Hawaii's commercial fishermen.

(b) Hawaii Fishing Operations and Infrastructure

The skipjack tuna fishing industry in Hawaii has steadily declined over the past twenty years. Low productivity, aged vessels, labor shortages, baitfish problems, and static marketing have resulted in generally low profitability. PTDF proposes a stimulative programme which will attempt to bring about fresh investment in the fleet.

(i) Marketing Analysis for Hawaii's Skipjack Tuna (1977)

The economic viability of the Hawaiian skipjack fleet has declined in recent years and the failure to make substantial growth in vessel return from sales is a primary cause for this problem. Market demand has remained static. The project plans to identify alternative marketing potentials for Hawaiian skipjack. If new marketing potential exists, then PTDF will contact a business specialist to analyze production and distribution costs in supplying the new market,

(ii) Leeward Hawaiian Islands Tuna Development (1979)

The project proposes charter of a pole-and-line vessel to conduct commercial fishing operations in the Leeward Islands during the period March-September 1979. Three 10-14-day cruises to cover a good portion of the island chain are proposed. This area is within reach of Hawaii's vessels but is currently being fished only by Japanese vessels.

(iii) Hawaii Skipjack Aerial Spotting (1977)

The traditional skipjack fishery in Hawaii depends on bird flock sightings to locate schools. Because of limited vessel range, the number of zero-catch trips suffered by the skipjack fleet is substantial.

Previous aerial spotting attempts have shown that the potential for increasing the effectiveness of the skipjack vessels may exist. The project will assess the effectiveness of aerial spotting in increasing Hawaii's skipjack production and analyze the economic feasibility of an industry-sponsored aerial spotting programme.

(c) Trust Territory Fishing Operations

PTDF has recognized the need to develop fisheries in the Trust Territory at the 'grass-roots' level, thus directly benefitting the islanders. Major industrial fishing is still far in the future, but small-scale fisheries having a relatively large impact on island economies can be developed presently. Micronesian fishing activities are generally artisanal and their technical skills minimal. Tuna resources are apparently seasonal and bait-fish supplies often sporadic. Thus, it is advisable to develop local commercial fishing operations around relatively simple, multi-use vessels.

(i) Ponape Multi-Use Vessel Demonstration and Training (1978-1979)

(ii) Multi-Use Vessel Demonstration and Training, Marshall Islands (1977-1978)

Programmes in Majuro (Marshall Islands) and Ponape (Eastern Caroline Islands) will demonstrate the feasibility of using 35-40-foot combination vessels, and will establish a cadre of local fishermen trained in the proper utilization of such vessels and appropriate techniques. Outside expertise will work directly with local interests to establish a fishing strategy based on pole-and-line, trolling, and bottom fishing techniques.

(d) Guam Infrastructure

(i) Assessment of Economic Benefits of Tuna Trans-Shipment in Guam

This project will provide the Government of Guam and the tuna industry with a realistic assessment of past, present, and future economic benefits accruing to the territory from tuna trans-shipment activities. Projections of potential future benefits will be used as a basis for recommendations on improvement and expansion of existing trans-shipment facilities.

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BOTTOM FISHING ON SEAMOUNTS

The Southwest Fisheries Center[1] recently undertook a survey (cruise 77-02-75, Part III, 12 May-27 June, 1977) in the area of the Northwestern Hawaiian Islands and Handcock Seamount (figures 1 and 2). The objectives and results of the cruise were as follows:

A. Conduct bottom trawling, lobster trapping, and handline fishing to determine availability and relative abundance of demersal fish and crustaceans at islands and banks of the Northwestern Hawaiian Islands from Raita Bank to Kure Island and over Hancock Seamount.

Surveys and some fishing were conducted at all the planned areas with the exception of Northampton Banks. In addition, a trap competition experiment was conducted at Necker Island.

1. Bottom trawling

A total of 31 trawl stations of 30 min. fishing time on the bottom were conducted. Of these, eight successful trawls were made with the Noreastern net before it hooked up on the bottom and was lost at Kure Island. The remainder of the trawls were made with the Norwegian net. Nine hauls were made at Maro Reef, eight at Laysan Island, five at Pearl and Hermes Reef, three at Lisianski Island, two each at Hancock Seamount and Kure Island, and one each at Raita and Salmon Banks.

A good deal of time was spent searching for suitable trawling grounds. Generally speaking, in depths beyond the upper bank, the bottom, in most of the areas surveyed, was found to be too rough and precipitous for trawling. In fact, during this cruise the lack of suitable trawling grounds was the limiting factor on the number of trawl stations, not lack of time.

Catches of particular interest were: 144.5 kg (318 lb) of ulua, *Caranx cheilio*, taken in 64 m (35 fathoms) off Pearl and Hermes Reef and 91.4 kg (201 lb) of 'red tail' opelu, *Decapterus russelli*, taken in 340.4 m (186 fathoms) off Laysan Island.

At Hancock Seamount, 20 kg (44 lb) of pelagic armorhead, *Pentaceros richardsoni*, were taken in 264-311 m (144-170 fathoms). In the same trawl, 134 individuals weighing 29 kg (64 lb) of an unidentified nomeid were also taken.

The catches usually consisted of a relatively narrow range of the more common shallow- and medium-depth reef fishes. Usually no single species was particularly numerous in a catch. Exceptions to

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1. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Center, Honolulu and la Jolla Laboratories, P.O. Box 3830, Honolulu, Hawaii, 96812.
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this generalization were: 1,073 puffers, Lagocephalus hypselogeneion, weighing 117 kg (257 lb) and caught in 110 m (60 fathoms) at Maro Reef, 93 kg (204 lb) of the same species caught in 110 m off Kure Island, and a total of 562 filefish, Pseudomonocanthus gerretti weighing 33 kg (72 lb) caught on three trawl stations at Maro Reef in 110-181 m (60-90 fathoms). Squat lobster, Scyllarides squammosus, and spiny lobster, Panulirus marginatus, were frequently caught in small quantities; the latter only on night trawls.

2. Trapping

Varying amounts of trapping effort were expended along the chain, including sets at Necker Island, Raita Bank, Maro Reef, Laysan Island, Lisianski Island, Salmon Bank, Pearl and Hermes Reef, Midway and Kure Islands. A total of 49 trap sets were made. A set consisted of either 4, 6, 12, or 15 strings of traps. Most of the sets during the cruise were made up of six strings (stations) and most strings consisted of either four modified Hawaiian type fish traps or eight California lobster pots. All sets consisted of a string of eight lobster pots alternated with a string of four fish traps. The only exceptions were the trap competition sets made at Necker Island and Maro Reef. A total of 1,112 trap-nights with lobster pots and 548 trap-nights with fish traps were expended during the cruise. Traps were baited with mackerel, Scomberomorus maculatus, and set between 1800 and 1930. They were picked up the following morning between 0800 and 1200. A total of 2,851 spiny lobsters weighing 2,418 kg (5,320 lb), and 657 squat lobsters, Scyllarides squammosus and Scyllarides sp. weighing 353 kg (777lb) were taken. Of these, 1,327 spiny lobsters and 397 squat losters were caught in the fish traps and 1,524 spiny lobsters and 260 squat lobsters in the lobster pots.

Catches in most of the areas fished were small. Sets made at Maro Reef, Laysan and Midway Islands produced the best catches. The largest catch was 428 lobsters caught at Maro Reef in 30-35 m (16-19 fathoms). The set consisted of 48 lobster pots and 24 fish traps. The smallest catch (one lobster) was in a set of 24 lobster pots and 12 fish traps in 15-26 m (8-14 fathoms) at Lisianski Island. Most of the spiny lobsters taken during this cruise were well over the minimum legal weight of 0.45 kg (1 lb). The average weight of spiny lobsters caught in the lobster pots was 0.88 kg (1.9 lb) and for the fish traps, 0.81 kg (1.8 lb). Individuals frequently weighed over 1.4 kg (3 lb). All lobsters taken were measured and sexed, and a total of 1,470 spiny lobsters were tagged and released.

Other species commonly trapped included moray eels of several species, conger eel, sea bass, Epinephelus quernus, wrasse, Bodianus bilunulatus, and goatfish, Parupeneus sp. However, with the exception of moray eels, the fish catch was remarkably small.

3. Handlining

Seventeen handline stations (two lines fishing with four hooks each) were made along the island chain, hooking mostly hapuupuu, E. quernus, kahala, Seriola dumerilii, ulua, Carangidae, and ehu, Etelis marshi.

The three largest single station catches were made at: Pioneer Bank where the catch consisting primarily of hapuupuu, ehu, kahala, and ulua was taken in 183-220 m (100-120 fathoms) and weighed 129 kg (283 lb); Pearl and Hermes Reef, hapuupuu and ehu taken in 165-320 m (90-175 fathoms) weighed 62 kg (136 lb), and Midway Islands, 13 hapuupuu and 1 ehu in 156 m (85 fathoms) weighed 63 kg (143 lb).

On SE Hancock Seamount, six pelagic armorhead, one alfonsin, Beryx splendens, two unidentified rubberfish, and three dogfish, squalus fernandinus, were caught in 256-659 m (140-360 fathoms).

B. Collect plankton and forage organisns with plankton nets and midwater trawls.

A total of 47 (24 day and 23 night) oblique plankton hauls to an estimated depth of either 100 or 200 m were made at prescribed environmental monitoring stations located off Nihoa, Necker Island, French Frigate Shoals, Garnder Pinnacles, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway and Kure Islands.

Because it was impractical to handle both bottom and midwater trawl gear, a pre-cruise decision was made to eliminate midwater trawling from this part of the cruise.

C. Collect date on oceanographic conditions with CTD and XBT casts.

A CTD cast to 1,000 m was made at 20 of the 21 offshore (200 m) oblique plankton stations. At Station No. 382, 25 miles east of French Frigate Shoals, the CTD probe became inoperative so the cast was aborted.

Ninety-three XBT casts were made, including one at every trawl and plankton station.

D. Conduct trolling to determine availability and relative abundance of pelagic fishes.

A total of 7.3 h of trolling at troll speeds was conducted on 7 days. The catch included 15 skipjack tuna, Katsuwonus pelamis, weighing 31 kg (68 lb), 27 yellowfin tuna, Thunnus albacares, 131 kg (269 lb), 18 kawakawa, Euthynnus affinis, 75 kg (165 lb), and 1 rainbow runner, Elagatis bipinnulatus, 2.5 kg (5.5 lb). No incidental trolling at cruise speed was conducted.

E. Conduct experiments to determine retention of lobster in unbaited traps.

At Maro Reef two so-called "ghost fishing" experiments were conducted.

F. Conduct experimental fishing with bottom longline and octopus pots as schedule permits.

Schedule not permitting, neither of the above experimental fishing techniques were tried.

G. Conduct gear competition experiments.

A single experiment was conducted at Necker Island. Four strings each of eight lobster pots were set in about 55 m (30 fathoms). In each of the four strings the pots were attached at a different distance from one another The intervals used were: 9.1 m (5 fathoms), 18.3 m (10 fathoms), 27.5 m (15 fathoms, and 36.6 m (20 fathoms).

At Maro Reef two experiments were conducted to compare the fishing efficiency of four-pot strings of lobster pots with eight-pot strings (all pots at 9.1 m intervals).

H. Miscellaneous observations and activities.

1. A total of 50 bird flocks was sighted. Six flocks were associated with skipjack tuna schools, one with a yellowfin tuna school, and nine were with unidentified schools.

   Nine herds of porpoise were seen, two of these were identified as bottlenose, Tursiops truncatus. Off Laysan Island single monk seals, Monachus schauinslandi, were seen swimming near the ship twice, and monk seals were also observed on the beaches at Laysan Island and Pearl and Hermes Reef. No counts were made of animals on shore.

2. Fish and invertebrate samples were either preserved in formalin or frozen for identification, stomach analysis, or otolith studies.

3. Salinity samples and surface temperature readings were taken with each XBT cast.

4. The surface thermosalinograph was run continuously.

5. Fathometer traces of the bottom were kept for the bottom trawl stations.

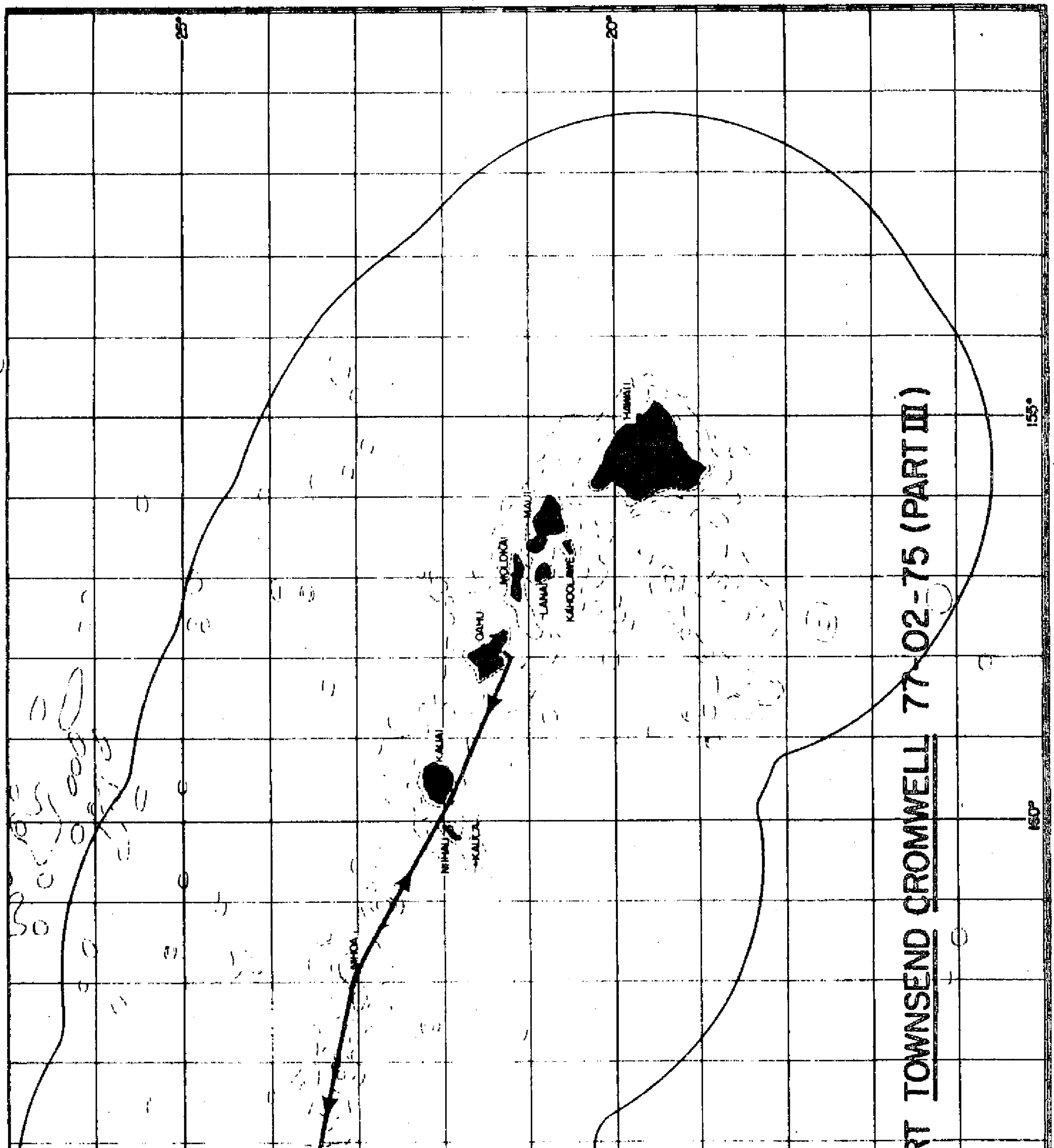
6. Standard weather observations were made at 0000, 0600, 1200, and 1800 G.m.t. by the ship's officers.

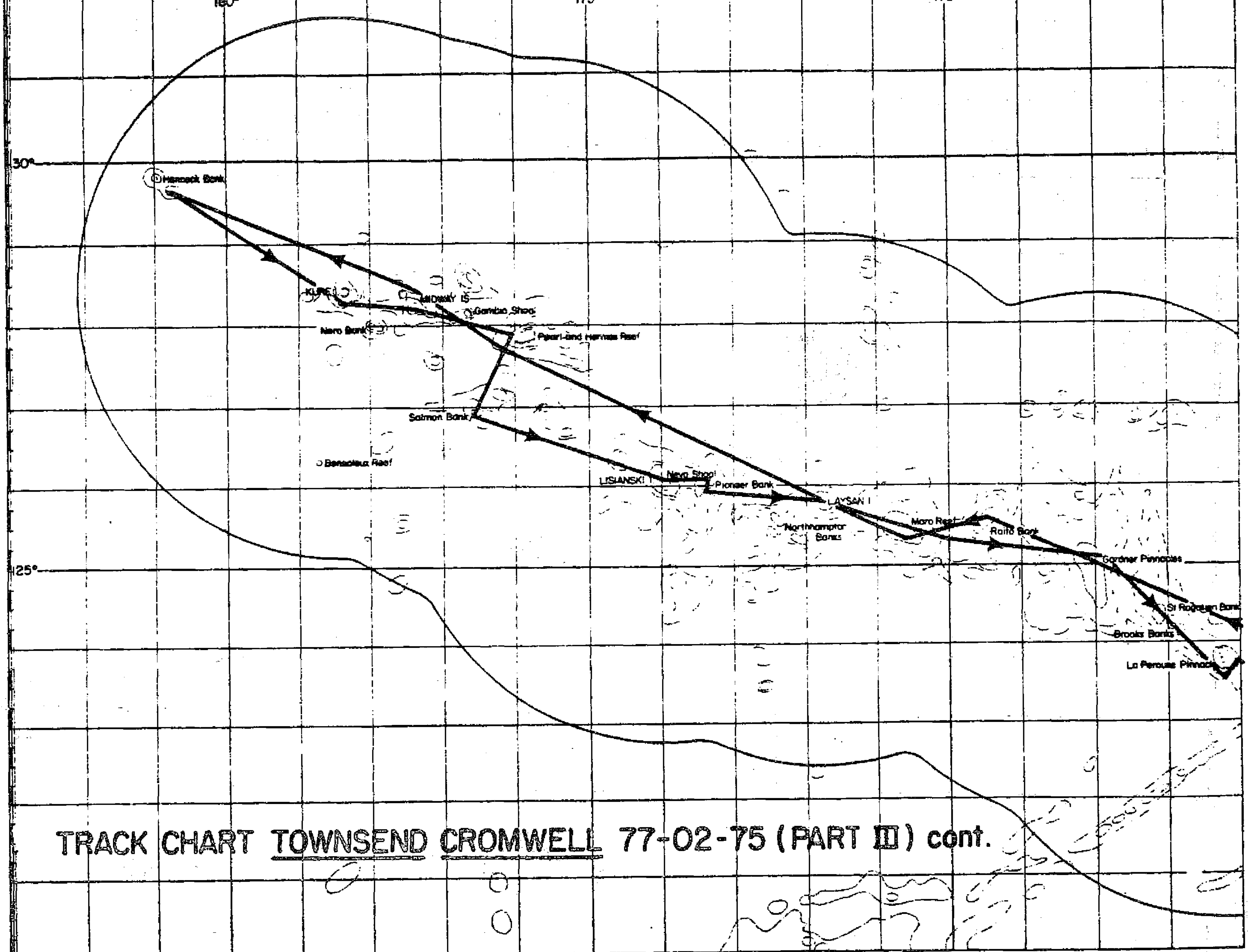
7. The Marine Operations Log, Deck Log, and Dead Reckoning Abstracts were kept and chart overlays of all stations were made by the ship's officers.

Scientific personnel

Reginald M. Gooding, Chief Scientist
Glenn R. Higashi, Research Assistant
Robert B. Moffitt, Research Assistant (May 31 - June 27)
John J. Naughton, Fishery Biologist (May 12-13)
Martina K.K. Queenth, Research Assistant
Paul M. Shiota, Research Assistant
Darryl T. Tagami, Research Assistant
Douglas T. Davis, Cooperating Scientist, MOP, University of Hawaii
Jayne L. Fitzgerald, Cooperating Scientist, MOP, University of Hawaii.

Figure 1


TRACK CHART TOWNSEND CROMWELL 77-02-75 (PART III)
HAWAII
MAUI
MOLOKAI
LANAI
OAHU
KAUAI
NECKER I
20°
155°
160°
165°



TRACK CHART TOWNSEND CROMWELL 77-02-75 (PART III) cont.

Figure 2

PROGRESS

The main project achievements are as follows:

1. Boats and equipment delivered

59 boats have been delivered up to 1 July 1977. This represents one third of the total Samoan motorized fishing fleet. The total value of boats, engines and equipment is US$ 129,147 (WS$ 103,318). With the present production of the boatyard at Vaitele and the number of orders received, the project will probably achieve its target of 120 boats by mid-1978.

2. Repayments

Total repayment up to 1 July 1977 is US$ 45,561 (WS$ 36,449). Repayment is generally satisfactory, with only two per cent of the repayments behind schedule. This repayment record has only been possible through repossession of defaulted repayers. Of the 59 boats delivered four have been repossessed and given to new owners. Four owners have repaid boats within nine months of receiving them. Normal repayment period is 18 months, with US$ 115 (WS$ 92) paid per month. The repayments are made to a Revolving Fund in the Development Bank entitled 'FAO Village Fisheries Project'.

3. Training

The Fisheries Division organises a seven-day training course in Apia for the crew that takes over the new boat. So far 170 fishermen have been trained. The crew learn to operate and maintain the engine and to rig fishing gear. After final tests the boat goes to the village with one of the Fisheries Division instructors on board to carry out actual fishing training over one week.

4. Marketing

The Fish Market in Apia was due to start operations on 7 July. Considerable delays were experienced in its construction by the Public Works Department, which meant that the Fish Marketing Scheme had to be rescheduled by four months. The Fish Market has a 28 cu. m. freezer provided by the Government and two flake ice machines of 600kg/24 hour capacity, both financed by the Project. Ice will be carried to outlying districts in insulated boxes on board a truck financed by the Project and fish will be bought at set prices. The scheme will enable village fishermen to keep their fish on ice for three to four days and sell it to the Fish Truck that comes three times a week[1]. On a pilot scale a fish marketing scheme has been operated since December in the Lefaga district. In spite of some early difficulties a total of 11 tons (24,000 lb) of fish has been brought to Apia over seven months. When the Fish Marketing Scheme starts it is estimated that an average of 1.5 tons of surplus fish will be brought to Apia per week.

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* FAO/DANIDA Village Fisheries Development Project TF/WES 6/DEN - Field Report no. 2. Experts: O. Gulbrandsen, FAO Fisheries Adviser, and A. Overa, FAO Naval Architect. SPC gratefully acknowledges permission to reproduce this Report in the Newsletter.

1. See article on Fish Marketing Scheme, page 29.

5. Boatbuilding

The boatyard at Vaitele employs 16 men, mostly ex-leper patients, and production is now five boats per month. Preparations have started for construction of boats in aluminium and the building of the first 28ft aluminium catamaran was due to commence with the return of the FAO Naval Architect, A. Overa, from homeleave on 1 July. The boatyard at Vaitele is now being established as a Cooperative Enterprise.

The type, number and value of boats delivered up till 1 July 1977 are as follows:

Type of boats	Number built	Value of boats only US$	Value including engine and equipment US$
18 ft V-bottom	1	600	600
23 ft V-bottom	2	1,250	3,718
28 ft V-bottom	1	900	1,719
23 ft Outrigger (Vaaalo)	1	300	841
19 ft Catamaran (Alia)	1	625	1,525
28 ft Catamaran (Alia)	46	46,710	91,186
28 ft diesel boat	7	10,500	25,680
Others			3,878
Total	59	60,885	129,147

From the above list it can be seen that the 28 ft catamaran (Alia) powered by an outboard motor is by far the most popular boat. The boatyard has 20 more orders for this boat, while only one additional order for the 28 ft diesel-powered boat has been received. Although the diesel boat has lower running costs, the investment is twice as high as the catamaran and the speed is 8.5 knots vs. 11 knots for the catamaran, an important factor when trolling for tuna. Due to limitations in depth of water most of the village cannot operate diesel-powered boats.

One 28 ft catamaran has been delivered to a fisherman in Rarotonga, Cook Islands.

6. Supply of fuel

The supply of petrol mixed with oil at five per cent duty to fishermen has been of great importance to the fishermen using outboard motors.

7. Repair service

Repair of outboard engines carried out by the Fisheries Division workshops in Apia and Salelologa continues to be an important contribution to the project. During the first six months of 1977 an average of four outboard engines per day were repaired.

WORKING RELATIONS

The Chief Fisheries Officer A. Philipp has overall responsibility for the execution of the project. Under him the following staff are working directly with the Project:

Training: Ueta Faasili and Pale Taumaia - Fisheries Assistants.
Milo Paulo, Tuku Poutoa, and Ueli O'Brien - Leading Fishermen.

Boatbuilding: Tau Faraimo - Fisheries Assistant.

Loan repayments & petrol delivery: Fili Suafoa - Fisheries Assistant.

Engine repair: Ino Petersen - Mechanic, Apia workshop, with two Assistant Mechanics under him.
T. Kapeneta - Mechanic, Salelologa workshop.

FELLOWSHIPS

The project has given three months' training to a boatbuilder from Tonga and at present two boatbuilders from Yap in the US Trust Territory are undergoing a five-month training course at the boatyard.

EQUIPMENT

The following equipment and supplies have been ordered up to 1 July 1977.

ITEM	APPROX. VALUE IN US$
120 outboard engines of 25 hp	66,300
2 outboard engines of 20 hp	2,300
1 outboard engine of 15 hp	400
1 outboard engine of 7,5 hp	400
68 outboard engines of 5 hp	15,900
14 Marine Diesel Engines of 20 hp	20,200
2 Toyota Landcruiser	11,800
1 Toyota Truck	9,000
4 Scotsman flake ice machines	13,300
2 7.5 kva generators	3,100
Boatyard construction	5,000
Boatbuilding materials and equipment	107,100
Boatbuilding labour	25,300
Tools	19,800
Spare parts	17,300
Fishing gear	40,300
Fish Market	4,000
Miscellaneous	7,300
Approximate total as at 1 July 1977	US$ 368,800

PROGRAMME OF WORK

1. Implementation of the Fish Marketing Scheme for Upolu.
2. Installation of an ice machine in Savaii.
3. Establishment of the boatyard as a cooperative enterprise and gradual transfer of all responsibility for ordering of boatbuilding materials.
4. Construction of prototype 28 ft catamaran in aluminium and gradual change-over to aluminium construction.

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FISH MARKETING SCHEME FOR UPOLU, WESTERN SAMOA*

1. OBJECTIVES

- To enable village fishermen to store their catch for five days
- To provide a market for surplus catches from the villages
- To assure supply of fresh and frozen fish to consumers in Apia at a stable price.

2. BACKGROUND INFORMATION

During the last two years the number of motorized boats in the villages of Western Samoa has increased from 73 to 198; of the latter, 134 are based in Upolu. The increase in the number of boats has meant that the fishermen find it increasingly difficult to sell their fish in the villages at a reasonable price before it goes rotten. Fishermen along the north coast of Upolu from Falefa to Mulifanua have the advantage of a frequent bus service to Apia where they can dispose of their catch while it is still fresh. However, fishermen on the south coast from Lefaga to Aleipata and including Fagaloa complain of great difficulty in selling surplus catch. The bus service is infrequent and the hire of a pick-up too expensive, except for unusually large catches.

The first objective of the Fish Marketing Scheme is to increase the time village fishermen can keep their catch fresh. Fish not kept on ice is only edible within 18 hours of being caught. With equal weight of ice and fish, it is possible to keep the catch fresh for five days in an insulated container. The FAO Village Fisheries Project has supplied two flake ice machines which are now installed in the Fish Market. The machines have a total capacity of 2,500 lbs of ice directly at the Fish Market at a price of WS$ 1.00 per 100 lb. The FAO Village Fisheries Project is also providing iceboxes at a cost of WS$ 35.00 each Fishermen on the south coast, however, will face difficulties in the supply of ice due to the cost of transport Until ice-making machines can be installed in the districts, a regular delivery service is essential. At present there do not seem to be any private operators interested in providing this service except at very high cost. The Fisheries Division therefore envisages utilizing the truck supplied by the FAO Village Fisheries Project to deliver ice three times a week to Lefaga, Safata, Falealili, Aleipata and Fagaloa The ice will be sold at WS$ 1.50 per 100 lb. The Fish Truck will stop at a selected village in each district and fishermen who want to buy ice and sell fish will have to be at these selected places at a prearranged time The Fish Truck will buy at a fixed price and thereby satisfy the second objective mentioned earlier.

The third objective will be met through the capacity to store fresh fish on ice for an additional one to two days at the Fish Market in Apia and in freezer storage for three to four months. The 1,000 cubic ft. freezer purchased by the Government in 1973 and at present installed at the Fish Market has the capacity to freeze down 2,000 lb of fish every 24 hours and to store 10,000 lb of fish.

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* Article kindly provided by the Fisheries Division, Department of Economic Development, Apia, Western Samoa.

Through New Zealand Aid, the Fish Market has also been supplied with a small freezer, cash register, scales and fishboxes, to permit retailing of fresh and frozen fish.

The Fisheries Division will operate the Fish Market and the Fish Truck initially, until sufficient experience has been gained. According to the decision of the Government, the operation can then be handed over to a "Fish Marketing Board" or to a private operator who will hire the premises at a fixed rent and provide the required service to village fishermen, under the control of the Fisheries Division.

3. WORK PLAN

3.1 The Fish Market

Personnel

Manager: Luatua T. Vesi, presently working in the Fisheries Division.

Duties:
- Under the director of the Chief Fisheries Officer to be responsible for the staff, equipment and funds provided for the operation of the Fish Market and the Fish Truck.
- To keep daily accounts for fish bought and fish and ice sold.
- To follow Treasury Department's instruction in the handling of funds provided by the Government for operation of the market.
- To ensure that only fish in a good condition is sold to consumers.
- To keep the Fish Market clean and ensure rapid disposal of fish offal.

Saleswomen (2): (new positions)

Duties:
- Under the direction of the Manager, to provide good service to the customers at the sales counter.
- To ensure that fish on display is well iced.
- To register every sale on the cash register.

Casual (1): (from Fisheries Division)

Duties:
- Under the instructions of the Manager, to load ice and unload fish.
- To clean fish ready for sale or for freezing.
- To dispose of offal and wash floor and equipment every evening.

Working hours:

Monday to Friday	Manager:	6.00 - 12.00, 1.30 - 5.00
	Saleswomen:	8.30 - 12.00, 1.30 - 4.30
	Casual:	8.00 - 12.00, 1.30 - 5.00
Saturday	Manager:	6.00 - 1.00
	Saleswomen:	8.30 - 12.30
	Casual:	8.00 - 1.00

Working hours per week:

Manager:	54.5 hours
Saleswomen:	36.5 hours
Casual:	42.5 hours

Fish shop opening hours

Monday to Friday:	8.30 - 12.00, 1.30 - 4.30
Saturday:	8.30 - 12.30

Yearly Operating Expenses

	WS$	Yearly cost WS$
Personnel		
1 Market Manager	3,400	
2 Saleswomen at WS$ 700/year	1,400	
1 Casual	700	
	WS$ 5,500	5,500
Electricity		
1 freezer 1,000 cu. ft. 11 kw x 100 hours/day = 110 kwh/day 110 kwh/day x 365 days x WS$ 0.07/kwh =	2,810	
1 freezer 25 cu. ft. 0.5 kw x 24 hours/day = 12 kwh/day 12 kwh/day x 365 days x WS$ 0.07/kwh =	307	
2 flake ice machines 1.2 tons ice/24 hours x 90 kwh/ton = 108 kwh/day 108 kwh/day x 200 days x WS$ 0.07/kwh =	1,520	
Lights estimated at	400	
	WS$ 5,037	5,037
	Total	10,537

	WS$	Yearly cost WS$
Depreciation	Total b/f	10,537
1 freezer valued at	5,000	
1 freezer valued at	500	
2 ice machines valued at	6,000	
Scales, etc, valued at	500	
	12,000	
Depreciation over 10 years = WS$ 1,200/year		1,200
Interest		
9% on capital invested		1,080
	Total yearly cost WS$	12,817

Revenue

Sale of fish

Weekly:	4,000 lb of fish with a mark-up of WS$ 0.06 per lb =	240
	5,000 lb of ice at WS$ 1,00/100 lb =	50
	WS$	290
	WS$ 290 per week x 50 weeks =	14,500
	Total yearly revenue WS$	14,500

Fish prices:

Buying price of fish at the Fish Market in Apia:[1]

Group 1 - WS$ 0.39 per lb

Filoa	(*Lethrinella miniata*)	- Long-nosed emperor
Snapper		
Malai	(*Lutjanus malabaricus*)	- Scarlet sea perch
Utu	(*Aprion virescens*)	- Green job fish
Palumalau	(*Etelis carbunculus*)	-
Papa	(*Epinephelus fasciatus*)	
Palusina	(*Aprion microlepis*)	- Rosy job fish
Malauli	(Carangidae)	- Trevally
Sapatu	(Sphyraenidae)	- Small barracudas
Sa'u	(*Makaira audax*)	- Marlin
Tafauli	(*Caranx ferdau*)	

1. Latin names as determined by the Project Leader, SPC Outer Reef Fisheries Project, when based in Western Samoa, and by the Fisheries Division, Western Samoa.

Group 2 - WS$ 0.34 per lb

Atu	(*Katsuwonus pelamis*)	- Skipjack
Asiasi	(*Thunnus albacares*)	- Yellowfin tuna
Tagi	(*Gymnosarda unicolor*)	- Dog tooth tuna
Kavalau	(*Auxis thazard*)	- Frigate mackerel
Masimasi	(*Coryphaena hippurus*)	- Dolphin fish
Anae	(*Srializa canaliculatus*)	
Atule	(*Selar crumenophtalmus*)	- Purse-eyed scad bream
Palutalatala	(*Ruvettus pretiosus*)	- Castor oil fish
Gatala	(*Epinephelus tauvina*)	
Ume	(*Naso unicornis*)	
Fuga	(*Thalassoma* sp.)	

Prices are for whole, ungutted fish up to 20 lb. For fish larger than 20 lb the fish will be bought gutted and cleaned, without the head, an cut into pieces of around 5 lb weight.

Mark-up: WS$ 0.06 per lb for both groups.

Sale price: Group 1 - WS$ 0.45 per lb.
Group 2 - WS$ 0.40 per lb.

The sale prices are based on surveys conducted by the Japanese Overseas Co-operation Volunteer during the last half year. The prices are the average prices at which fish is sold at the New Market. Considerable variations occur, which means that when much fish is coming into the New Market the prices there will be lower than at the Fish Market. When the supply is short, the prices will be higher. The presence of the Fish Market will, therefore, tend to stabilize the price which will be of considerable advantage both to the consumer and the fisherman.

3.2 The Fish Truck

Personnel

Fish Buyer: (Until a new position is established, this can be done by JOCV Marketing volunteer)

Duties:

- Under the control of the Manager to be responsible for the sale of ice and purchase of fish by the Fish Truck.
- To ensure that only fish in good condition is bought.
- To keep an account of ice sold and fish bought, and to present these accounts to the Manager for control of cash and weighing of fish.

Driver: (Until a new position is established, this can be done by present driver at Fisheries Division)

Duties:

- Under the control of the Manager, to be responsible for the safe driving and correct maintenance of the Fish Truck.
- To assist in loading and unloading of fish and ice.

Casual: (Utilize existing casual at the Fisheries Division).

Duties: - To assist in loading and unloading of the Fish Truck.

Working hours:

Monday, Wednesday, Friday	6.00 - 5.00
Tuesday, Thursday, Saturday	6.30 - 12.30

Working hours per person per week: 51

Fish Truck Schedule:

Monday, Wednesday, Friday

District	Village	Time of Arrival	Time of Departure
Apia			6.30
Lefaga	Savaia	7.40	8.20
Safata	Fausaga	8.50	9.30
Falealili	Poutasi	10.00	10.40
Aleipata	Turtle Hatchery	11.50	12.30
Apia		4.00	

Tuesday, Thursday, Saturday

District	Village	Time of Arrival	Time of Departure
Apia			7.00
Fagaloa	Salimu	8.30	9.00
Apia		10.30	

Yearly Operating Expenses

Personnel		WS$	Yearly cost WS$
Fish Buyer		1,600	
Driver		1,100	
Casual		900	
	WS$	3,600	3,600

Truck

Assuming WS$ 0.20 per mile for diesel fuel, maintenance and depreciation Mileage per week = 420, Mileage per year 420 x 50 = 21,000 miles Cost of truck 21,000 miles x WS$ 0.20/ mile =	WS$	4,200	4,200
		Total	7,800

Revenue:

	WS$
Fish bought per week: 3,500 lb.	
Fish bought per year: 3,500 x 50 = 175,000 lb/year	
Mark up per lb. = WS$ 0.04	
Sale of fish WS$ 0.04 x 175,000 =	7,000
Transport of ice WS$ 0.50 per 100 lb.	
Assuming 4,000 lb ice per week =	
200,000 lb/year, 2,000 x WS$ 0.50/100 lb. =	1,000
Total yearly revenue WS$	8,000

Mark-up: WS$ 0.04 per lb for both groups

Buying price: Fish Group 1 - WS$ 0.35 per lb.
Fish Group 2 - WS$ 0.30 per lb.

During the first months of operation it will probably be necessary to pay the fishermen cash when they deliver the catch to the truck in order to gain the necessary confidence. However, it would not be prudent to continue carrying as much as WS$ 600 in cash on the Fish Truck, and any payment should, therefore be payable by voucher, to be presented to the Manager at the Fish Market in Apia.

4. FUTURE DEVELOPMENT

The organization and price structure of the Fish Marketing Scheme should be reconsidered in the light of the experience gained during the first six months of operation.

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SOME ASPECTS OF THE BECHE-DE-MER INDUSTRY IN ONGTONG JAVA, SOLOMON ISLANDS

K. Crean*

INTRODUCTION

Ongtong Java atoll is situated in the South West Pacific between latitude 5°01 - 5°33' and longititude 159°42' on the fringe of island Melanesia. The nearest land mass in the rest of the Solomons (fig. 1) is Santa Ysabel 270 km to the south. The atoll is kidney-shaped (fig. 2) with a maximum length NW to SE of 70 km and a width ranging from 11 to 36 km. It is thus amongst the largest of the Pacific atolls. The perimeter of the atoll is composed of wide reef flat, broken in places by passages and enclosing a lagoon of some 1420 km^2 in area. Islands occur around the atoll and the two largest of these, Luaniua and Pelau, are the main population centres.

The atoll is located in a zone of continuously heavy rainfall, with an annual mean precipitation of 320 cms. Temperatures are uniform, with a daily average of 30°C, range from a minimum of 27°C to a maximum of 33.5°C. Wind is variable with a velocity (assessed on the Beaufort Scale) ranging from 5 to 20 km per hour. The wind direction from May to October is generally between South and South East. From December to April the winds are more variable but are mostly north or north west. Humidity is high throughout the year.

The natural vegetation comprises _Scaevola taccada_, _Terminalia samoensis_ and _Pandanus tectorius_ on the small sand and shingle cays; _Bruguiera gymnorrhiza_ mangrove in the tidally inundated depressions inside annular cays and islets and broadleaf woodland dominated by _Pisonia grandis_ in the interior of the large islets. The vegetation of almost all the Ontong Java islands has been drastically altered during man's occupation, and coconut plantation or woodland is now the overwhelmingly dominant vegetation type.

The animal resources of the atoll islands are limited but those of the productive reef are abundant. These areas provide the main fishing grounds for considerable catches of sea bream (_Sparus_ spp.) trevally (Carangidae), emperors (_Lethrinus_ spp.) and barracuda (_Agrioposphyraena barracuda_). Tridacna clams, cuttlefish and octopus are common inhabitants of the coral reefs in shallow water. Four species of turtle are found within the lagoon: Green (_Chelonia mydas_) hawksbill (_Eretmochelys imbricata_) leather back (_Dermochelys coriacea_) and loggerhead (_Caretta caretta_). The green turtle is a regular item in the diet of the local people.

The small population of the atoll, 1025 people, is divided between Luaniua in the south and Pelau, some 55 km to the north. The inhabitants are of Polynesian origin. Their main occupations are fishing, copra production, trochus shell collecting and the bêche-de-mer industry.

Bêche-de-mer or sea slugs (class Holothuroidea, phylum Echinodermata) are a food item, although they are not eaten in Ongtong Java but exported from the Solomons to Chinese communities in South East Asia. The bêche-de-mer is a delicacy for the

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* Fisheries Division, Ministry of Natural Resources, Solomon Islands.

Chinese people; it has become part of their life and tradition to eat it on festive occasions. It is usually purchased in a dried form and then at the time of cooking the dry pieces are soaked in water until they become soft. The softened pieces are cleaned and used in making various dishes. The nutritional composition (Sachithananthan, 1972) of bêche-de-mer processed from the sand fish (Holothuria scabra) is as follows:-

	Percentage composition by weight
Protein	43.1
Fat	2.2
Moisture	27.1
Ash	27.6

The people of Ongtong Java learned the methods of catching and processing sea slugs from Japanese instructors who visited the atoll just before the Second World War. However, it is only within recent years that the industry has developed; the incentive is provided by the high prices paid for bêche-de-mer: at present $A 5.50 per kg for first grade products.

THE HOLOTHUROID RESOURCES WITHIN THE ONGTONG JAVA ATOLL

The comparatively shallow lagoon waters support a number of holothuroid species. McElroy (1973) tentatively identified 15 separate species collected in a one week survey. It is possible to delineate five habitats (table 1) within the lagoon, and holothuroids are found throughout these habitats, ranging from the inter tidal zone to the 'floor' of the lagoon. Numbers of individual holothuroid species are high, especially in the reef slope and reef shallows habitats where, for example, it is not unusual to find specimens of breadloaf fish Stichopus (variegatus?) in large groups, one individual but a few metres away from the next. Some species e.g. Stichopus chloronatus appear to have a restricted habitat preference - coral 'heads' in shallow water (zone II) - whilst others, such as prickly fish (Thelenotus ananas), range from zone I to zone IV.

Table 1: Description of habitats within lagoon (modified from McElroy 1973)

	Depth	Description
I	0 - 2 metres	Shallow reef flat: Influenced strongly by tides, characterised by scattered coral colonies (usually dead). Fragments of dead coral litter the reef surface, mainly sand or debris/sand. Water contains suspended material. Current strong and variable.
II	2 - 6 metres	Reef flat: Not strongly influenced by tides. Live coral formation scattered on a predominantly coralline sandy bottom.
III	6 - 25 metres	Reef slope: Gradient variable. Steep slope - basically a coral face. Gentle slope - scattered coral formations on a coralline sand bottom.
IV	6 - 30 metres	Reef shallows: Emergent reef area usually between 20 - 25 metres deep, scattered coral formations. Reef visible from surface.
V	30 - 46 metres	Lagoon floor: Substrate unconsolidated, comprising coral chips and sand. Absence of coral structures or colonies.

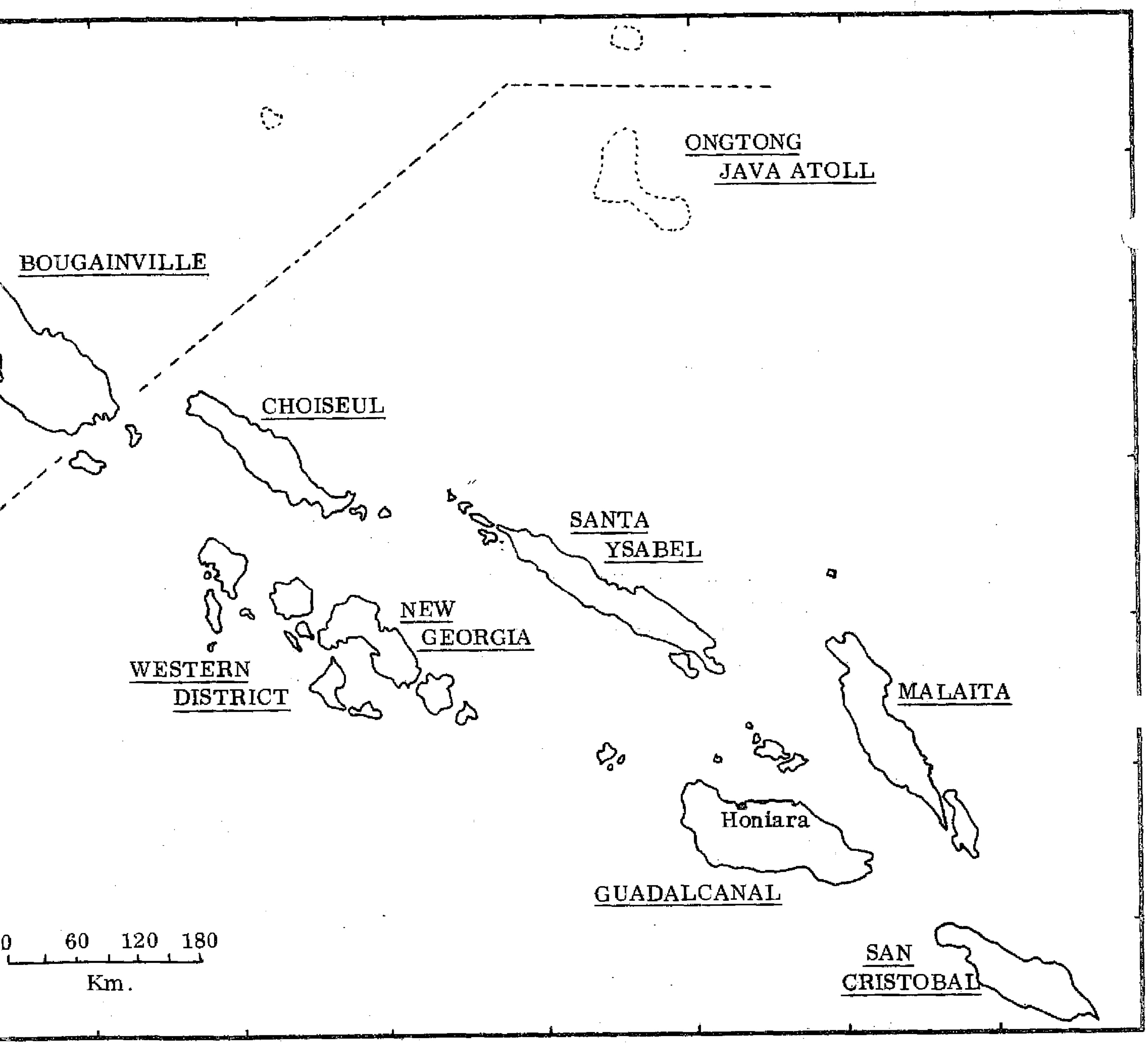

Fig. 1: THE SOLOMON ISLANDS, SHOWING POSITION OF ONGTONG JAVA ATOLL

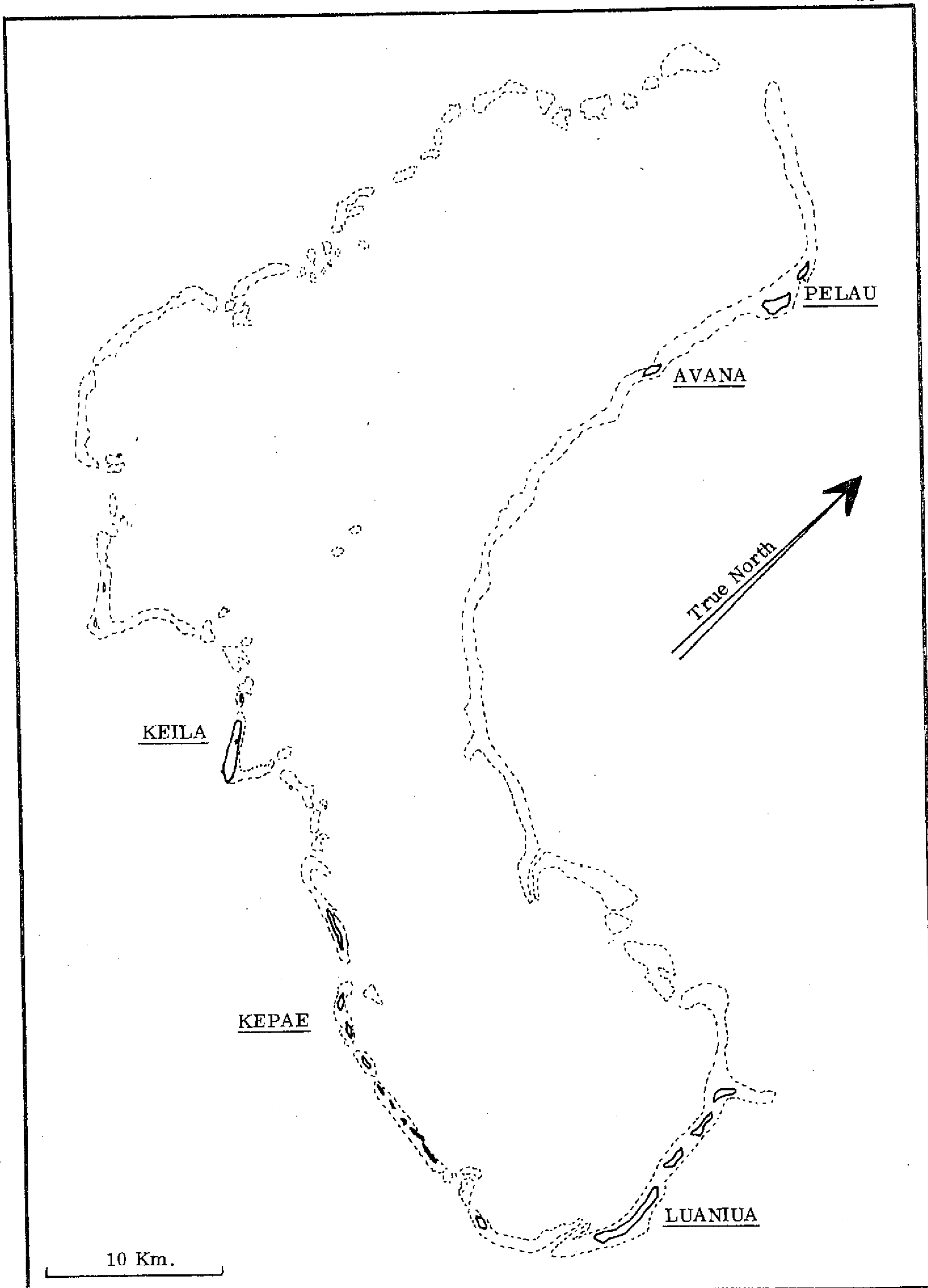

Fig. 2: ONGTONG JAVA ATOLL

Not all holothuroids are suitable for making into bêche-de-mer: the market prefers those species which can readily be processed and exhibit characters of good shape, large size and thick body wall. The Ongtong Java fishermen collect only two species for processing; the teat fish (Microthele nobilis) and the black fish, (Actinopyga miliaris), despite the existence of other species in the lagoon which have some commercial value.

M. nobilis is recognised by the presence of about six lateral, teatlike papillae which are contractile. The body is oval and flattened with a very thick body wall and five anal teeth. The colour of this holothuroid ranges from black through to white, although the upper surface is usually dark. These animals are generally found in abundance in deeper water (of depth greater than 20 metres) living on sand, coral or seaweed-covered substrates. A. miliaris is a holothuroid of cylindrical shape with numerous tube feet; the latter are usually arranged in three bands on the ventral surface. This species also possesses five anal teeth and is found in water of depth greater than two metres.

Live weight and length measurements were determined on 181 specimens of M. nobilis which had been collected for processing. The lengths (after contraction) ranged from 33 -52 cm with a mean of 40 cm, whilst weight (before evisceration) ranged from 1000 - 3650 g with a mean of 1740 g.

The M. nobilis and A. miliaris populations of the Ongtong Java atoll have suffered considerable exploitation within the last decade and there is no doubt that their overall numbers have decreased, especially in the shallower parts of the lagoon. Now fishermen must travel considerable distances and fish in deeper water to find substantial catches of these holothuroids. To make a useful assessment of the future of the bêche-de-mer industry, information on the reproduction, growth, recruitment and life cycle of commercially important holothuroids will be necessary.

THE BECHE-DE-MER INDUSTRY

The fishermen use sail-powered outrigger canoes to reach the holothuroid collecting areas, although with the substantial profits from the industry an increasing number of outboard motors and fibreglass canoes are being used. Processing bases are often established on uninhabited islands, with as many as 200 to 300 fishermen collecting holothuroids for processing.

With favourable weather conditions - clear sky, calm sea and non turbid water - holothuroids can be collected in water up to 30 metres in depth. The fishermen use a lead weight which has a barbed hook and the whole structure is attached to a line. When a holothuroid is located, the fishermen lowers the weighted point until it is a few feet directly above the animal. Then the weighted point is released and the holothuroid is speared on its dorsal surface. On contact the animal contracts, making the hook fast and is then pulled quickly to the surface. The holothuroid is then unhooked and placed in the canoe, where it is kept for the duration of that particular fishing trip.

The weighted collecting device (average total length 140 mm) comprises a shaped lead, the widest end of which is set with a short, barbed point. Figure 3 illustrates the collecting device and table 2 details measurements from three such devices. The weight must be heavy enough (average 2.48 kg) to stabilise the collecting device, to allow the fishermen to aim, and to ensure that the barbed point penetrates the tick body wall of the holothuroid. The point must not be too long (average 32 mm) as it is important that the ventral surface of the holothuroid is not punctured. The point must be adequately barbed (average length of barb is 12 mm) to ensure that the holothuroid stays attached whilst it is hauled to the surface.

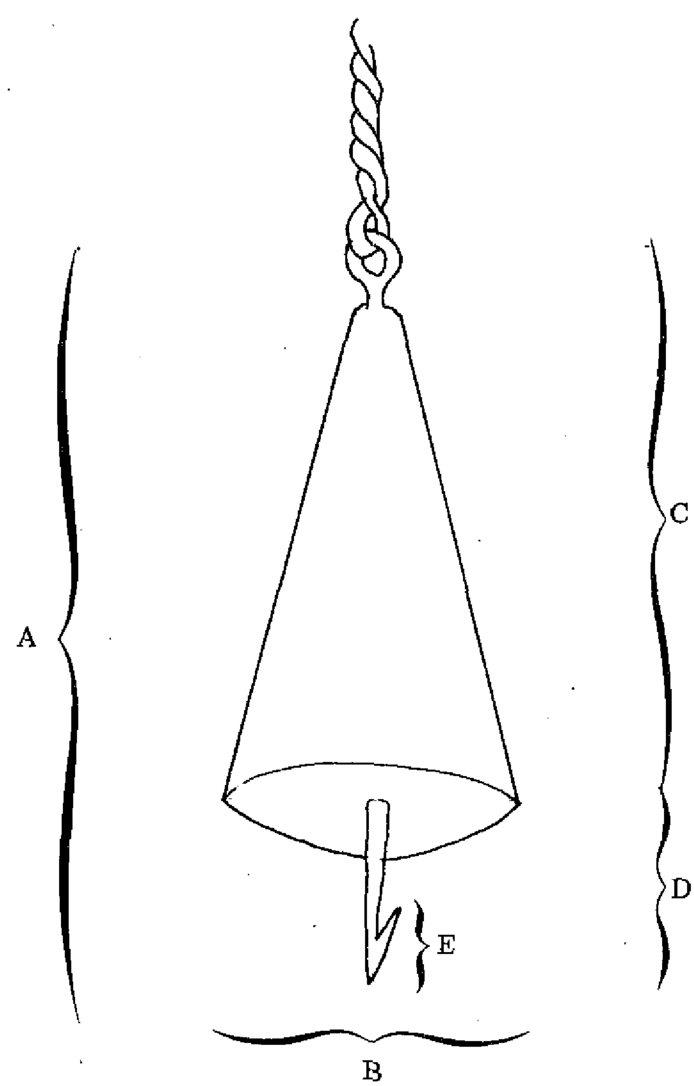

Fig. 3: WEIGHTED SPEARING POINT USED TO COLLECT BECHE-DE-MER. (2/3 actual size)

Table 2: Dimensions and weight of three weighted spears used to collect bêche-de-mer

	Code (See fig 3)	1	2	3	Average
Weight (kg)		2.18	2.66	2.61	2.48
Total length (mm)	A	145	135	140	140
Maximum lead diameter (mm)	B	67	55	55	59
Lead length (mm)	C	113	96	114	108
Spear point length (mm)	D	32	39	26	32
Barb length (mm)	E	11	17	9	12

Table 3 shows the holothuroid catches for the fishermen of Luaniua village recorded over a nine day period. A total catch of 7,122 specimens of M. nobilis was recorded at an average rate of 11.1 specimens per man hour. The holothuroids caught are returned to base four to six hours after capture. A large proportion of the catch will have eviscerated (ejection of parts of alimentary and respiratory tracts) during the journey, although all will still be live.

Table 3: Holothuroid catches for Luaniua Village, Ongtong Java, recorded over a 9-day period.

Day	Number of men fishing	Time fished (man hours)	Total catch (individual holothuroids)	Catch/man/hour
1	19	57.0	684	12.0
2	21	52.5	656	12.5
3	25	87.5	878	10.0
4	14	65.8	598	9.1
5	10	30	389	12.7
6	25	81.25	1562	19.2
7	22	121	1188	9.8
8	29	87.0	720	8.3
9	19	76	456	6.0
Mean	20.4	74.1	791	11.1

Processing of the holothuroids begins on return to land base. The first stage is precleaning. Air trapped inside the holothuroid body (caused by viscera/gut contents blocking the anal and oral orifices) will expand during the cooking process and cause the body wall to rupture. Thus it is important to remove the viscera, and those holothuroids which have not eviscerated are made to do so by driving a pointed stick into the anal opening. Whilst precleaning is in progress a large container of clean sea-water is set to boil, on a fire fuelled with coconut husks or mangrove wood. The freshly caught holothuroids are placed in the boiling sea-water for up to one and a half hours. The product is tested during boiling to determine whether it is properly cooked. A specimen is taken from the cooking vessel, cooled and dropped on the ground - if it is elastic and 'bounces' it has been properly cooked; if not it is returned to the boiling water then retested after a short time interval. Finally the properly cooked holothuroids are taken from the boiling water and allowed to cool. Loss of weight during precleaning/cooking is considerable: 69 per cent on average with a 34 per cent loss in length.

The cooled, cooked holothuroids are taken to the sea where they are 'gutted' and washed. Using a sharp knife, a cut is made on the dorsal surface running in a straight line between the oral and anal openings. The cut holothuroid is held open and the remnants of the viscera are removed using the fingers; the body cavity is then washed to remove extraneous tissue and sand. Loss of weight after gutting/ washing is on average 9 per cent of the total starting weight with negligible loss in the body length. Prior to drying the body of the holothuroid is opened wide and short sticks (on average 1.5 - 5 cm in length) are inserted across the body cavity The function of the sticks is to open the flaps of the body wall, thereby ensuring that the product will dry evenly. The number of sticks used varies with the length of the holothuroid. For specimens of up to 10 cm usually one stick is used, up to 20 cm, two sticks.

The holothuroids are now ready for the final stage of the processing - smoke drying. The latter is a long process (some 120 hours) carried out at comparatively low temperatures. The holothuroids which are ready for drying are ranked on a metal or wooden griddle set some 70 - 100 cm above an open fire, a similar griddle is set some 70 cm above the first. The griddle racks are usually housed in a small building constructed from timber with dried leaf walls. This building helps to concentrate the effects of the smoke and heat.

For the first twelve hours the holothuroids are ranked on the lower griddle. This exposes the inner body cavity to the smoke and a temperature of between 70 - 78°C. The average weight loss during this period is a further eight to nine per cent of the live weight, similarly the overall length of the product is reduced by a further six to seven per cent. Fuel for the smoke drying process is collected from the islands in the lagoon. There does not appear to be a preferred species of wood, although quite frequently trimmed mangrove is used. Once the interior of the holothuroid is dried the sticks are removed and the product is allowed to smoke dry on the higher of the two griddles, at a temperature ranging between 36 - 47°C. The product is turned frequently to ensure even drying. This process usually lasts for five days (120 hours). Weight and length change during the drying period are summarised in tables 4 and 5 and figure 4. The final product (bêche-de-mer) has an average weight of six to seven per cent of the live weight, with a total length of some 52 per cent of the original. The final product if properly processed has a long storage life; bêche-de-mer have been stored for over two years without deteriorating. In Ongtong Java the bêche-de-mer are packed in copra sacks and shipped to buyers in Honiara (the Solomon Islands capital) from where they are exported to markets in Hong Kong and Singapore.

Table 4: Weight loss recorded in five specimens of teatfish (M. nobilis) during processing

Processing stage		Live non Eviscerated	Cooked + Eviscerated	Gutted + washed	Dried	Dried	Dried	Dried	Dried	Dried
Time (hours)		Start	0.45	0.68	12.68	24.68	38.09	61.18	92.51	108.85
Temperature range (^{o}C)		30 - 33	100	30 - 33	70 - 78	38 - 44	38 - 47	36 - 46	38 - 44	40 - 44
01254*	Weight (g)	1191	353	242	138	110	110	106	103	83
	% original weight	100	29.6	20.3	11.6	9.2	9.2	8.9	8.6	6.9
01251*	Weight (g)	1213	388	287	165	138	110	89	51	51
	% original weight	100	31.9	23.7	13.6	11.4	9.1	7.3	4.2	4.2
01250*	Weight (g)	1378	419	309	193	151	124	110	76	76
	% original weight	100	30.4	22.4	14.0	10.9	9.0	7.9	5.5	5.5
01241*	Weight (g)	1198	441	280	186	151	138	131	96	996
	% original weight	100	36.8	23.4	15.5	12.6	11.5	10.9	8.0	8.0
01249*	Weight (g)	1400	420	331	199	165	112	96	83	96
	% original weight	100	30.0	23.6	14.2	11.8	8.0	6.8	5.9	6.8
Mean	Weight (g)	1276	404	290	176	143	119	106	88	87
	% original weight	100	31.7	22.7	13.8	11.2	9.3	8.3	6.9	6.8

* Sample numbers

Table 5: Length changes recorded in five specimens of teatfish (*M. nobilis*) during processing

Processing stage		Live non Eviscerated	Cooked + Eviscerated	Gutted + washed	Dried	Dried	Dried	Dried	Dried	Dried
Time (hours)		Start	0.45	0.68	12.68	24.68	38.09	61.18	92.51	108.85
Temperature range (°C)		30 - 33	100	30 - 33	70 - 78	38 - 44	38 - 47	36 - 46	38 - 44	40 - 44
01254*	Length (cm)	42	25	25	21	20	20.6	19.5	19.0	18.5
	% original length	100	59	59	50	48	49	47	45	44
01251*	Length (cm)	38	24	24	22	20.5	20.5	20.0	19.5	19.5
	% original length	100	63	63	58	54	54	53	51	51
01250*	Length (cm)	35	25	25	23	21	20.0	20.0	19.5	19.5
	% original length	100	71	71	66	60	57	57	56	56
01241*	Length (cm)	37	27	27	24	23	23.5	22.5	21.0	21.0
	% original length	100	73	73	65	62	63	60	57	57
01249*	Length (cm)	41	27	27	23	21	20.5	21.0	21.0	21.0
	% original length	100	66	66	56	51	50	52	51	51
Mean of % Original length		100	66.4	66.4	59	55	54.6	53.8	52	51.8

* Sample numbers

Fig. 4: RELATIONSHIP BETWEEN LOSS OF LENGTH/WEIGHT AND TIME DURING HOLOTHUROID PROCESSING.

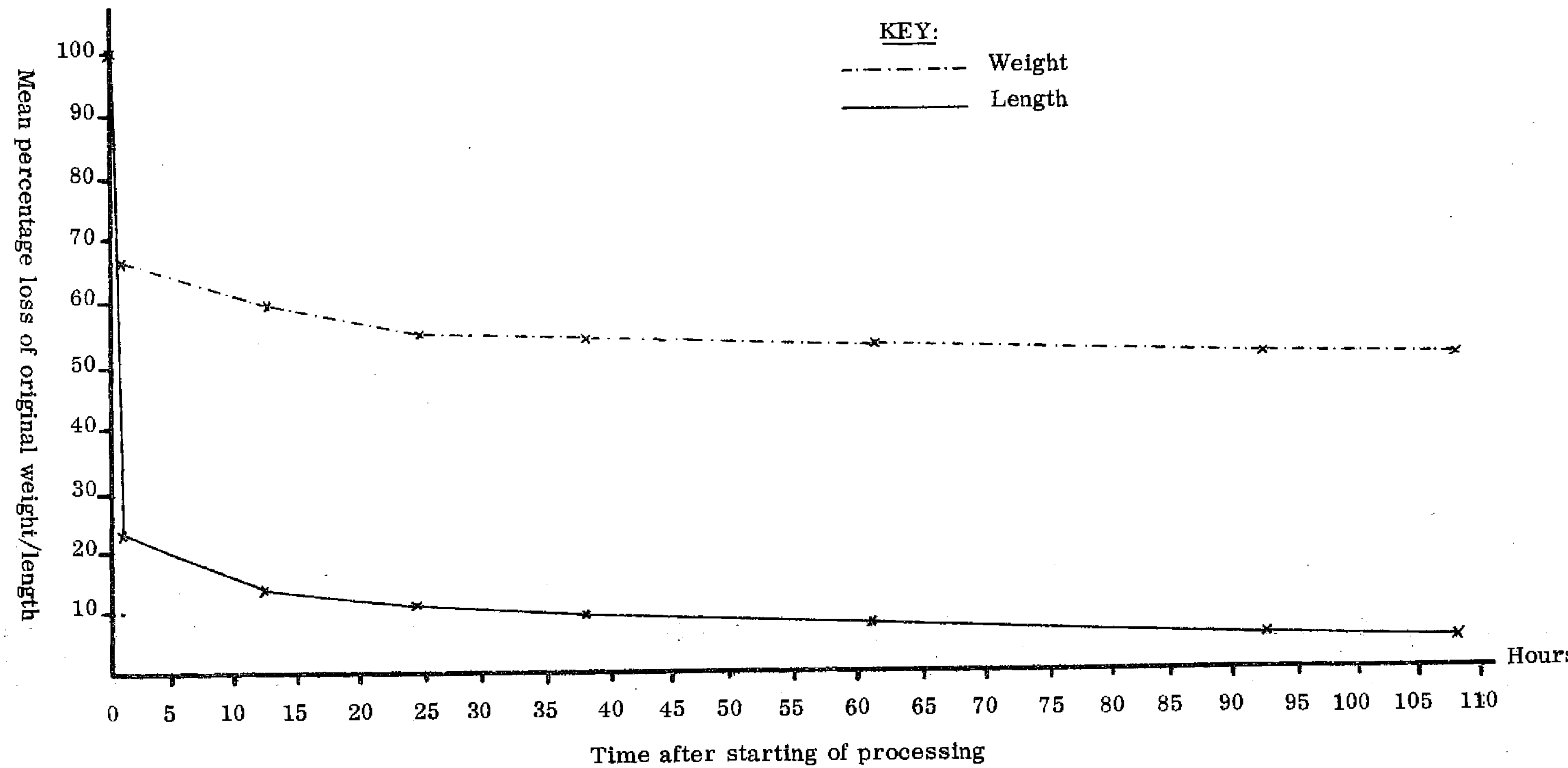

Table 6 contains length and weight data for 100 specimens of bêche-de-mer. The average weight of individual specimens was 116.7 g with an average length of 213 mm. The relationship linking weight and length calculated for this sample of 100 is described by the equation $W = 0.0064\ L^{1.82}$.

Table 6: Frequency distribution length/weight from sample of final product Bêche-de-mer.

Weight classes (g)	
15 - 30	
30 - 45	1
45 - 60	1
60 - 75	8
75 - 90	10
90 - 105	9
105 - 120	29
120 - 135	11
135 - 150	11
150 - 165	17
165 - 180	1
180 - 195	1
195 - 210	
210 - 225	1
225 - 240	
240 - 255	
255 - 270	
Total	100

Length classes (mm)	
160 - 170	3
170 - 180	9
180 - 190	6
190 - 200	7
200 - 210	19
210 - 220	18
220 - 230	17
230 - 240	9
240 - 250	4
250 - 260	6
260 - 270	1
270 - 280	1
280 - 290	
290 - 300	
Total:	100

Mean weight value = 116.7 g

Mean length value = 213 mm

The final product is subject to grading, the criteria of which are species of holothuroid processed and size and quality of final product. Based on species type, the first grade holothuroid for processing is the teatfish (M. nobilis). Blackfish (A. miliaris), prickly fish (Thelenota ananas), surf red fish (A. mauritiana) rank second or third grade. Grades (with slight variations depending on the buyer) based on final product length are usually within the following range:-

8 ins or above	1st grade
6 - 8 ins or above	2nd grade
4 - 6 ins or above	3rd grade
3 - 4 ins or above	4th grade

Bêche-de-mer which has been holed during processing, burned, poorly dried, over-cooked or badly twisted during drying is rejected. However, that proportion of the 'rejected' stock which has been poorly dried can be further processed to an acceptable form. Similarly a sliced product can be made from the acceptable parts of badly twisted or holed bêche-de-mer.

The production of bêche-de-mer in Ongtong Java is at present considerable, with the industry yielding an estimated 100 - 150 metric tons per annum. Table 7 shows an analysis of bêche-de-mer shipments to one buyer (who deals with approximately 20% of the Ongtong Java production) in Honiara. The figures cover a $4\frac{1}{2}$ month period in 1976 and a yield of 13 836 kg of bêche-de-mer valued at a total of $A 28, 899.

Table 7: Analysis of bêche-de-mer imports from Ongtong Java to a Honiara buyer.

1976 month	Number of bags	Total weight (kg)	Total value ($A)
July	70	2, 656.7	5, 929.20
August	46	2, 730.2	5, 952.11
October	39	2, 469.4	5, 730.90
November	84	4, 694.3	8, 641.06
December	22	1, 285.5	2, 645.96
Total	261	13, 836.1	28, 899.25

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OYSTER BREEDING IN THE NEW HEBRIDES

J.P Hallier*

Like many other South Pacific territories, the New Hebrides have tried to develop oyster farming to meet local consumer demand and, if yields measured up to expectations, to export the surplus to New Caledonia, already a major importer of Australian oysters.

Since oyster breeding is one of the most long-standing and best mastered forms of aquaculture, it is largely devoid of the pitfalls liable to be encountered in the process of rearing other kinds of marine animals.

1. Choice of species: Crassostrea gigas

As in many other territories of the South Pacific, Crassostrea gigas was selected in the New Hebrides, in preference to the two local species, C. glomerata and C. echinata, for the following reasons:

- C. gigas is virtually the sole species existing in the South Pacific for which large supplies of spat are easily available;
- this avoids the difficulties attending the collection of native spat, a tricky matter since local stocks are never very large and their spawning period, about which little is known, does not seem to be as seasonal or high yielding as that of C. gigas in Japan or C. angulata in Europe;
- C. gigas, a fast growing species, is very similar in appearance and taste to C. angulata and therefore likely to go down well with European consumers in the New Hebrides and in New Caledonia

2. Site of project

Because of their geographic location, between 13° and 20° S, the New Hebrides enjoy a relatively stable humid tropical climate, especially in the northern part of the island chain, which means that fluctuations in water temperature are very slight, particularly in the lagoons. At the Mounparap Oyster Breeding Station on the island of Santo, water temperatures at a depth of 1 metre range between a minimum of 24.1° and a maximum of 30.4°C. However, frequent depressions and cyclones call for sites to be set up in well-protected areas; hence the choice of Lamap in Port Sandwich Bay on Malekula Island and Mounparap on the east coast of Santo, where several tiny islands form a lagoon into which a number of small rivers flow. Continuous trials were conducted on both these sites, over a period of one year at Lamap and two years at Mounparap. Other, smaller-scale trials were carried out on the island of Efate near Vila.

* Fisheries Biologist

3. Procedures

Lamap

300,000 seed oysters were imported in three consignments from a Californian hatchery[1]. The spat was initially placed in small trays (50 x 50 x 15 cm), made of wood and mosquito netting, and the trays then left to lie 70 cm below the water surface on galvanised iron rafts suspended from P.V.C. pipe 'floats'.

As soon as the spat had grown to between 0.5 and 0.8 cm, it was put into PLENO oyster baskets and re-immersed at a depth of 50 cm to 1 m. When it reached 3-4 cm, it was placed permanently in (NORTENNE) bags and laid on the same rafts as the trays.

Mounparap

Cylinders measuring 20 cm in diameter and 5 to 6 cm in length were cut from P.V.C. tubing and used in preference to trays. Both ends were sealed off by mosquito netting held in place by rubber bands, and the cylinders placed on shelves immersed at depths of 30, 60 and 90 cm.

As soon as it had reached 0.8 to 1 cm in size, the spat was arranged in large trays measuring 4 m in length, 1 m in breadth and 10 cm in height. The wooden frame of each tray was parasite-proofed with a layer of 'Flintkote' (tar) and its bottom and removable cover were made of black plastic netting, first comparatively fine (0.5 cm square mesh) then wider-meshed (to 3 cm) as growth proceeded. These rearing trays floated between 0.50 and 1 m below the surface.

4. Results

Growth

Growth rates were regularly recorded for many batches. Growth was always excellent at Mounparap, but extremely slow at Lamap, where a high mortality rate caused the loss of all oysters in less than 12 months, and resulted in the centre having to be closed down. The good growth rates recorded at Mounparap are illustrated by the graph in Figure 1, representing a batch which, when the trial began on 9th January 1975, numbered 1,514 oysters with a mean individual weight of 10.34 grammes. A slackening in the growth rate is observed from November to February/March when water temperatures are at their peak and rainfall is generally high. Such a growth rate makes it possible to produce marketable oysters ranging in weight from 40 to 55 gms within a year or 18 months.

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1. Throughout the programme we started with non-settled spat imported from a Californian hatchery or, more often, from oyster farms in the Bay of Sendai, Japan.

Fig. 1: GROWTH CURVE FOR A BATCH OF 1,514 C. gigas IMPORTED FROM JAPAN (individual weight ranging from 5 to 15 grammes on arrival, 9th January 1975).

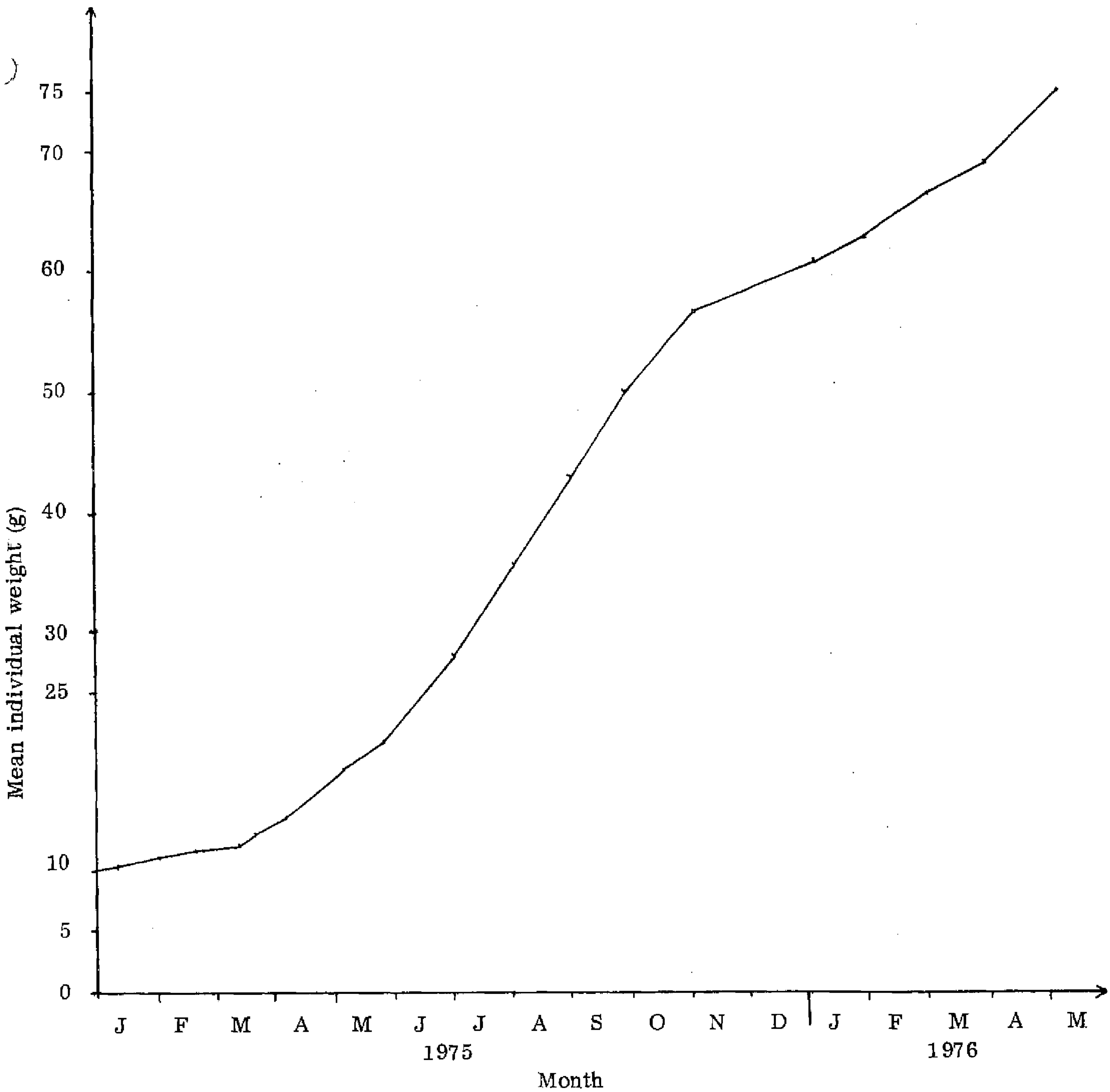
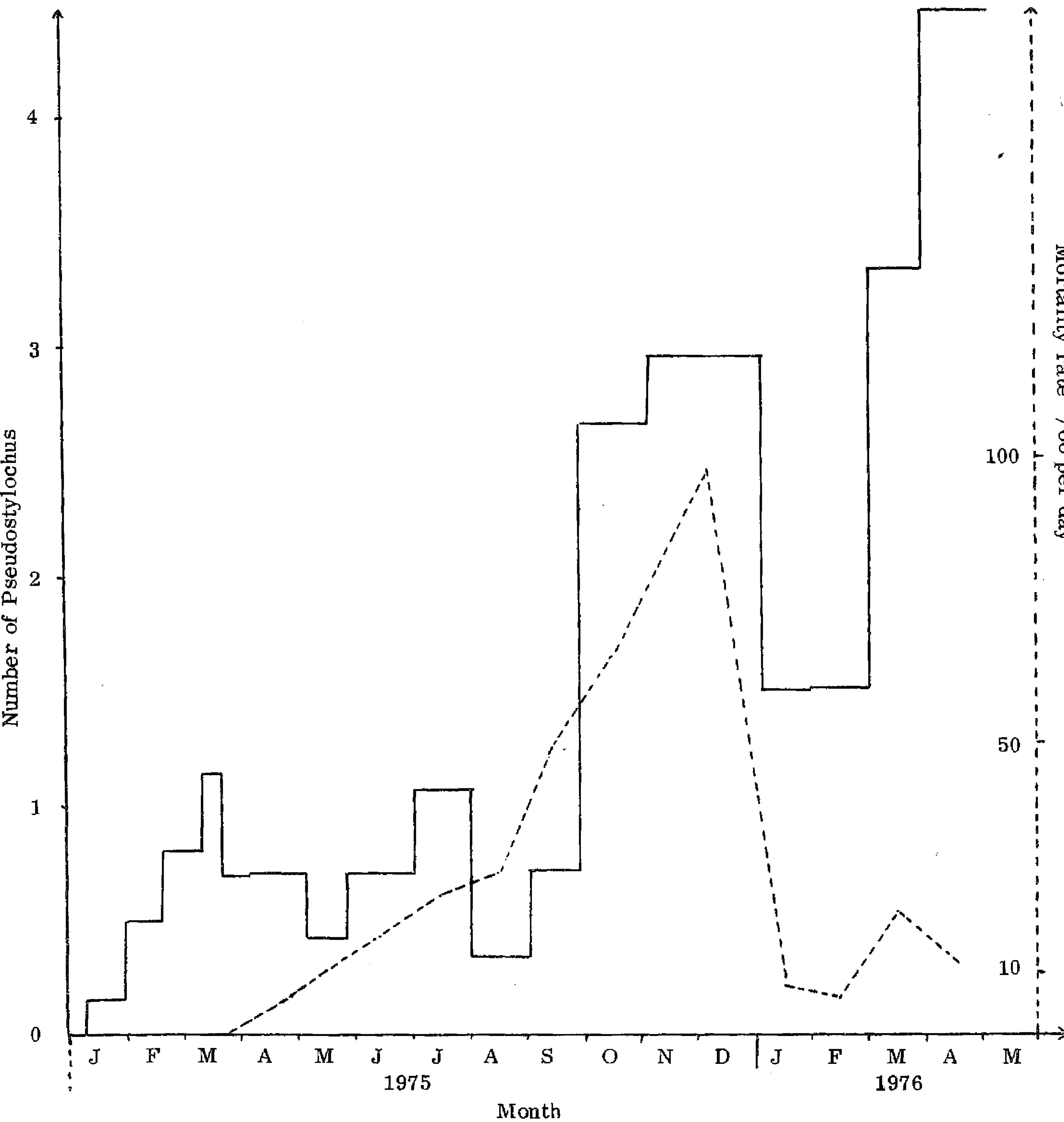


Fig. 2: MORTALITY RATE NOTED IN A BATCH OF 1,514 C. gigas AND VARIATIONS IN THE NUMBER OF PSEUDOSTYLOCHUS FOUND IN THIS BATCH THROUGHOUT THE TRIAL
(mortality rate expressed as a figure per thousand per day)



Mortality

The mortality rate show in Figure 2 concerns the batch referred to above in connection with growth, and expressed as a figure per thousand per day. The overall mortality rate for this batch was 568‰ in 16 months. Figure 2 also shows the dramatic development of the principal parasite Pseudostylochus[1].

A link obviously exists between the numbers of this pest present and the oyster mortality rate recorded in 1975; however in 1976 another factor came into play, probably a drop in water salinity due to heavy rainfall.

If we include the losses that occurred during transportation and in the first month of rearing (losses varying from 50% and 96% according to the length and delays of transport and the degree of heat shock suffered by the spat), the mortality rate for the entire batch over a period of two years was 89%. Under such conditions, oyster farming is not a paying proposition, particularly if mortality remains high even in the large-size oysters, as shown in Figure 2.

Flesh and shell quality

The oysters produced were usually 'fat', with excellent flesh that filled the shell. The formation of sexual products, their release, fertilization and spat-fall all took place in a normal manner.

The shape of the shell was always highly satisfactory. Nevertheless, during the periods of rapid growth it did not prove to be sufficiently thick and broke at the muscle when opened. Shells were attacked by parasites, either the sponge Cliona (1.5 to 14.0%, average 4.5%) or the worm Polydora (25-50%; average 37%).

Conclusions

In the light of these rather disappointing results, the breeding of C. gigas in the New Hebrides had to be discontinued without any definite conclusions being reached. A number of facts were, of course, established and some assumptions can be put forward. The harmful action of the parasites Polydora and especially Pseudostylochus seems beyond doubt, but it may also be assumed that C. gigas has difficulty in becoming acclimatized to warm tropical waters and that it is this inadaptation which makes it more susceptible to parasites as well as to variations in the physical and chemical conditions of the environment; whence the excessive mortality rates and slackening of growth observed during the hot season, which is, moreover, the period of highest rainfall.

In order to put this hypothesis to the test, it would be useful to compare these trials with those conducted in other territories of the South Pacific, if only to avoid large investments being made on the strength of initially successful results, as was the case in the New Hebrides.

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1. Pseudostylochus is a flat worm measuring less than 1 mm in thickness and reaching a maximum length of 5 to 6 cm. Its shape varies and it is capable of moving in all directions, in much the same way as an amoeba. It lives in darkness and is highly sensitive to fresh water.

MARINE CONSERVATION IN TONGA [1]

W.A. Wilkinson *

Fostering the concept of Marine Conservation in a subsistence society is not an easy task. South Pacific Islanders have traditionally believed that the reefs and lagoons always would continue to provide their annual bounty. Although this assumption has served islanders well for centuries, unfortunately the modern need to support increasing populations, coupled with changed fishing methods, has placed excessive pressures on these resources. In some areas destruction of reef habitats and over-exploitation of fish stocks has resulted. In recent years, the Kingdom of Tonga has had the foresight to see the dangers, and has taken remedial steps in time.

Perhaps the most significant of the Kingdom's efforts has been the establishment of a large marine reserve in the lagoon called Fanga'uta, situated in the centre of the main island of Tongatapu, as a fully protected area. This lagoon, an inland water area of some 7,000 acres (2830 ha), is very shallow with deeper channels running through it from seaward. Actually an estuarine area, the lagoon serves as a vital nursery ground for many reef and other food fishes which are the main-stay of the local subsistence fishery.

The Lagoon also supports juvenile populations of grey mullet (Mugil cephalus) and several species of penaeid prawns, the most important commercially being Penaeus semisulcatus (De-haan) and Metapenaeus ensis (De-haan). However, within the lagoon there is no commercial exploitation of these prawns, as bottom trawling has been found to be unselective and destructive, killing large quantities of juvenile food fishes, mainly in the snapper family. (Lethrinus and Lutjanus sp.). The lagoon area is also an important breeding and nursery ground for these species. Actually, all commercial fishing in this area has been stopped, and effective legislation has now been promulgated giving legal powers to the Government's Fisheries Division to control the methods of fishing in this area; to protect the mangrove periphery; to ensure maintenance of habitats for valuable food fishes; to ensure control of the influx of noxious effluents harmful to fish stocks; and to control human developments along the lagoon periphery which might affect the ecosystem. The legislation has now been in effect for over 18 months and already local fishermen appear to have fully accepted the situation. Conditions in the lagoon have improved; for example there has been a marked improvement in the beds of the mussel Modiolus agripeta which has, in recent years, been over-exploited to near extermination of the population. Other species of shellfish such as the clam Codakia sp., are also important features of the lagoon. Three species of the edible alga Caulerpa are also found in the lagoon, principally in very shallow areas. These have been used extensively by the local Tongans, and are a rich nutrient additive to their traditionally high carbohydrate diet of root crops. This resource has also suffered from excessive harvesting in the past.

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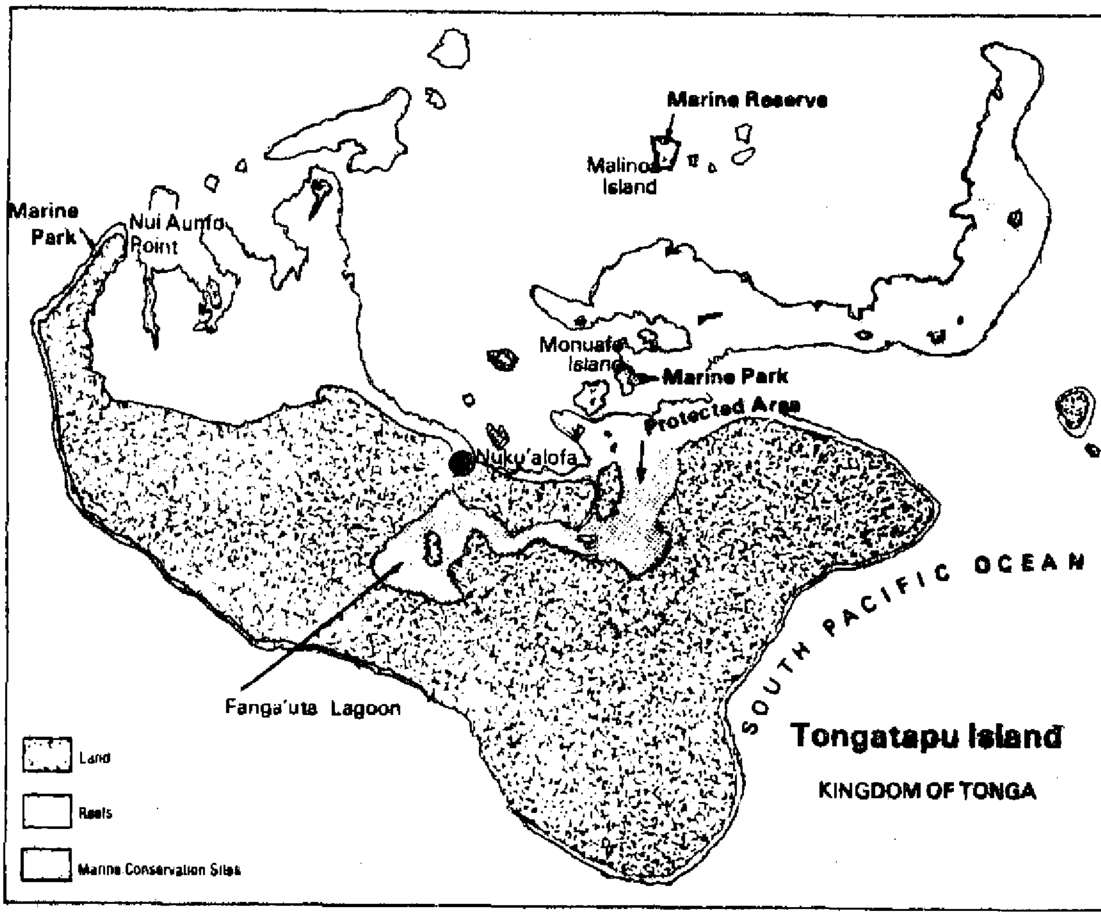
1. This article originally appeared in vol. 2, no. 2 of Parks and is reproduced here by kind permission of the editor.



The establishment of the Fanga'uta protected area is quite a significant accomplishment in the Tonga region, and already benefits to the ecosystem are noticeable. This will make the task of establishing similar protected areas elsewhere in the Kingdom an easier one. Legislation to establish Marine National Parks and Reserves in Tonga is already in existense, and several well-defined areas have already been set aside for this purpose. One such area includes recreational beaches, on the mainland of Tongatapu, which are favored areas for visiting tourists. The visitors will not be precluded from these areas but they will be required to observe basic rules of conservation. For example, shells and live corals will be protected and tourists are encouraged to observe the exotic reef fishes and coral formations in their natural habitats. Parks such as these should be an attraction to tourists, a fact which has been proven elsewhere in the world.

Two outlying islands also have been declared as Marine Reserves. The island of Malinoa, approximately nine miles north of Nuku'alofa, has historical as well as natural interest. There, in earlier times, would-be assassins of the then Prime Minister Rev. Shirley Baker were summarily shot beside their own graves. The graves are clearly marked and well tended to this day – perhaps an indication of some sympathy for the deceased. Nearer the capital of Nuku'alofa the typical atoll called Monuafe has also been declared a Reserve. This is considered one of the best shelling atolls with a fringing reef of Stag's head coral. (Acropora sp.). This area has suffered recently from a local method of fishing – called "Tu'afeo" in Tongan – which is particularly destructive to habitat and fauna.

The method is simplicity itself: a large coral head is encircled by a small mesh net, and then the coral head is systematically broken up and the small escaping reef fishes captured in the encircling net. All fish — unfortunately mostly very small specimens — are taken in this way, and the habitat itself is irretrievably destroyed. Creation of Marine Parks can effectively control this destructive method of fishing, which has devastating effects on the long-term productivity of the reef.

In Tonga, we are pleased to note that the South Pacific Commission has recently appointed an Environmental Officer to its staff. He will be involved in the coordination of conservation efforts throughout the region, as well as advising on environmental policies, both terrestrial and marine. Hopefully, educational systems in the region will play their part in ensuring that environmental studies — even in the simplest terms — are included in the curriculums of both primary and secondary schools. Only by inculcating essential concepts in the young people of the islands will we ensure the future preservation and wise use of island marine ecosystems, which is so essential for future food requirements, as well as the attractiveness of the islands to visitors. Though much remains to be done, the Kingdom of Tonga has made an encouraging beginning. We hope other Pacific Islands areas will follow.

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UNIVERSITY OF THE SOUTH PACIFIC: DIPLOMA IN TROPICAL FISHERIES

In 1972, the University of the South Pacific established a two year course leading to a Diploma in Tropical Fisheries. The primary aim of the course of study is not to provide personnel for private industry. Instead, students are prepared to assume middle-level positions with fisheries departments. Possible placements for diploma holders could include working as fisheries extension officers, research or laboratory assistants, serving on government or exploratory vessels in various positions, monitoring fishing operations, or assisting in marketing or processing operations. It is hoped, therefore, that graduates will contribute to the overall development of fisheries in their own territory and throughout the South Pacific region.

The diploma programme is a rounded one combining lectures and practical work in four areas:

(a) Biological (identification, life histories, ecology and management);

(b) Marine (boat handling, navigation, maintenance and repair of boats and engines);

(c) Technological (gear, catching and processing marine products); and

(d) Economic and social (extension methods, human organisation, bookkeeping and marketing).

Completing the course ensures exposure to and appreciation of many different aspects of fisheries work. Effective cooperation between government officers in different areas of specialisation requires some understanding of each other's aims and methods. In addition, shifts from one type of specialized government service to another are often frequent. Therefore, the most versatile employee will be one well-grounded in a variety of related subjects.

The course in tropical fisheries attempts to provide its students with the necessary broad base by offering ten courses each year. At the end of each year of the programme students will be assessed as having passed or failed the total programme. No candidate may proceed to the second year of the programme unless he has satisfactorily completed the first year of study.

During the first year all students are expected to pass the following courses:

1. Invertebrate zoology - an introduction to marine invertebrate animals. Particular emphasis is given to the commercially significant species of the region

2. Ichthyology - the biology and classification of fishes. Practical laboratory and field work are part of the course. Emphasis is placed on tropical marine species.

3. Human nutrition - the importance of nutrition and proper diet in maintaining good health including the role of the various food components in the diet.

4. Keeping records - understanding accounts and learning a simple method of keeping financial records which can be used by fishermentin the region. The student will learn to keep an analysed cash book and will prepare simple profit and loss accounts, bank and cash reconciliation statements, and balance sheets

5. Public speaking - an examination of the basic concepts, theories and practices of speaking in public.

6. Practical navigation and boat handling, Part A - introductory instruction and practical demonstration in instruments, charts, tides, compass use, steering and finding position. Identifying types of bottom suitable for fishing, handling vessels in open areas while travelling, fishing and coming to anchor and operating small boats with outboard and inboard motors are also covered.

7. Gear technology, Part A - introductory work and practical demonstration on gear used in fishing, particularly in the South Pacific region. Includes knowledge of knots and splices, blocks and tackles, use of both natural and artificial material in making fishing gear, types and construction of nets and traps.

8. Practical fishing, Part A - instruction in basic fishing methods including repair and preventative maintenance of gear. Also cleaning, preserving, grading and marketing marine products.

9. Navigation and Pilotage - lectures and practical demonstrations in marine navigation, chartwork and pilotage.

10. Seamanship and safety - includes use of vessel equipment, methods of handling small boats, weather forecasting and emergency procedures. In addition to learning various safety procedures, the student completes a course in first aid leading to the award of a certificate by the St. John Ambulance Brigade.

Studies continue in the second year with the following courses:

1. Oceanography and marine ecology - an introduction to physical, chemical and biological oceanography and the interaction of marine organisms with this environment,

2. Fisheries biology and management - a survey of the factors concerned with fish production and the objectives of fisheries management and fishing regulations.

3. Economics, budgeting and costing - an introduction to the concepts of supply and demand, price level competition, marketing, allocation and economic resources as related to fisheries operations in the region.

4. Extension - an examination of extension practices of particular use to the extension worker in Pacific fisheries.

5. Practical navigation and boat handling, Part B - a continuation and expansion of the first year's course.

6. Gear technology, Part B - advanced training in the use of gear used in fishing
7. Practical fishing, Part B - advanced training in the operation of different types of fishing gear including added instruction in keeping proper fishing records.
8. Aquaculture - methods used to culture plants and animals in both marine and fresh water environments.
9. Marine engineering knowledge - a study of various types of marine propulsion systems stressing safety and preventative maintenance.
10. Graphical communication - basic principles of technical drawings to communicate ideas and instruction.

The course is open to students from the region encompassed by the University of the South Pacific and is located on the University campus within the School of Natural Resources. Candidates must have passed the New Zealand University Entrance examination including English and biology or an equivalent to this examination. Alternatively, candidates can be accepted after successful completion of the Preliminary I (Science) programme.

In certain cases an applicant might be eligible for enrollment despite not meeting the above qualifications. The University Senate will take into account the applicant's age, academic background, his previous employment and his potential for meeting the requirements of the course work.

Tuition and board costs for regional students are approximately $F 1585 for the 1977 school year. For non-regional students the combined costs are approximately $F 1825. Neither figure includes transportation to Fiji, if required. Scholarships to the amount of $F 1800 each may be available to some students. Registration for the first term of 1977 was 14 February 1977.

For 'more information write to:

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